

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

LIBERTY ENERGY INC. AND LIBERTY ENERGY SERVICES LLC,
Petitioners,

v.

U.S. WELL SERVICES, LLC,
Patent Owner.

Case IPR2025-01424
Patent No. 11,211,801

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I. INTRODUCTION

1. My name is Dr. Robert A. Durham. I make this declaration based upon my own personal knowledge and, if called upon to testify, would testify competently to the matters contained herein.

2. I have been asked to provide technical assistance in the inter partes review of U.S. Patent No. 11,211,801, which I may abbreviate as “the ’801 Patent” or refer to as the “Challenged Patent.” This declaration is a statement of my opinions on issues related to the unpatentability of claims of the ’801 Patent. I am being compensated at my normal rate of \$350 per hour for my analysis, plus reimbursement for expenses. My compensation does not depend on the content of my opinions or the outcome of this proceeding.

II. EXPERIENCE AND QUALIFICATIONS

3. In formulating my opinions, I have relied upon my knowledge, training, and experience in the relevant art. My qualifications are stated more fully in my curriculum vitae, which has been included as Appendix A to this Declaration. My CV also lists publications on which I am a named author and identifies parties on behalf of whom I have previously provided expert testimony within the past four years. Here, I provide a brief summary of my qualifications.

4. I am a consulting engineer with experience in a number of technical areas. I have oil and gas industry expertise from drilling and completion to downstream. As a consultant, I have worked with oil field production companies, refining and chemical plants, equipment manufacturers, and technology development companies for over twenty years. My work relates to the subject matter of the U.S. Pat. No. 11,211,801 (“the ’801 Patent”), which I describe below in Section VII (“Overview of the Challenged Patent”).

5. I received my Bachelor of Science in Electrical Engineering and Master of Engineering and Technology Management degrees from the University of Tulsa in 1992 and 1997, respectively. After years of professional work and research, I received my Ph.D. in Engineering Management from Kennedy Western University in 2004.

6. I have also served in leadership positions in the Petroleum and Chemical Industry Committee (PCIC) of the Institute of Electrical and Electronics Engineers (IEEE) for nearly twenty years. IEEE is the world’s largest technical professional association. The PCIC is the premier forum for the exchange of electrical applications technology related to the petroleum and chemical industry. From 2005 to 2012, I served as Secretary, Vice Chair, and ultimately chair of the Production Subcommittee of the PCIC. The Production Subcommittee is the primary

method for PCIC members to communicate technical papers related to drilling, wellhead, and facilities operations of oil and gas wells. In 2013, I was appointed as Vice-Chair of the Standards Subcommittee of the PCIC, a role which transitioned to Chair in 2014. I served as Chair until 2022. The Standards Subcommittee of the PCIC is the Sponsor of IEEE standards relating equipment operations in the Oil and Gas Industry. The PCIC Standards Subcommittee sponsors nearly 50 oil and gas-related standards. In September 2022, I was elected as an Executive Officer of the PCIC. I will serve as an Executive Officer for eight years, serving two-year terms in each position: Secretary, Vice Chair, Chair, and Chair of Advisory and Awards.

7. My peers have recognized my contributions, particularly in the area of electrical equipment in the oil and gas industry. Because of this recognition, in 2019 I was elevated to the grade of Fellow of the IEEE for “contributions to submersible electrical equipment analysis and multi-point ground methods in hazardous petroleum and chemical environments.” The IEEE Fellow grade is limited to the top 0.1% of the membership of IEEE worldwide.

8. I have worked directly in the oil and gas fields both as an employee and as a consulting engineer. From 2000 until the end of 2002, I was employed as Manager of Electric Infrastructure for New Dominion, LLC (NDL). In that capacity, I administratively owned and was responsible for all electrical equipment, including

overhead power lines, transformers, switchgear, drives, and motors, throughout NDL's production, exploration, and drilling areas.

9. After a brief stint as Vice President for EDG Power Group, responsible for Engineering and Project Management of generation and co-generation facilities across the U.S., I transitioned to the role of consulting engineer. In that role, I have served as a consulting engineer in designing, constructing, and analyzing all kinds of systems, especially those in the oil and gas industry. This has included the design and selection of equipment and the analysis of equipment failures in the oil and gas field from drilling/completion sites to production facilities, midstream, and downstream (refinery) locations.

10. In addition, I am a principal of PEDOCS, Inc., an oil and gas production company which has operated 50 oil and gas production wells in Oklahoma. As such, I am familiar with operations of oil and gas wells including well stimulation, completion, hydraulic fracturing and production.

11. I have been familiar with oil and gas drilling, fracturing (fracking) and completion operations for nearly twenty years. In addition to being responsible for interfacing with drilling and fracturing operations with regards to electrical needs as an employee of New Dominion, LLC, I have been further educated about drilling, fracturing and operations as I have consulted and investigated incidents on multiple

well drilling, fracturing and completion pad sites over my engineering consulting engagements.

12. I have been familiar with power distribution, including generation, transmission and distribution equipment. As an employee, I worked as a design and construction engineer for generation facilities for Central and Southwest (now American Electric Power, AEP). I was also responsible for the design and construction of generation facilities when employed by EDG Power Group, as discussed above. While at AEP, I spent three years as a transmission planner, responsible for modeling transmission systems and developing plans for increased power distribution capacities at high voltages. While at New Dominion LLC, I owned and was responsible for the design, construction and maintenance of several hundred miles of medium voltage (5 – 25 kV) distribution lines, switchgear, drives and motors used for oil and gas drilling, completion and production. Over the last ~ 20 years I have consulted with numerous clients ranging from utilities to oil and gas development and production companies on the design, upgrades and maintenance of generation and power distribution facilities.

13. I have been familiar with the Occupational Safety and Health Administration (“OSHA”) and its responsibilities at oil and gas locations. I have consulted and investigated incidents on multiple oil and gas sites where OSHA has

also performed investigations about injuries and fatalities that have occurred at oil and gas locations, including drilling, fracturing and completion operations. As Principal Scientist of THEWAY Labs, part of my responsibilities include overseeing the Health Safety and Environmental (HSE) program at THEWAY Labs, including establishing policies and procedures commensurate with OSHA requirements at all locations, including requirements for oil and gas sites.

14. I author or co-author over fifty published papers and five books. A list of publications that I have written over the last thirty years is included in my professional CV, which is attached as Appendix A.

15. Therefore, based on my education, professional experience of over 30 years, and scholarly books and publications, I am an expert in the relevant field of the '801 Patent and have been an expert in this field since before the '801 Patent was filed with the United States Patent and Trademark Office ("USPTO"). I am familiar with how a person having ordinary skill in the art would have understood and used the terminology found in the '801 Patent and the prior art references at the time of filing.

III. TASK SUMMARY AND MATERIALS REVIEWED

16. I have been asked to review the Challenged Patent and its prosecution history, to provide an understanding of the technology relevant to the Challenged

Patent, to review certain prior-art references, and analyze whether or not those references disclose or teach limitations of claims from the Challenged Patent. The opinions stated in this declaration are from the perspective of a person of ordinary skill in the art (POSITA).

IV. LIST OF EXHIBITS

17. In forming my opinions, I have reviewed the Challenged Patent, its prosecution history and referenced cited by the Examiner, the materials cited in the List of Exhibits, and the materials cited throughout my declaration.

Ex.	Description
1001	U.S. Patent No. 11,211,801 to Oehring and Hinderliter (filed June 17, 2019 and issued December 28, 2021) (“ 801 Patent ” or “ Challenged Patent ”)
1002	File History of U.S Patent No. 11,211,801 (App. No. 15/183,387) (“ 801 Patent File History ”)
1003	Declaration of Dr. Robert Durham
1004	PCT International Patent Application Publication WO2018/071738 A1 by Reckels <i>et al.</i> entitled “Electric Hydraulic Fracturing System” (“ Reckels ”)
1005	“IEEE Recommended Practice for Electric Power Distribution for Industrial Plants” (“ IEEE Red Book ”), <i>ANSI/IEEE Red Book-1986</i> , pp. 1–609, 1986, doi: 10.1109/IEEESTD.1986.86376.
1006	Claim Listing
1007	U.S. Patent Pub. No. 2017/0030178 to Oehring and Hinderliter (filed October 12, 2016) and published February 2, 2017) (“ Oehring178 ”)

1008	Solar Turbines Power Generation and Product Selection Guide (“ Solar Turbines ”), available as of May 12, 2016 at https://web.archive.org/web/20160512094159/http://s7d2.scene7.com/is/content/Caterpillar/C10550166
1009	U.S. Patent Publication No. 2012/0255734 to Coli (“ Coli ”)
1010	Kumar, B., et al, “Harmonics in Offshore Electrical Power System,” 2005, Offshore Technology Conference (“ Kumar ”)
1011	TM2500 Mobile Power Plant webpage at GEPower.com, available as of October 1, 2017 at https://web.archive.org/web/20171001044253/https://www.gepower.com/gas/gas-turbines/tm2500
1012	Declaration of Mina Ching, Internet Archive
1013	Declaration of Sylvia Hall-Ellis, Ph.D.
1014	Lionel B. Roe, PRACTICES AND PROCEDURES OF INDUSTRIAL ELECTRICAL DESIGN (McGraw-Hill: 1972), ISBN: 0-07-053390-3
1015	Camara, John A., “Electrical Engineering Reference Manual for the Electrical and Computer PE Exam,” 6 th ed. (Professional Publications, Inc. 2002), ISBN: 1-888577-56-8
1016	IEEE100: THE AUTHORITATIVE DICTIONARY OF IEEE STANDARDS TERMS, 7 th ed. (IEEE Press: 2000), ISBN: 0-7381-2601-2
1017	U.S. Patent No. 1,743,771 to Hall <i>et al.</i>
1018	Fink, Donald G., STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS, 13 th ed. (McGraw-Hill, New York: 1993), ISBN: 0-07-020984-7.
1019	U.S. Patent Publication No. 2011/0241590 to Horikoshi et al., entitled “Motor Driving Apparatus Having Fault Diagnostic Function” (filed Feb. 11, 2011 and published Oct. 6, 2011).

1020	National Electrical Code, 2017 Edition, National Fire Protection Association
1021	Solar Turbines Turbomachinery Systems For Oil and Gas Applications, available as of May 12, 2016 at https://web.archive.org/web/20160512100652/http://s7d2.scene7.com/is/content/Caterpillar/C10550151
1022	Solar Turbines Product and Solutions – Oil and Gas, available as of May 8, 2016 at https://web.archive.org/web/20160508213125/https://mysolar.cat.com/en_US/products/oil-and-gas.html
1023	Solar Turbines Products and Solutions – Power Generation, available as of May 8, 2016 at https://web.archive.org/web/20160508192056/https://mysolar.cat.com/en_US/products/power-generation.html

Other than Exhibit 1002, all citations to exhibits reference original page numbers found in the underlying document, and all emphases are added.

V. SUMMARY OF CONCLUSIONS AND GROUNDS FOR CHALLENGE

18. After reviewing the materials identified in the List of Exhibits, I have concluded that each of the Challenged Claims of the '801 Patent would have been obvious to a person of ordinary skill in the art, based on the following grounds.

Ground	'801 Claims	Basis for Challenge
1.	1-4, 6, 8-10, 12-14, 16, 18, and 19	Obvious over <i>Reckels</i> (Ex. 1005) in view of <i>IEEE Red Book</i> (Ex. 1006)
2.	5, 15	Obvious over <i>Reckels</i> in view of <i>IEEE Red Book</i> , <i>Solar Turbines</i> (Ex. 1008), and <i>Coli</i> (Ex. 1009)

Ground	'801 Claims	Basis for Challenge
3.	7, 17	Obvious over <i>Reckels</i> in view of <i>IEEE Red Book</i> and <i>Oehring178</i> (Ex. 1007)
4.	11, 20	Obvious over <i>Reckels</i> in view of <i>IEEE Red Book</i> , <i>Oehring178</i> , and <i>Kumar</i> (Ex. 1010)

VI. LEGAL STANDARDS

A. LEVEL OF ORDINARY SKILL IN THE ART

19. When interpreting a patent, I understand that it is important to identify the relevant art pertaining to the patent-in-suit as well as the level of ordinary skill in that art at the time of the claimed invention. The “art” is the field of technology to which the patent is related.

20. I have been instructed by counsel that the person of ordinary skill in the art (“**POSITA**”) is a hypothetical person who is presumed to know the relevant prior art. I understand that the actual inventor’s skill is not determinative of the level of ordinary skill. I further understand that the factors that may be considered in determining the level of skill include: the types of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field. I understand that not all such factors may be present in every case, and one or more of them may predominate.

B. LEGAL STANDARD FOR CLAIM CONSTRUCTION

21. I understand that the first step in determining whether a patent claim would have been anticipated or obvious is to ascertain how a POSITA would have understood the claim terms.

22. I have been instructed by counsel on the law regarding claim construction and patent claims, and I understand that a patent may include two types of claims: independent claims and dependent claims. An independent claim stands alone and includes only the limitations it recites. A dependent claim can depend from an independent claim, or it can further depend from another dependent claim. I understand that a dependent claim includes all the limitations that it recites, in addition to all the limitations recited in the claim(s) from which it depends.

23. It is my understanding that in proceedings before the USPTO, the claims of a patent are to be construed under what is referred to as the “Phillips standard.” I understand that this means that claim terms of a patent are given the meaning the terms would have to a POSITA, in view of the description provided in the patent itself and the patent’s file history.

24. I understand that to determine how a person of ordinary skill would understand a claim term, one should look to those sources available that show what a person of skill in the art would have understood the disputed claim language to

mean. I understand that, in construing a claim term, one looks primarily to the intrinsic patent evidence, including the words of the claims themselves, the remainder of the patent, and the patent's prosecution history. I understand that extrinsic evidence, which is evidence external to the patent and the prosecution history, may also be useful in interpreting patent claims when the intrinsic evidence itself is insufficient.

25. I understand that words or terms should be given their ordinary and accepted meaning unless it appears that the inventors were using them to mean something else. In making this determination, the claims, the remainder of the patent, and the prosecution history are of paramount importance. Additionally, the patent and its prosecution history must be consulted to confirm whether the patentee has acted as its own lexicographer (i.e., provided its own special meaning to any disputed terms), or intentionally disclaimed, disavowed, or surrendered any claim scope.

26. In comparing the claims of the Challenged Patent to the prior art, I have considered the Challenged Patent and its file history in light of the understanding of a person of skill at the time of the alleged invention.

C. ANTICIPATION

27. It is my understanding that the claims of a patent are anticipated by a prior art reference if each and every element of the claim is found either explicitly or inherently in a single prior art reference or system. I understand that inherency requires a showing that the missing descriptive matter in the claim is necessarily or implicitly present in the allegedly anticipating reference, and that it would have been so recognized by a POSITA. In addition, I understand that an enabling disclosure is a disclosure that allows a POSITA to make the invention without undue experimentation. Although anticipation typically involves the analysis of a single prior art reference, I understand that additional references may be used to show that the primary reference has enabling disclosure, to explain the meaning of a term used in the primary reference, and/or to show that a characteristic is inherent in the primary reference.

D. OBVIOUSNESS

28. I understand that the prior art may render a patent claim “obvious.” I understand that two or more prior art references (e.g., prior art articles, patents, or publications) that each disclose fewer than all elements of a patent claim may nevertheless be combined to render a patent claim obvious if the combination of the prior art collectively discloses all elements of the claim and one of ordinary skill in

the art at the time would have been motivated to combine the prior art in such a way. I understand that this motivation to combine need not be explicit in any of the prior art, but may be inferred from the knowledge of one of ordinary skill in the art at the time the patent was filed. I also understand that one of ordinary skill in the art is not an automaton, but is a person having ordinary creativity. I further understand that one or more prior art references, articles, patents or publications that disclose fewer than all of the elements of a patent claim may render a patent claim obvious if including the missing element would have been obvious to one of skill in the art (e.g., the missing element represents only an insubstantial difference over the prior art or a reconfiguration of a known system).

29. I understand that under the doctrine of obviousness, a claim may be invalid if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a POSITA to which the subject matter pertains.

30. To assess obviousness, I understand that I am to consider the scope and content of the prior art, the differences between the prior art and the claim, the level of ordinary skill in the art, and any secondary considerations to the extent they exist.

31. I understand that any evidence of secondary indicia of non-obviousness should be considered when evaluating whether a claimed invention would have been

obvious to one of ordinary skill at the time of invention. These secondary indicia of non-obviousness may include, for example:

- a long felt but unmet need in the prior art that was satisfied by the claimed invention;
- commercial success of processes claimed by the patent;
- unexpected results achieved by the invention;
- praise of the invention by others skilled in the art;
- the taking of licenses under the patent by others; and
- deliberate copying of the invention.

32. I understand that there must be a nexus between any such secondary indicia and the claimed invention.

33. It is also my understanding that there are additional considerations that may be used as further guidance as to when the above factors will result in a finding that a claim is obvious, including the following:

- the claimed subject matter is simply a combination of prior art elements according to known methods to yield predictable results;
- the claimed subject matter is a simple substitution of one known element for another to obtain predictable results;
- the claimed subject matter uses known techniques to improve similar devices or methods in the same way;
- the claimed subject matter applies a known technique to a known device or method that is ready for improvement to yield predictable results;

- the claimed subject matter would have been “obvious to try” choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;
- there is known work in one field of endeavor that 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 would have been predictable to a POSITA;
- there existed at the time of the invention a known problem for which there was an obvious solution encompassed by the patent’s claims; and
- there is some teaching, suggestion, or motivation in the prior art that would have led a POSITA to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed subject matter.

34. Finally, I understand that a claim may be deemed invalid for obviousness in light of a single prior art reference, without the need to combine references, if the elements of the claim that are not found in the reference can be supplied by the knowledge or common sense of one of ordinary skill in the relevant art.

E. PRIORITY DATE

35. I understand that, subject to the next paragraph, the asserted “priority date” of a patent is the earlier of: (a) the date on which a patent application is filed; or (b) the date on which an earlier-filed patent application is filed if the patentee claims the benefit of priority to that earlier-filed patent application.

36. I understand that it is not enough for a patent to merely claim the benefit of an earlier-filed application, but that additional criteria must be met. In particular, the prior application itself must describe the claimed invention, and must do so in sufficient detail that one skilled in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought. First, I understand that a priority-date analysis is on a claim-by-claim basis. Second, I understand that, in order for a patent claim to be entitled to the filing date of an earlier patent application, a “Section 112 analysis” must be conducted. I am informed that a “Section 112” analysis encompasses looking to the earlier patent application, and ascertaining whether that earlier patent application meets both the written-description and enablement requirements as of the filing date of the earlier application. I understand that it is not enough that the claim would have been obvious from the earlier application, but that application itself must describe the claimed invention.

37. I understand that in order to satisfy the written description requirement the earlier application must reasonably convey to those skilled in the art that the inventors had possession of the subject matter of the patent as of the filing date of the earlier application. I have been informed that it is the disclosures of the earlier patent application that count, and that while the meaning of terms, phrases, or diagrams in the earlier patent application must be interpreted from the vantage point

of one skilled in the art, all of the claimed limitations must appear in the specification. Further, I understand that this analysis is not a question of whether one skilled in the art might be able to construct the claimed invention from the teachings of the disclosure. The question is not whether a claimed invention is an obvious variant of that which is disclosed in the specification; rather, I understand that an earlier application must itself describe each of the claim limitations.

38. I also understand that in order to satisfy the enablement requirement, the earlier application must enable a person of ordinary skill in the art to practice the claimed invention without undue experimentation.

VII. OVERVIEW OF THE CHALLENGED PATENT

A. DISCLOSURE OF THE '801 PATENT

39. The '801 Patent relates to a “hydraulic fracturing system” that includes a “mobile grid assembly for powering an electric hydraulic fracturing pump in limited space environments.”¹ The '801 Patent describes “a singular mobile platform of at least one mobile power unit (MPU) and at least one first switchgear that is configured to handle electric power from the MPU.”² Power generated by the MPU is provided to “directly power[] fracturing pump trailers or units (FPs),” which

¹ Ex. 1001 ('801 Patent) 1:16-19.

² Ex. 1001 ('801 Patent) 1:54-57.

include one or more fracturing pumps for performing fracturing operations at a wellsite.³ The '801 Patent also describes implementing “a common bus where much of the equipment is on the same circuit. As such, the common bus of the present disclosure supports the voltage and combined current requirements of the various equipment loads.”⁴ Figure 5 of the '801 Patent, copied below depicts an example hydraulic fracturing system, including MPUs 502, fracturing pump trailers 504, switch gear 512, and power cable interconnects 514.⁵ “In this configuration, power cable interconnects 514a,b are provided between the MPUs 502a-c to act as a common bus for load sharing.”⁶ To account for this load sharing configuration, where the power of MPUs 502 can be combined to power the fracturing pump trailers 504, the '801 Patent explains that “the switch gear, interconnect cables, and electrical bus bars are sized to handle all of the available electrical current that can be generated by the combined MPUs.”⁷

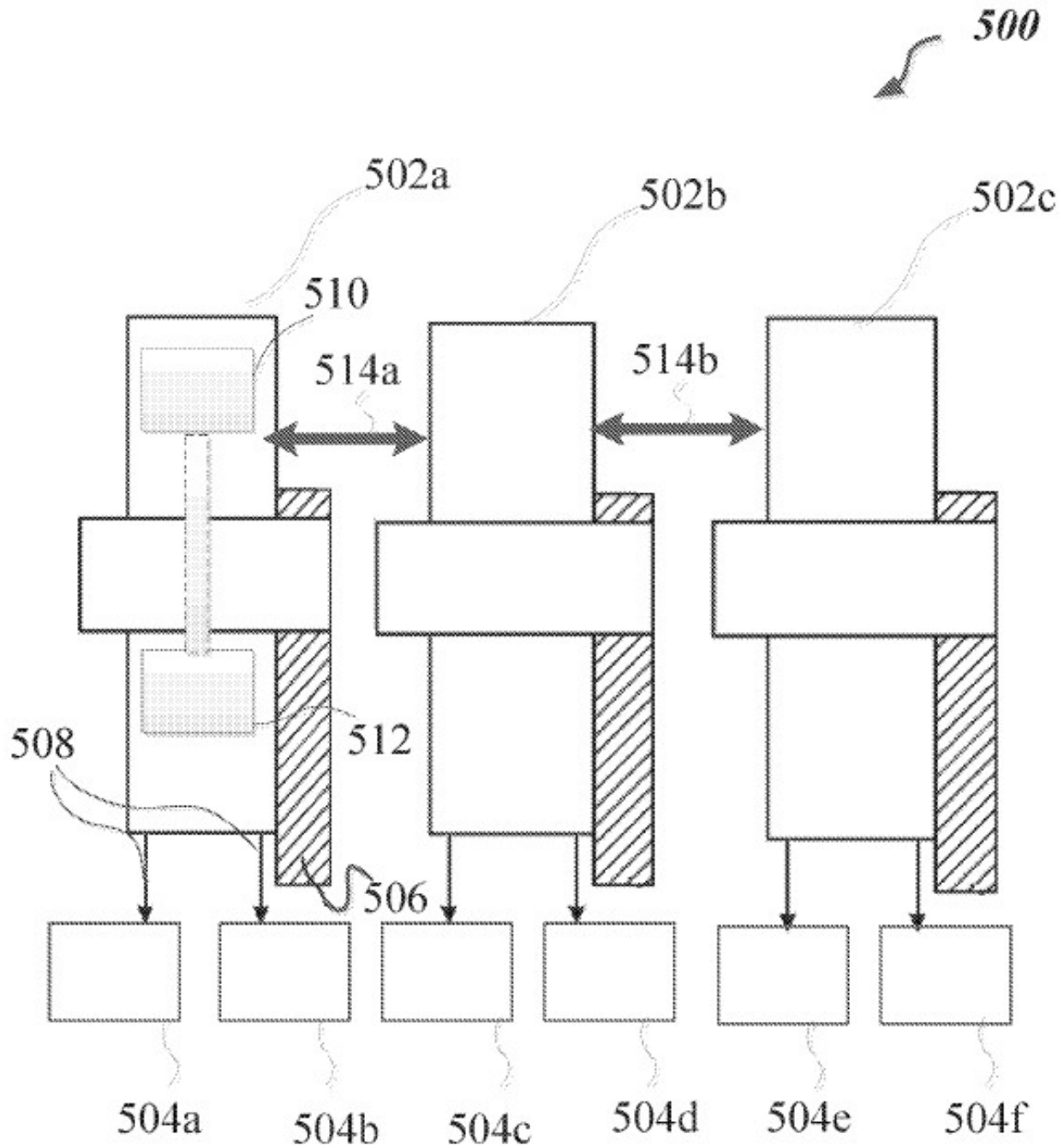
³ Ex. 1001 ('801 Patent) 5:32-67, 11:44-47.

⁴ Ex. 1001 ('801 Patent) 4:18-23.

⁵ Ex. 1001 ('801 Patent) 10:21-35.

⁶ Ex. 1001 ('801 Patent) 10:29-31.

⁷ Ex. 1001 ('801 Patent) 5:42-45.



Ex. 1001 ('801 Patent) Fig. 5.

40. The '801 Patent explains that by integrating several electrical components on a single MPU, “fewer physical connections are needed to be established or stowed during transportation,” and the need for “a separate switch

gear trailer or skid” is eliminated, thereby increasing mobility, saving space, and reducing cost of deploying power distribution systems in fracturing sites.⁸ Further, the ’801 Patent explains that by incorporating an interconnecting cable to act as a common bus between multiple MPUs, excess power from a turbine generator can be redistributed within the system, thereby improving overall efficiency of the system.⁹

A. PRIORITY DATE OF THE ’801 PATENT

41. I understand that the ’801 Patent (which was filed as U.S. Patent App. No. 12/443,273, or “’273 Application”) which was filed on June 17, 2019. I further understand that the ’387 Application sought direct priority from U.S. Provisional Application No. 62/684,797 (the “’787 Provisional”), filed June 15, 2018. Accordingly, it is my opinion that the earliest possible priority date for the Challenged Claims of the ’801 Patent would be no earlier than when the 62/685,797 Provisional was filed. Regardless of whether the ’801 Patent receives the filing date of June 17, 2019 or the provisional filing date of June 15, 2018, the references that I use below are all Prior Art even before June 15, 2018.

⁸ Ex. 1001 (’801 Patent) 3:64-67, 4:7-13.

⁹ Ex. 1001 (’801 Patent) 4:18-33.

B. CHALLENGED CLAIMS

42. The Challenged Claims of the '801 Patent, which are Claims 1-20, are set forth below. Some of the claim elements have been further sub-divided (and labeled as part "1.1", "1.2" or similar, where the first number indicates the claim number, and the following decimals refer to sub parts of that claim) for ease of reference.

Claim	Description
1[p]	1. A system comprising:
1[a]	A first mobile unit:
1[b]	at least one switch gear to be associated with at least one transformer, an interconnect, and a bus bar; and
1[c]	at least one first generator coupled to the at least one switch gear and located on the first mobile unit with the at least one switch gear,
1[d]	the first mobile unit configured to provide power generated by the at least one first generator using electrical buses of the at least one switchgear and using the at least one transformer, the interconnect, and the bus bar, the power for loads on one or more external mobile units,
1[e]	the at least one switchgear, the electrical buses, the interconnect, and the bus bar sized to support voltage and current requirements of the loads and to support voltage and current outputs of the at least one transformer with the at least one first generator in a load sharing arrangement with a second generator of a second mobile unit.
2	2. The system of claim 1, wherein the system is part of a hydraulic fracturing system that consumes the power and that comprises a wellbore and at least one pressuring system to create fractures in a subterranean formation that surrounds the wellbore.
3	3. The system of claim 1, further comprising: at least one fracturing pump (FP) mobile unit of the one or more external mobile units, the at least one FP mobile unit physically external relative to the

	first mobile unit, wherein the at least one transformer is provided to condition the power supplied to the at least one FP mobile unit.
4	4. The system of claim 1, further comprising: a predetermined number of FP mobile units comprised in the one or more external mobile units, the predetermined number of FP mobile units determined by a maximum of the power available from the at least one first generator and handled by the at least one switch gear.
5	5. The system of claim 1, further comprising: a predetermined number of first generators comprising the at least one first generator, the predetermined number of first generators having individual power output values that is lesser than a power output of an isolated single generator occupying all available space in an independent mobile unit physically external to the first mobile unit.
6	6. The system of claim 1, further comprising: the at least one switchgear being physically arranged to replace an electronic equipment room (EER) of at least one of the one or more external mobile units that is designed to comprise the EER.
7[a]	7. The system of claim 1, further comprising: at least one Variable Frequency Drive (VFD); and
7[b]	at least one Motor Control Center (MCC), the VFD and the MCC being on individual ones of the one or more external mobile units that is physically external relative to the first mobile unit.
8	8. The system of claim 1, further comprising: the interconnect configured to couple the first mobile unit with the second mobile unit, the second mobile unit having at least one second switch gear in addition to the second generator, the interconnect to transmit power in support of redundancy in addition to the load sharing arrangement between the first mobile unit and the second mobile unit.
9[a]	9. The system of claim 1, further comprising: the at least one switch gear configured in the load sharing arrangement by being in part on an incoming side of the at least one transformer such that the sizing is based at least in part on current available for the voltage output of a

	secondary side of the at least one transformer that is coupled to the at least one first generator and the second generator; or
9[b]	the at least one switch gear configured in the load sharing arrangement by being in part on an outgoing side of the at least one of the at least one transformer such that the sizing is based at least in part on the current available at the secondary side of the at least one transformer that is coupled to the at least one first generator and the second generator.
10[a]	10. The system of claim 1, further comprising: at least one load sharing FP mobile unit coupled, as at least one of the loads, with a second FP mobile unit of the one or more external mobile units; and
10[b]	a datavan in the one or more external mobile units for control of the at least one load sharing FP mobile unit, the datavan offering the control of the at least one load sharing FP mobile unit instead of a second control available from within the first mobile unit.
11	11. The system of claim 1, further comprising: the at least one transformer being an isolation transformer that is located in the one or more external mobile units, the isolation transformer being physically external relative to the first mobile unit and being configured for filtering harmonics between the at least one first generator and the loads in the one or more external mobile units.
12[p]	12. A method comprising:
12[a]	providing a first mobile unit with at least one first generator and at least one switchgear located together in the first mobile unit, the at least one first generator coupled to the at least one switch gear on the first mobile unit, the at least one switch gear to be associated with at least one transformer and with an interconnect and a bus bar;
12[b]	generating power from the at least one generator;
12[c]	providing the power using electrical buses of the at least one switchgear and using the at least one transformer the interconnect, and the bus bar, the power for loads in one or more external mobile units, the at least one switchgear, the interconnect, the bus bar, and the electrical buses sized to support voltage and current requirements of the loads and to support voltage and current outputs of the at least one transformer with the at least one first generator in a load sharing arrangement with a second generator of a second mobile unit.

13[a]	13. The method of claim 12, further comprising: providing at least one fracturing pump (FP) mobile unit of the one or more external mobile units that is physically external relative to the first mobile unit; and
13[b]	conditioning the power supplied to the at least one FP mobile unit using the at least one transformer.
14	14. The method of claim 12, further comprising: determining a number of FP mobile units for the one or more external mobile units based at least in part on a maximum of the power available from the at least one first generator and handled by the at least one switch gear.
15	15. The method of claim 12, further comprising: determining a number of generators for the at least one first generator based at least in part on the number of first generators having individual power output values that is lesser than a power output of an isolated single generator occupying all available space in an independent mobile unit physically external to the first mobile unit.
16	16. The method of claim 12, further comprising: physically arranging the at least one switch gear to replace an electronic equipment room (EER) of at least one of the one or more external mobile units that is designed to comprise the EER.
17[a]	17. The method of claim 12, further comprising: providing at least one Variable Frequency Drive (VFD); and
17[b]	providing at least one Motor Control Center (MCC), the VFD and the MCC being on individual ones of the one or more external mobile units that is physically external relative to the first mobile unit.
18	18. The method of claim 12, further comprising: coupling the first mobile unit with the second mobile unit using the interconnect, the second mobile unit having at least one second switch gear in addition to the second generator, the interconnect to transmit power in support of redundancy in addition to the load sharing between the first mobile unit and the second mobile unit.
19[a]	19. The method of claim 12, further comprising: coupling at least one load sharing FP mobile unit to share the at least one load of a second FP mobile unit of the one or more external mobile units and
19[b]	controlling, via a datavan in the one or more external mobile units, the at least one load sharing FP mobile unit, the datavan offering the control of the at

	least one load sharing FP mobile unit instead of a second control available from within the first mobile unit.
20	20. The method of claim 12, further comprising: filtering harmonics between the at least one first generator and the loads in the one or more external mobile units using an isolation transformer as the at least one transformer that is in the one or more external mobile units, the isolation transformer being physically external relative to the first mobile unit.

VIII. LEVEL OF ORDINARY SKILL IN THE ART

43. A person of ordinary skill in the art would have either (1) a Bachelor of Science in Mechanical Engineering, Electrical Engineering, Petroleum Engineering or an equivalent field as well as at least 2 years of academic or industry experience in the oil and gas industry, including well drilling, completion, or production, including design and/or analysis of power systems or (2) at least four years of industry experience in the oil and gas industry including well drilling, completion, or production including design and/or analysis of power systems.

IX. CLAIM CONSTRUCTION

44. It is my opinion that a POSITA would understand all the claim terms to have their plain and ordinary meaning, and I have applied the plain and ordinary meaning, in the context of the '801 Patent, for all claim terms.

X. TECHNOLOGY BACKGROUND AND STATE OF THE ART

45. In the subsections below, I describe some of the basic principles of engineering that would be used, or at least considered for use, on a hydraulic fracturing site. The principles discussed in the subsections below would have been well-known to a POSITA in the 2018 timeframe, and long before.

A. EXEMPLARY REFERENCES CORROBORATING THE GENERAL ENGINEERING KNOWLEDGE**1. Roe (Ex. 1014)**

46. As an example of such general engineering knowledge, Exhibit 1014 (“*Roe*”) is a textbook published in 1972, entitled *Practices and Procedures of Industrial Electrical Design*. Exhibit 1014 contains true and correct copies of pages from the *Roe* textbook.

47. *Roe* is a textbook of basic electrical engineering knowledge that is useful in the design and operation of industrial electrical systems. My first exposure to *Roe* was as an electrical engineering student in the late 1980s / early 1990s. I “borrowed” *Roe* from the library of my father (Dr. Marcus O. Durham, PhD, PE, LFIEEE, “Dr. Marc”) as a reference and a teaching tool when I began working at Public Service Company of Oklahoma as a power systems intern in 1989. Dr. Marc had purchased the book from the University of Oklahoma Bookstore as a textbook for a course in industrial electrical design that he took in the mid-1970s while he was

pursuing graduate studies as well as licensure as a Professional Engineer. The book passed to me when he downsized his library upon retirement in about 2013.

48. *Roe* was “written for the whole of the engineering profession, for practicing engineers as well as for students. Thus it is a reference book containing facts which all members of the field may find useful.”¹⁰ *Roe* further describes the usefulness of the book: “Project engineers from other fields such as civil, mechanical and chemical engineering should have no difficulty in understanding matters of electrical design after reading this book or a specific chapter of it.”¹¹ Thus, *Roe* provides evidence of general engineering knowledge, known in the field decades before the priority date of the Challenged Patent.

49. As discussed above, *Roe* contains general engineering knowledge with regards to electrical systems in an industrial environment. A POSITA would have understood that an oil and gas fracturing location is such an industrial environment. Specifically with regards to the subject matter of the Challenged Patent, *Roe* discusses basic electrical systems including the use of the following:

- Generators
- Circuit breakers

¹⁰ Ex. 1014 (*Roe*) p. xv (Preface).

¹¹ Ex. 1014 (*Roe*) p. xvi.

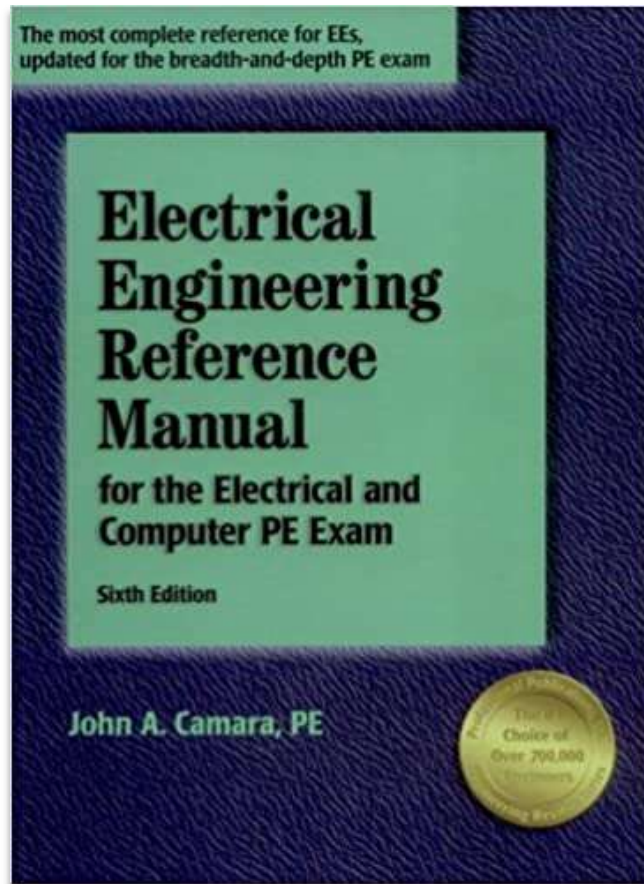
- Step-up transformers
- Circuit breaker locations
- Step-down transformer
- Distribution System
- Additional transformers
- Protection and Control
- Tie breakers,
- Substations

All of these concepts were within the general knowledge of engineers at the time of the '801 Patent and long before.

2. EE-Reference (Ex. 1015)

50. EE-Reference refers to a textbook authored by John A. Camara, entitled “Electrical Engineering Reference Manual for the Electrical and Computer PE Exam.” This particular version of *EE-Reference* is the Sixth Edition, was published in 2002 by Professional Publications, Inc., and has ISBN: 1-888577-56-8. Exhibit 1015 contains true and correct copies of pages from EE-Reference. I acquired my copy of *EE-Reference* around 2005, have used it in my regular practice of engineering since then, and have taught Professional Engineering (PE) Exam

courses out of it. The cover of *EE-Reference* states that it is “[t]he most comprehensive resource available for the electrical PE exam.”¹²



EE-Reference provides evidence of general engineering knowledge, known in the field decades before the priority date of the Challenged Patent.

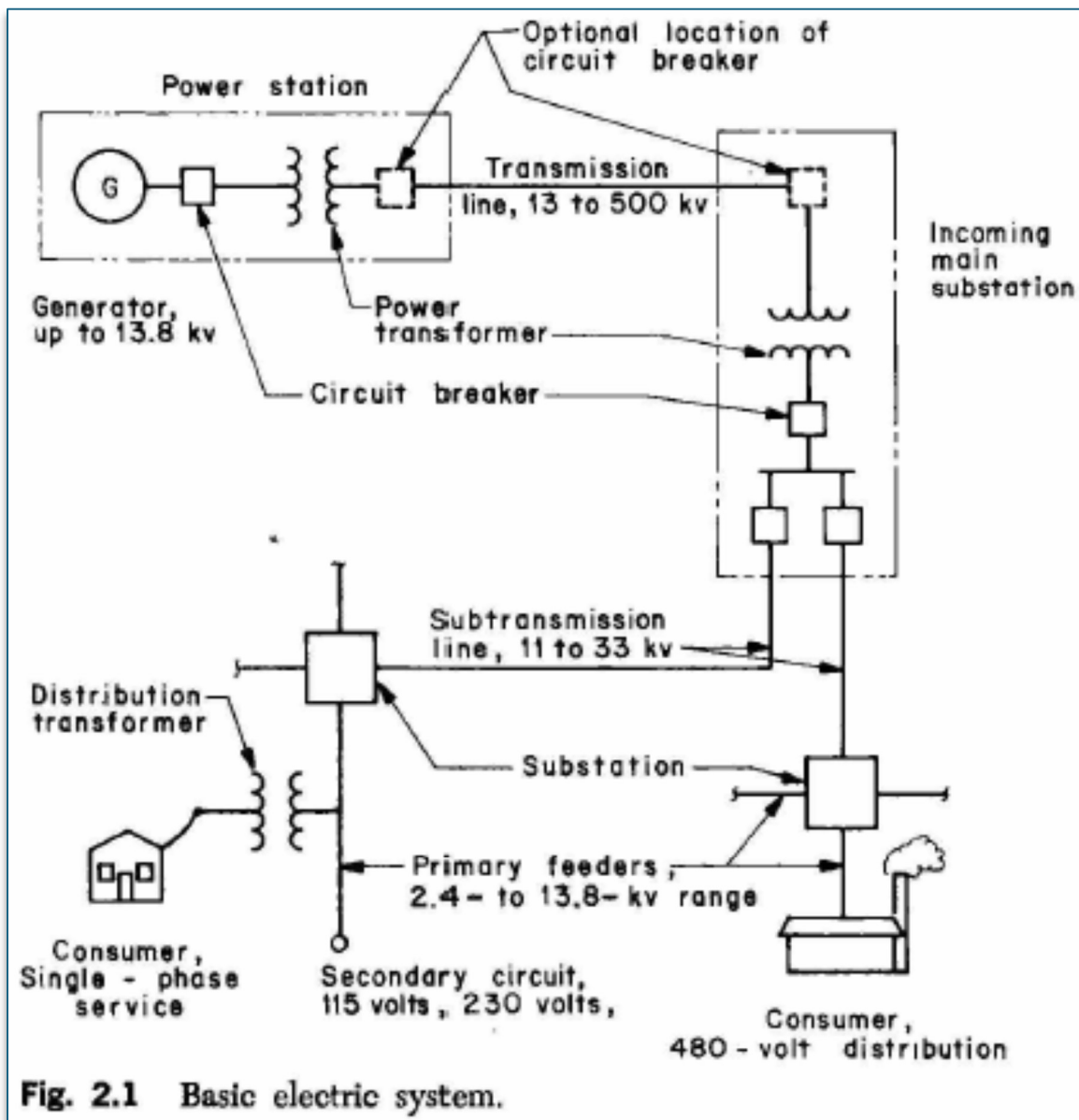
¹² Ex. 1015, cover

B. BASIC ELECTRIC SYSTEMS

51. The configuration of transmission lines, substations, power generation, and dedicated power generation sub-systems, and how they deliver power to electric motors, was well-known general engineering knowledge.

52. For example, Chapter 2 of *Roe* is entitled “The Basic Electric System.” The layout of a basic electric system was known at least by 1972 at the time of *Roe*, and is shown below in Figure 2.1 from *Roe*¹³:

¹³ Ex. 1014 (*Roe*), p. 9 (Fig. 2.1).



Roe then discusses basic components, which I summarize in the subsections below, including generators, transmission lines, switchgear, step-up transformers, step-down transformers, and other such components.

53. Another example of the pervasiveness of the general-engineering knowledge associated with a basic electric system is shown in Exhibit 1015, entitled

the *Electrical Engineering Reference Manual for the Electrical and Computer PE Exam* (“*EE-Reference*”). As implied by the title, this was a basic engineering reference manual that engineers used in 2002 (more than a decade before the earliest possible priority date of the ’801 Patent), including to study for their Professional Engineer examinations. *EE-Reference* includes Chapter 35, entitled “Power Distribution.” Within this chapter, *EE-Reference* includes Section 35.1, entitled “Fundamentals.” The Fundamentals section shows a power distribution system, figure copied below, with components similar to those shown in Exhibit 1014 (*Roe*).

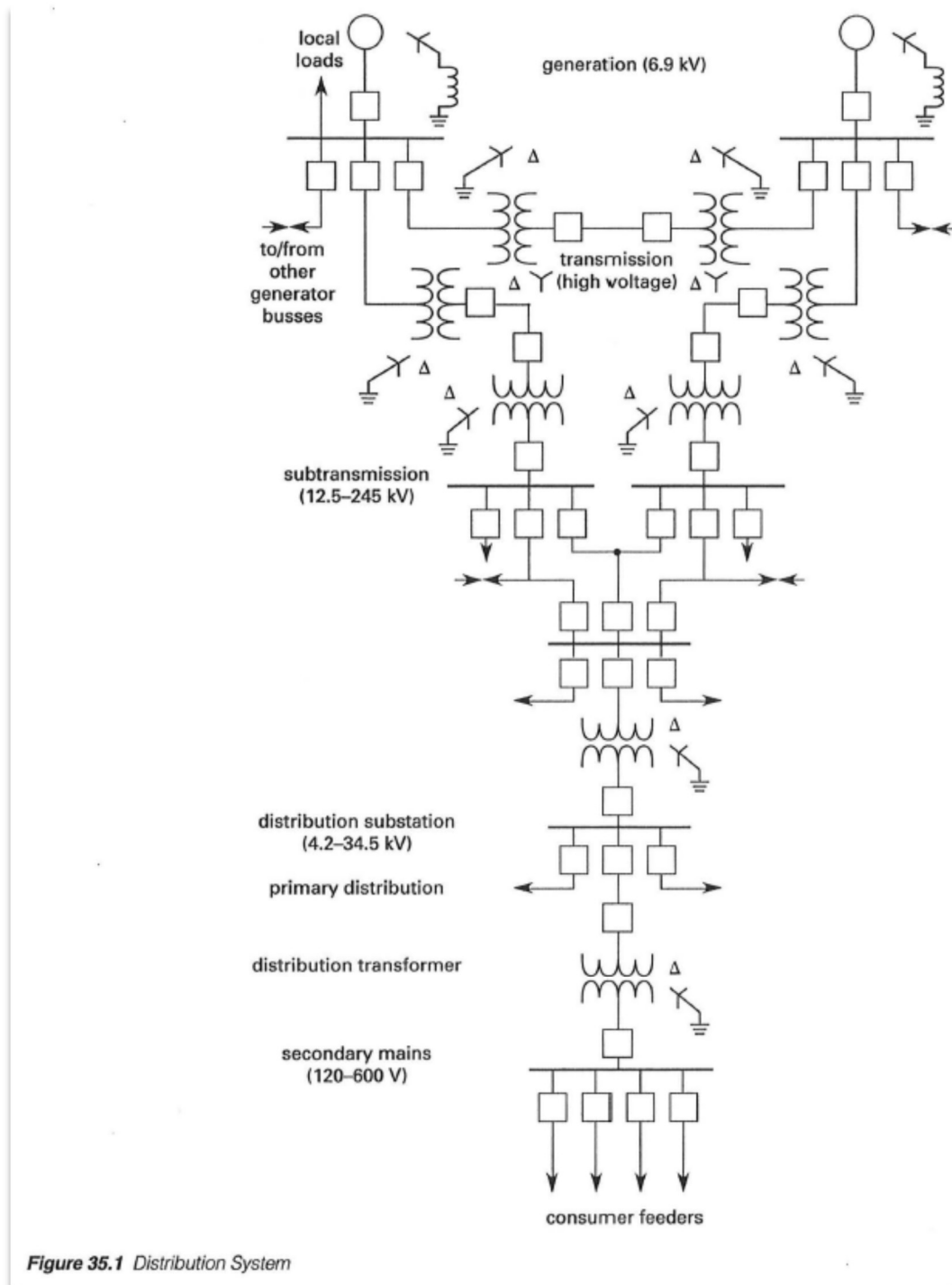
54. *EE-Reference* defines an “electric distribution system” as follows¹⁴:

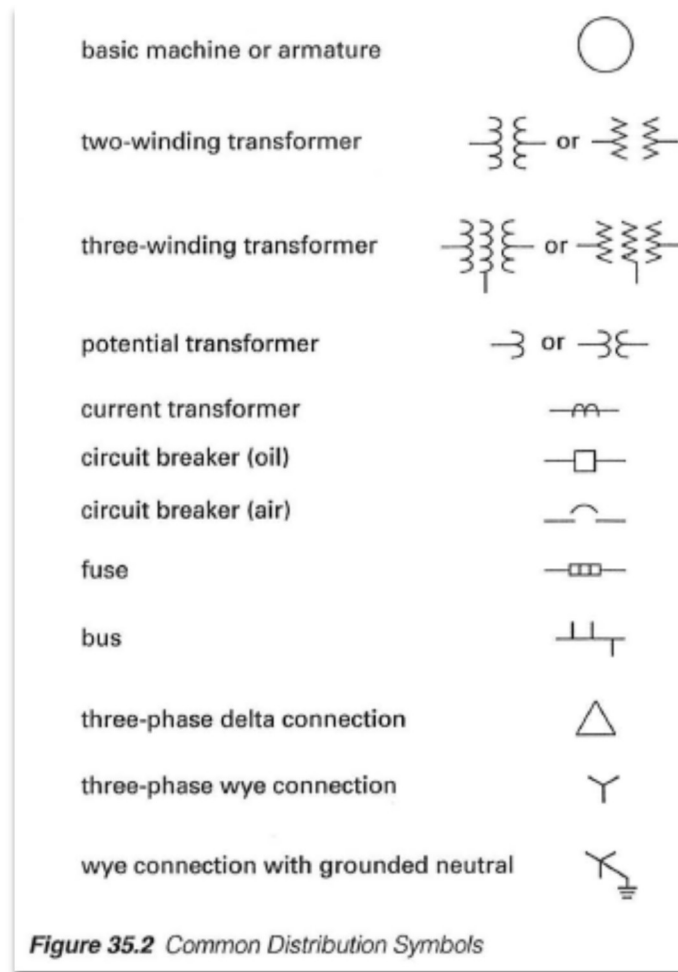
The *electric distribution system* is the circuitry, high-voltage **switchgear**, transformers, and related equipment that receives high voltage from the source and delivers it at lower voltages. Its function is to receive power from large bulk sources, that is, generation sources, and distribute it to users at the voltage level and degree of reliability required. A hypothetical distribution system one-line diagram is shown in Fig. 35.1. The electric utility may consider the distribution system as that portion of Fig. 35.1 from the distribution substation to the consumer. The symbols used are explained in Fig. 35.2

Figures 35.1 and 35.2 from *EE-Reference* are shown below.¹⁵

¹⁴ Ex. 1015 (*EE-Reference*) p. 35-1.

¹⁵ Ex. 1015 (*EE-Reference*), p. 35-2, 35-3 (Figs. 35.1, 35.2).

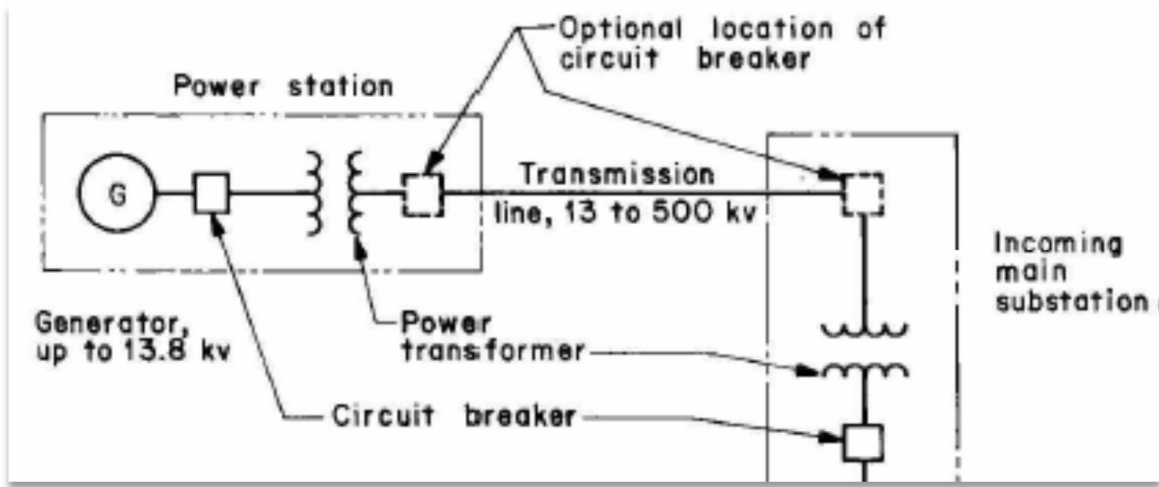




Components of the basic electric system are further explained below, each of which would have been well-known in the art and part of general engineering knowledge long before the filing date of the '801 Patent.

C. POWER GENERATION AND LOAD SHARING

55. It was general engineering knowledge that a “generator is a device used to transform energy into electrical energy.”¹⁶ The generator is identified with a circled “G” in the top-left corner:¹⁷



“The standard frequency in the United States” for transmission of electrical energy “is 60 cycles per second (cps) for normal utility systems.”¹⁸ The generator is connected to a “prime mover” (e.g., engine or turbine), which is fueled with a source of energy such as “fossil fuels.”¹⁹ The generator “produces electricity at a relatively low voltage,” such as “up to 13.8 kV.”²⁰

¹⁶ Ex. 1014 (*Roe*) p. 9.

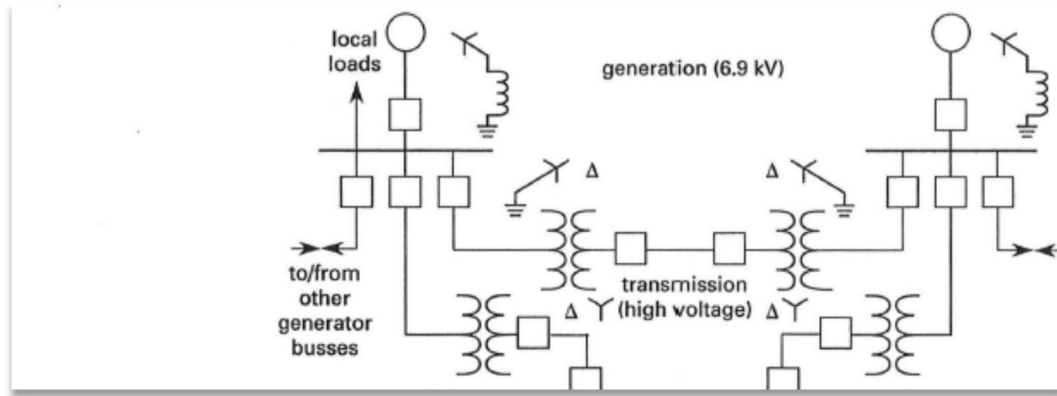
¹⁷ Ex. 1014 (*Roe*) p. 9 (Fig. 2.1) (excerpted).

¹⁸ Ex. 1014 (*Roe*) p. 9-10.

¹⁹ Ex. 1014 (*Roe*) p. 8.

²⁰ Ex. 1014 (*Roe*) p. 8-9 (Fig. 2.1).

56. *EE-Reference* provides an example of a generator operating at 6.9 kV (kilovolts).²¹



Further descriptions of generators is provided in Chapter 33 of *EE-Reference*, as are prime movers such as turbines, mechanical drives, etc. Further, Chapter 33 (section 33.7) discusses “Parallel Operation” of generators. Parallel operation of generators is simply operating generators in a fashion so that they share load, often referred to as “load sharing”. As described in *EE-Reference*, “One or more generators may be attached to a given power bus.”²² “Parallel operation of generators occurs for myriad reasons, including shifting of the load to shut down a generator for maintenance, to increase the capacity available and so on.”²³ “The division of real load among

²¹ Ex. 1015 (*EE-Reference*) p. 35-2 (Fig. 35.1) (excerpted).

²² Ex. 1015 (*EE-Reference*) p. 35-1

²³ Ex. 1015 (*EE-Reference*) p. 33-6.

generators operating in parallel [i.e., load sharing] is determined by the speed of the generators and the characteristics of the prime mover speed-governing system.”²⁴

D. TRANSMISSION LINES

57. It was general engineering knowledge that a “transmission line is a system of conductors, such as wires, waveguides, or coaxial cables, that conducts power or transmits signals from one terminal to another.”²⁵ For a single-phase system, it was generally known that transmission lines would include two “wires” (hot and neutral), sometimes with a separate ground wire. For a three-phase system, it was generally known that transmission lines would include 3-5 wires (3 phase wires, sometimes a neutral wire, and sometimes a ground wire).

58. It was generally known that transmission lines could be essentially any length, as needed, based on the distance from one electrical components to another.²⁶ According to *Roe*, the purpose of transmission lines “is to span long distances.”²⁷ Accordingly, transmission lines of various lengths were readily known and applied. The calculations used to analyze transmission lines of varying lengths were well-known, such as those described in Chapters 27 and 37 of *EE-Reference*.

²⁴ Ex. 1015 (*EE-Reference*) p. 33-7.

²⁵ Ex. 1015 (*EE-Reference*) p. 37-2; see Ex. 1014 (*Roe*) p. 11.

²⁶ See Ex. 1015 (*EE-Reference*) p. 37-3 (describing transmission lines that can be between “0” and “240 km (150 mi)” long).

²⁷ Ex. 1014 (*Roe*) p. 11-12.

E. CIRCUIT BREAKERS AND SWITCHGEAR

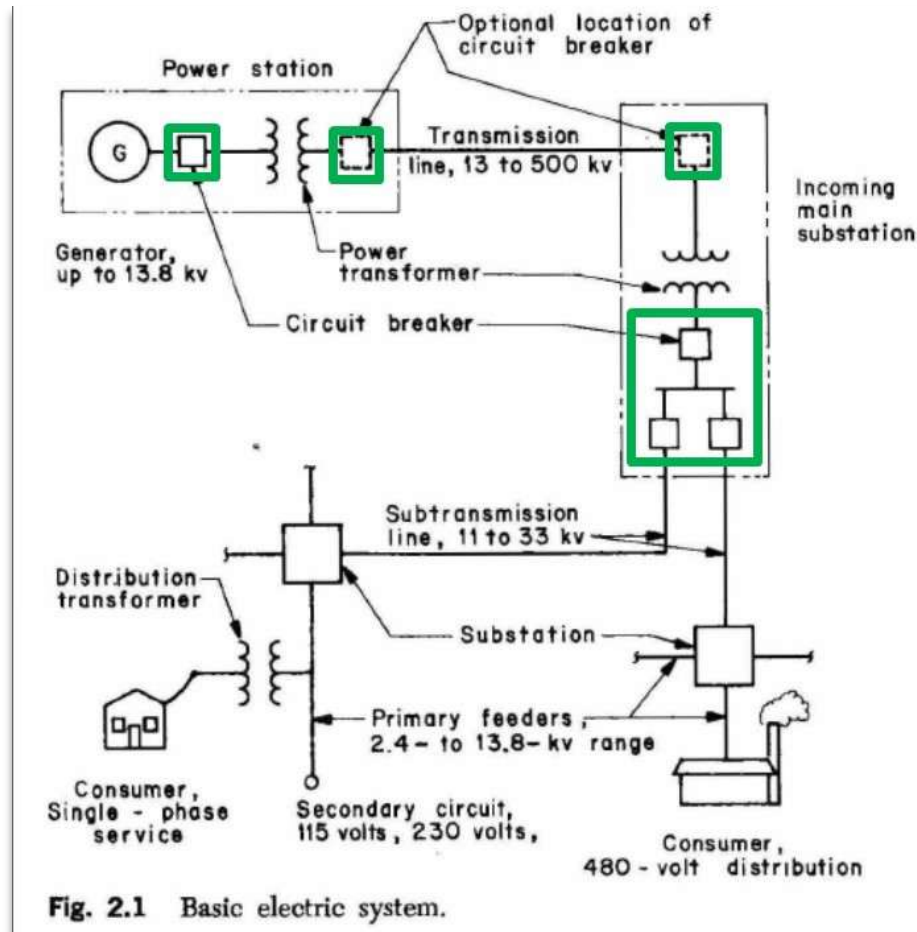
59. It was general engineering knowledge to include multiple terminus points within a power-distribution system in order to readily connect and disconnect certain components, such as for purposes of maintenance or to prevent damage from excessive currents. In 1972, *Roe* described circuit breakers as follows:²⁸

The conductors leaving the generator terminate in a *circuit breaker*. The function of this piece of equipment is to prevent excessive currents in the system beyond the generator. At the same time, it can be made to serve as a protective device to prevent overloading of the generator. Circuit breakers come in many forms, shapes and sizes.

With all these differences, all circuit breakers have one thing in common: They disconnect a circuit from the supply when the current in the system exceeds predetermined limits. The circuit breaker may also serve double duty as a disconnect device or switch, being operated manually instead of automatically.

Roe depicts multiple sets of circuit breakers, some of which have been annotated in green below:

²⁸ Ex. 1014 (*Roe*) p. 10.



Ex. 1014 (*Roe*) p. 9 (Fig. 2.1) (annotated).

As can be seen in *Roe*, it was generally known to place a circuit breaker between a generator and a transformer to isolate one from the other.

60. It was also generally known that a circuit breaker along with its associated control, instrumentation, metering, protective devices and supporting

structures is referred to as “switchgear.” For example, the *IEEE Standards Dictionary* in 2000 described switchgear in such a manner.²⁹

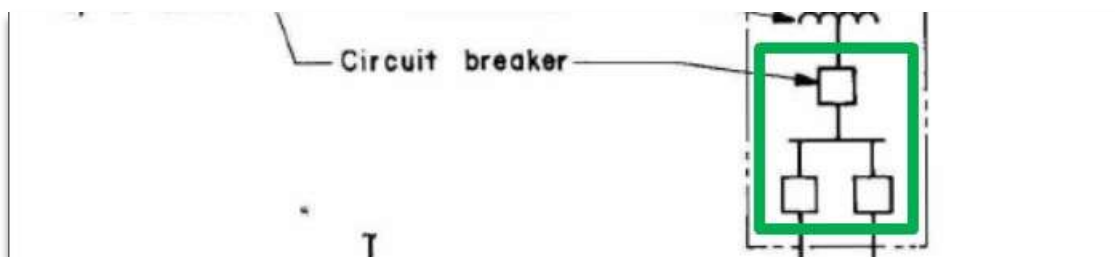
switchgear (1) A general term covering switching and interrupting devices and their combination with associated control, instrumentation, metering, protective and regulating devices, also assemblies of these devices with associated interconnections, accessories and supporting structures used primarily in connection with the generation, transmission, distribution, and conversion of electric power.

(SWG/PE/IA/PSP) C37.20.3-1996, 1015-1997,
C37.20.2-1993, C37.20.1-1993r, C37.100-1992

(2) (hydroelectric power plants) An assembly of equipment used to switch and control electrical power.

(PE/EDPG) 1020-1988r

It was also generally known that switchgear often contain multiple circuit breakers, which is depicted in annotated Figure 2.1 from *Roe*.



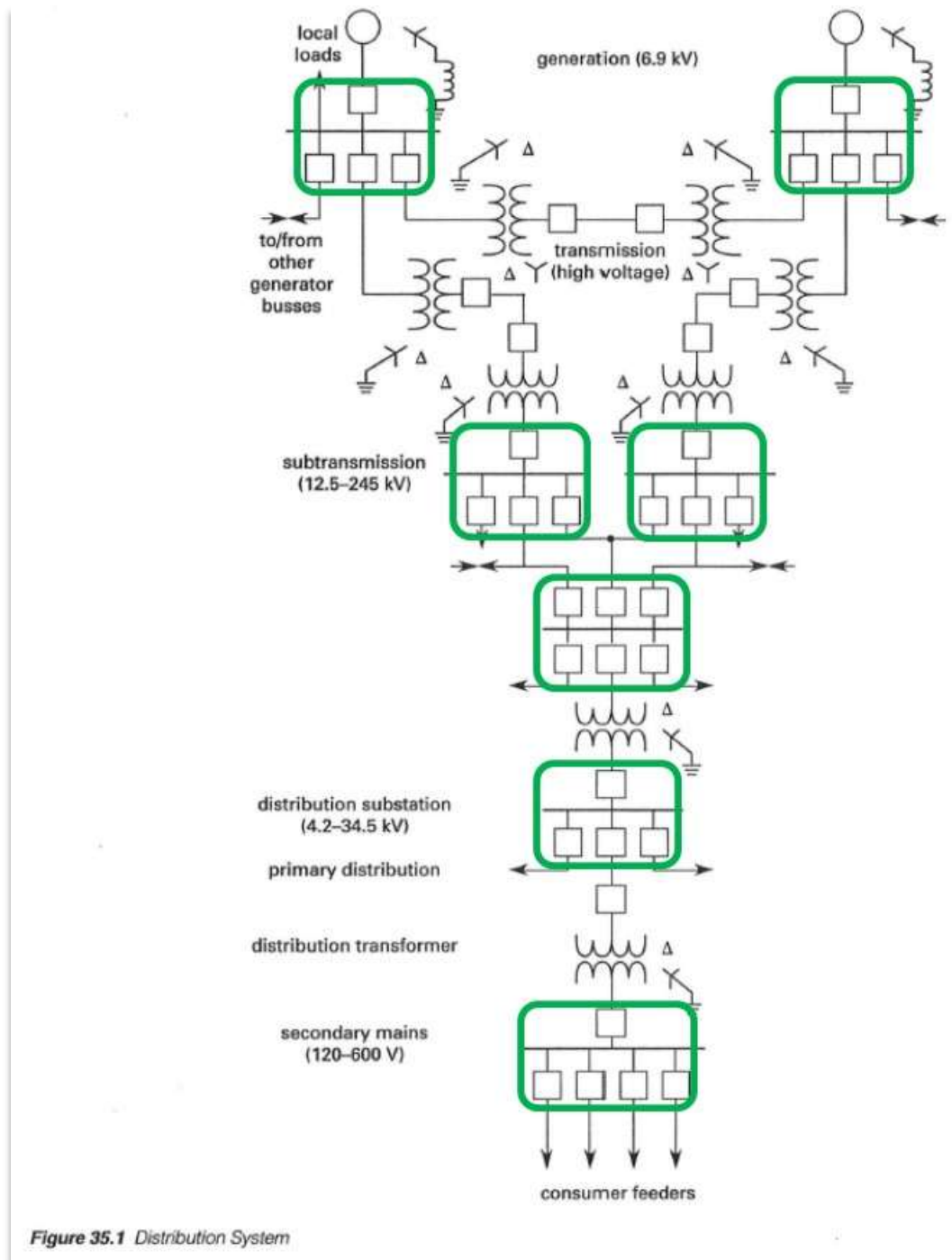
Ex. 1014 (*Roe*) p. 9 (Fig. 2.1) (excerpted and annotated).

The above switchgear is depicted as a component of a substation: “the part of an electric system containing one or more power transformers, switchgear, bus-bar

²⁹ Ex. 1016 (*IEEE Standards Dictionary*) p. 1135.

distribution, regulating equipment and (sometimes) a control building.”³⁰ Multiple switchgear are also depicted in Figure 35.1 of *EE-Reference*. These are annotated in green.

³⁰ Ex. 1014 (*Roe*) p. 13.



Ex. 1015 (*EE-Reference*) p. 35-2 (Fig. 35.1) (annotated).

As can be seen above, it was generally known to place switchgear in multiple locations in the power-distribution system, particularly at locations where voltage changes or at portions of the power system need to be disconnected either manually or automatically.

61. As another example of the widespread use of switchgear, U.S. Patent 1,743,771 (filed in 1926, “*Hall*”) describes a “system of electric distribution” containing “an automatic switching arrangement for controlling the connections between a plurality of sources and a plurality of distribution circuits.”³¹ *Hall* describes “two distribution busses which are adapted to be connected together by a tie breaker,” sources including “generator 4 which is adapted to be connected to the bus 1 by means of a circuit breaker 5,” and loads that can be supplied by multiple generators or a single generator, depending on the size of the load.³² While *Hall* does not use the word “switchgear” verbatim, it does nevertheless disclose a switchgear. The “automatic switching arrangement for controlling the connections,” “tie breaker,” and “circuit breaker 5” are all examples of switchgear, and would have been recognized as such by a POSITA.³³

³¹ Ex. 1017 (*Hall*) p. 1 lines 1-5.

³² Ex. 1017 (*Hall*) p. 1 lines 34-52.

³³ See Ex. 1016 (IEEE Standards Dictionary) p. 1135 (defining “switchgear”).

F. TRANSFORMERS

62. It was general engineering knowledge that transformers were components that enable efficient transmission of electrical energy in power-distribution systems:³⁴

A transformer is an electrical device consisting of two or more multiturn coils of wire placed in close proximity in order to link the magnetic field of one to the other. This linkage allows the transfer of electrical energy from one or more alternating circuits to one or more other alternating circuits through the process of magnetic induction. The transformer can be used to raise or lower the value of a capacitor, inductor, or resistor. It enables the efficient transmission of electrical energy at high voltage over great distances [i.e., using a step-up transformer], and then is used to lower the voltage to safe values for industrial, commercial, and household use [i.e., using a step-down transformer].

63. It was general engineering knowledge that transformers can be broadly classified as “step-down” (decreases voltage) or “step-up” (increases voltage) transformers, depending on the number of winding turns on the transformer:³⁵

If the turns ratio is greater than unity, the transformer decreases the voltage and is termed a *step-down* transformer. If the turns ratio is less than unity, the transformer increases the voltage and is termed a *step-up* transformer.

³⁴ Ex. 1015 (*EE-Reference*) p. 28-1.

³⁵ Ex. 1015 (*EE-Reference*) p. 28-4.

64. ***Step-up transformer:*** It was general engineering knowledge that a generator “produces electricity at a relatively low voltage,” such as “up to 13.8 kV” (shown in Fig. 2.1).³⁶ “To prepare the electricity for transmission over long distances, it is fed into a device known as a transformer. The voltage is then raised by transformer action”³⁷ The step-up transformer allows for longer-distance transmission of the electric power while reducing electric losses. As was known to engineers, the reason that stepping up the voltage reduces the amount of power lost in transmission is due to the well-known relationship between voltage, current, and power. Electric power is the product of the voltage and current as shown below:³⁸

$$P = V \cdot I$$

In the above equation, P is the power being transmitted (Watts), V is the voltage (Volts), and I is the current (Amps). As would be readily understood by a POSITA, for a fixed amount of power being transmitted, as voltage increases, current will necessarily decrease. Resistive losses in transmission are governed by the relationship shown below:

$$P_{loss} = I^2 \cdot R$$

³⁶ Ex. 1014 (*Roe*) p. 8-9.

³⁷ Ex. 1014 (*Roe*) p. 8.

³⁸ This is the simplest definition used for DC and single-phase AC systems. For three-phase AC systems, the relationship is $\sqrt{3} \cdot V \cdot I^*$, where I^* is the mathematical conjugate of the current.

In the above equation, P_{loss} is the amount of power lost in transmission (Watts), I is current (Amps), and R is resistance (Ohms). As current decreases, the amount of losses in the transmission line decrease by a squared factor. As an example, if voltage is increased by a factor of 10 (e.g., from 5 kV to 50 kV), the amount of current will decrease by a factor of 10 and losses would decrease by a factor of 100 (i.e., 10^2). Thus it was generally known to increase the efficiency of an electrical transmission system by using step-up transformers to increase voltage for transmission, and by using step-down transformers to lower the voltage for use.

65. *Roe* provides a section entitled “The Stepup Transformer,” which explains the generally known concept (even in 1972 and well before) that the “purpose of the transformer is to raise the voltage from the rated voltage of the generator to a new voltage level, suitable for transmitting over long distances.”³⁹ Functionally, a “step up” transformer is used anytime voltage needs to be increased.

66. ***Step-down transformer:*** It was general engineering knowledge that after the voltage has been transmitted long distance, it is too high to be safe “for industrial, commercial, and household use.”⁴⁰ The purpose of the step-down transformer is to reduce the voltage from the level used in the transmission line to

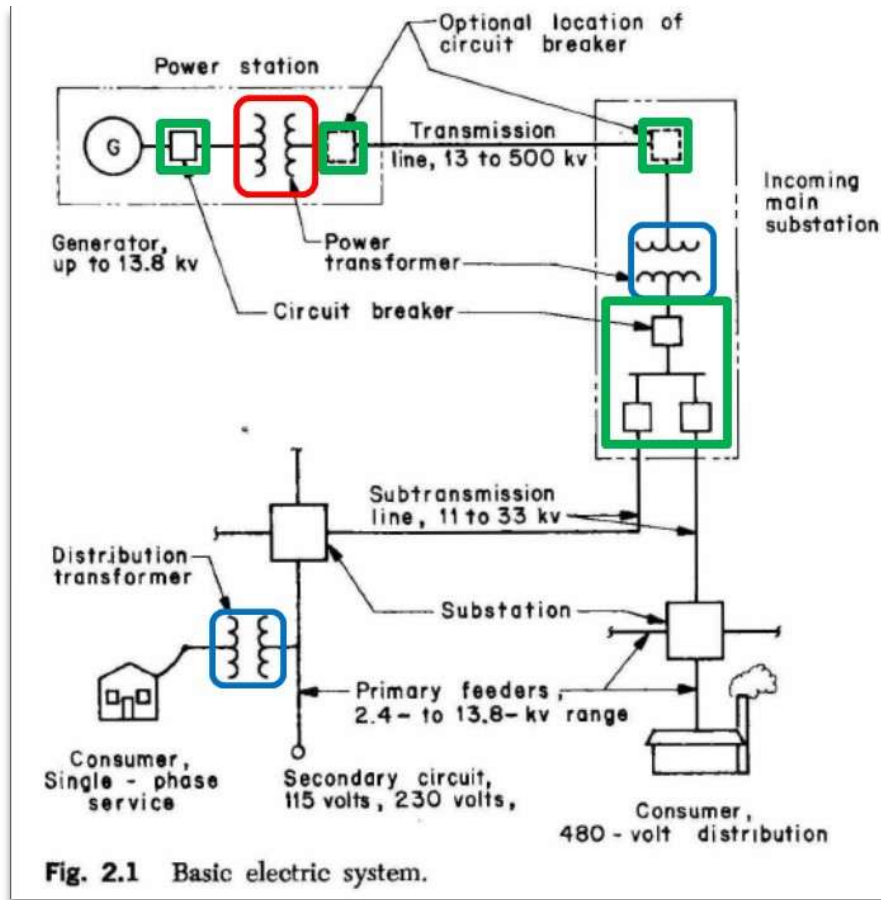
³⁹ Ex. 1014 (*Roe*) p. 10.

⁴⁰ Ex. 1015 (*EE-Reference*) p. 28-1.

one more suitable for distribution to various locations or equipment. As described by *Roe*, “The transmission line terminates in a stepdown transformer,” with appropriate switchgear as shown in Figure 2.1.⁴¹ Functionally a “step-down” transformer is used any place voltage levels need to be reduced. Step-up and step-down transformers may also be located inside substations, as described further in sections below.

67. Example locations of step-up and step-down transformers are shown in both *Roe* Figure 2.1 and *EE Reference* Figure 35.1. In the diagrams below, step-up transformers have been annotated with red rectangles, and step-down transformers have been annotated with blue rectangles. Some switchgear are annotated in green. Switchgear are also part of the substations, as described in Section X.G.

⁴¹ Ex. 1014 (*Roe*) p. 12.

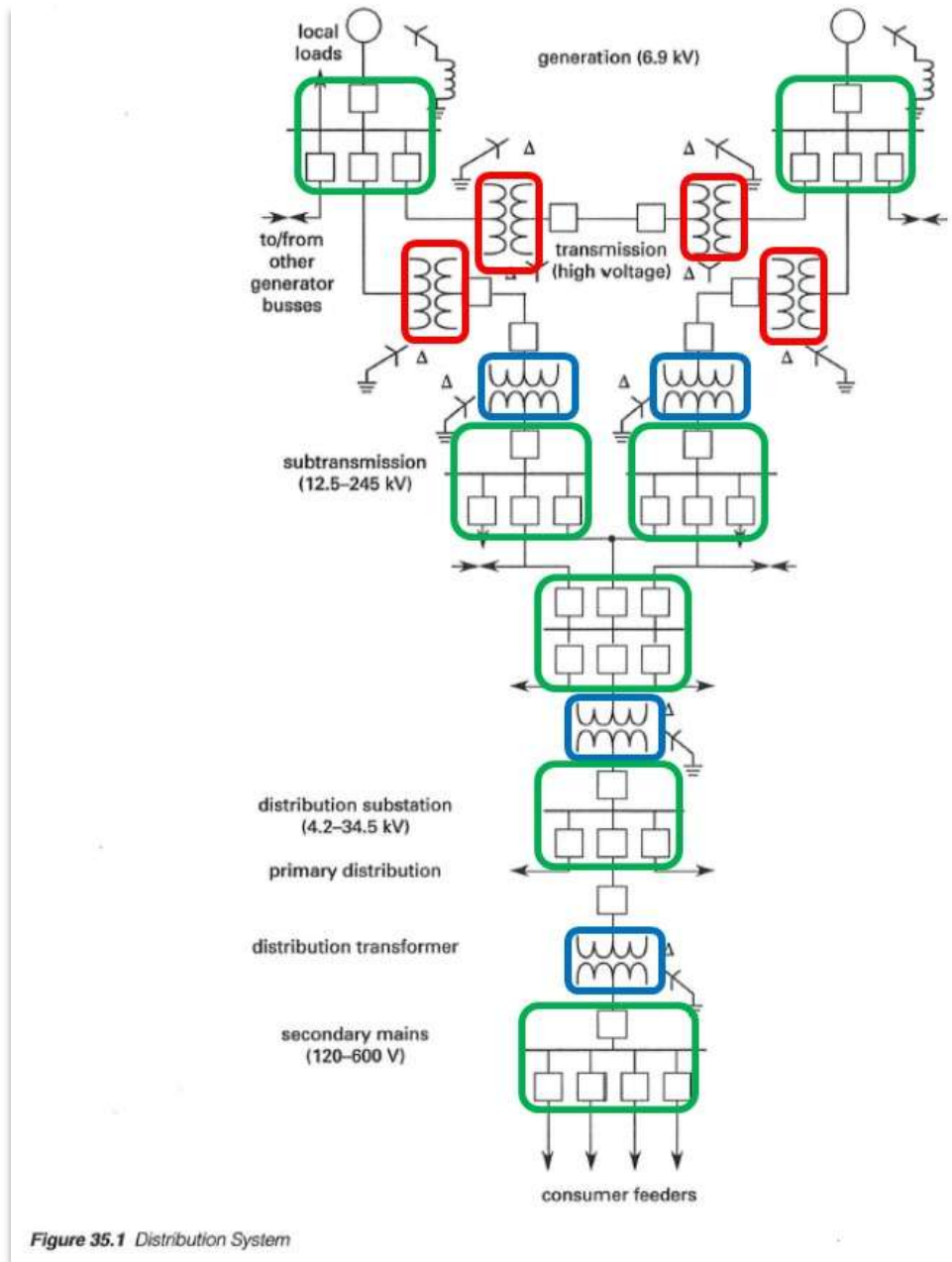


Ex. 1014 (*Roe*) p. 9 (Fig. 2.1) (annotated).

In the figure above from *Roe*, a step-up transformer (red) is located between the generator and transmission line, and is used to increase the voltage from “up to 13.8 kV” to “13 to 500 kV” for transmission over the transmission line. A step-down transformer (blue) then decreases the voltage at the main station down to “11 to 33 kv.” Another step-down transformer (labeled “Distribution transformer”) is then used to further decrease the voltage. Transformers are also included in the substations, as described in Section X.G.

68. *EE-Reference* also provided numerous examples of step-up transformers (red) and step-down transformers (blue). Certain switchgear are also shown (green).⁴²

⁴² Some locations of switchgear are not annotated in order to improve clarity of the figure.



Ex. 1015 (*EE-Reference*) p. 35-2 (Fig. 35.1) (annotated).

In the example shown above, the generator (at the top) provides electricity at 6.9 kV. Step-up transformers (red) are located by the generator and are used to increase the voltage for “transmission (high voltage).” The voltage is then reduced to 12.5-245

kV with a step-down transformer (blue) at the subtransmission substation, to 4.2-34.5 kV at the distribution substation, followed by further reductions in voltage to 120-600 V for distribution through the secondary mains. Switchgear (green) are placed throughout the power system to be able to isolate components from one another.

G. SUBSTATIONS

69. It was general engineering knowledge that a substation “is the part of an electric system containing one or more power transformers, switchgear, bus-bar distribution, regulating equipment and (sometimes) a control building.”⁴³ Though there are many considerations in designing an electric system with substations, “usually the specifications are outlined either by the customer or by the utility companies in the area. This, then, leaves only the “conventional calculations and selection of equipment.”⁴⁴

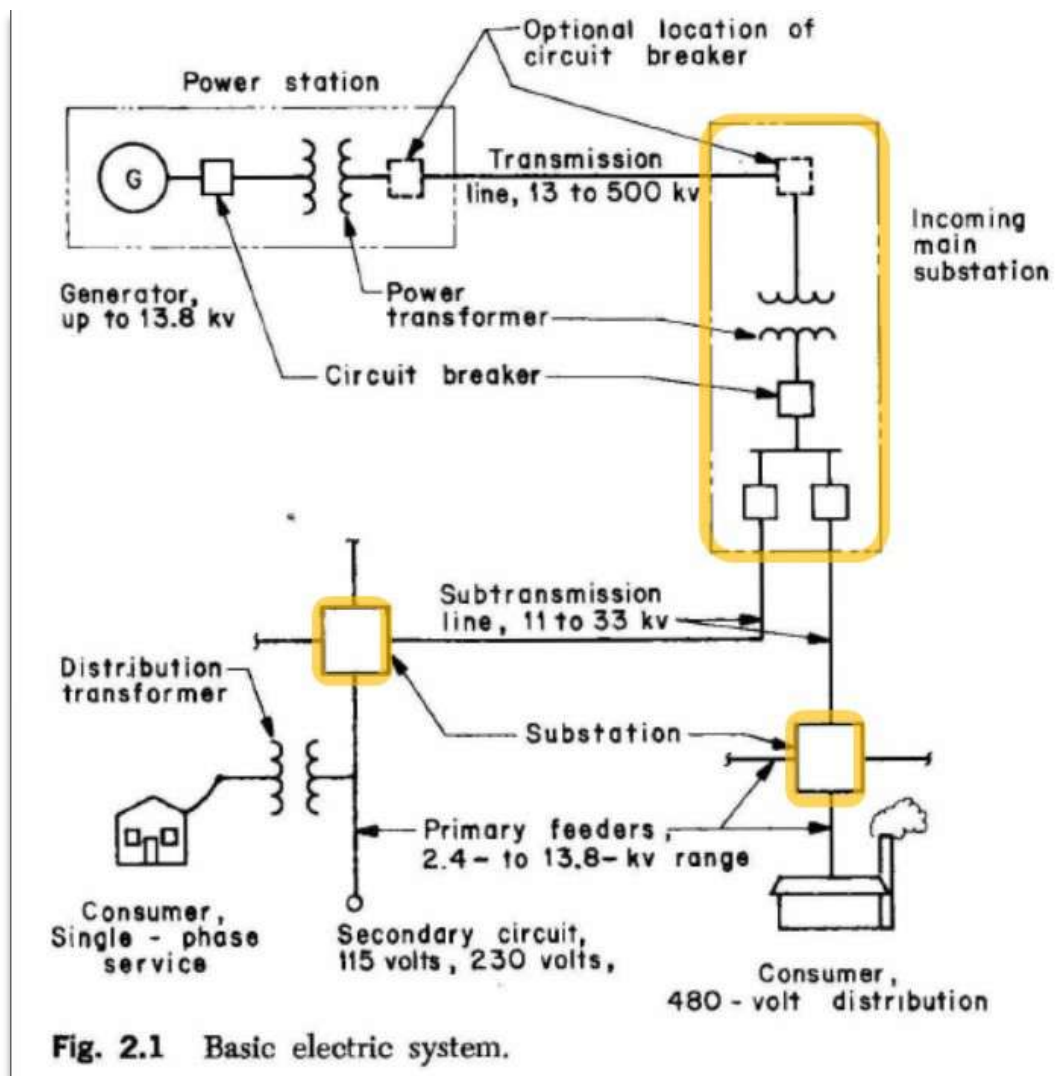
70. A substation is a larger group of equipment operating together as described above. A substation can include large, outdoor high-voltage equipment (such as is seen in utility substations), or smaller, self-contained equipment (such as a secondary unit substation inside an industrial facility). A known function of a

⁴³ Ex. 1014 (*Roe*) p. 13-14.

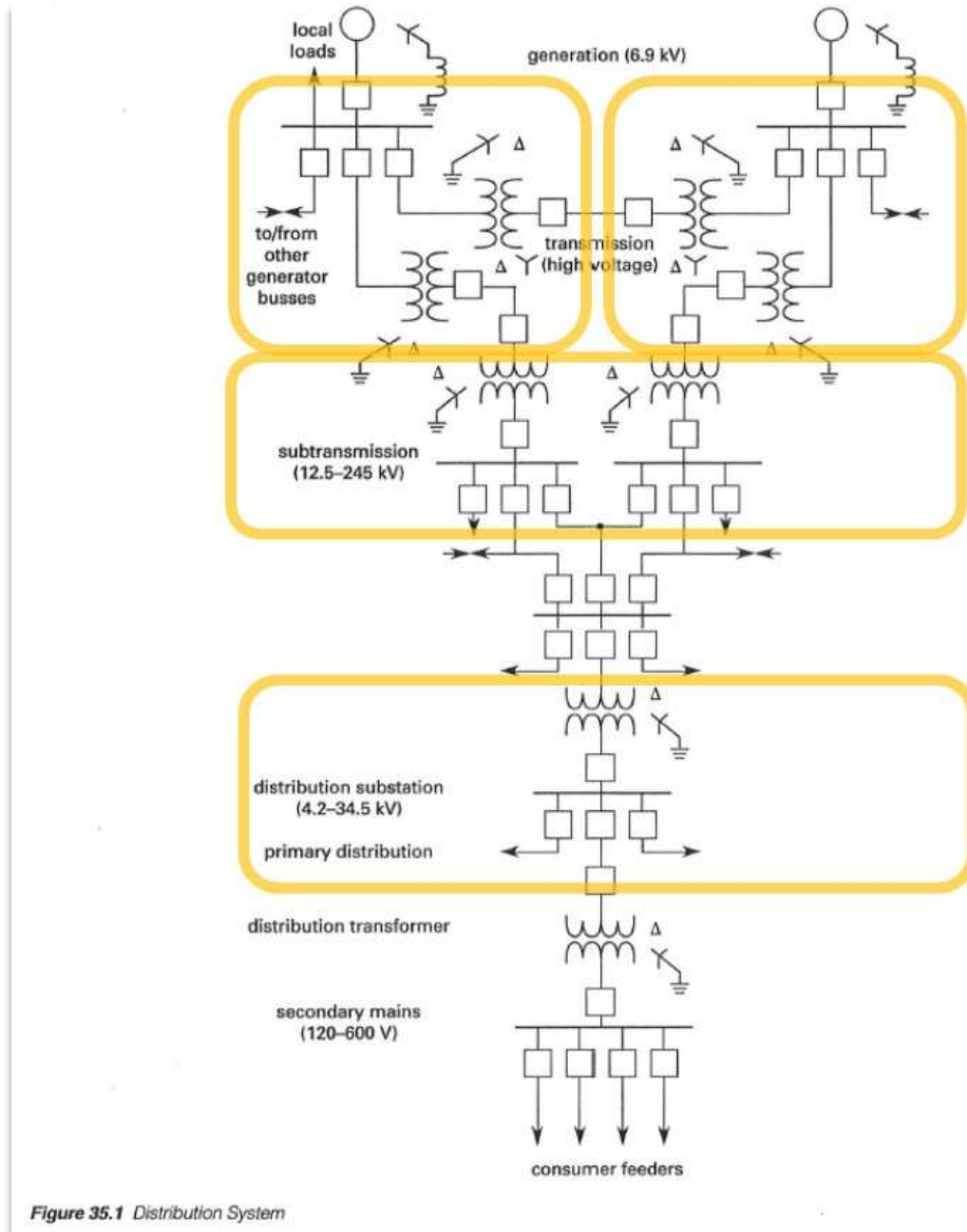
⁴⁴ Ex. 1014 (*Roe*) p. 14.

substation is the functional grouping of transformers, switchgear and other equipment. Though substations provide a common point to connect to utilities, substations are not restricted to utilities.

71. Substations are expressly shown (and labeled) in *Roe*, and implicitly depicted in *EE-Reference*. In the figures below, yellow boxes have been added around substations.



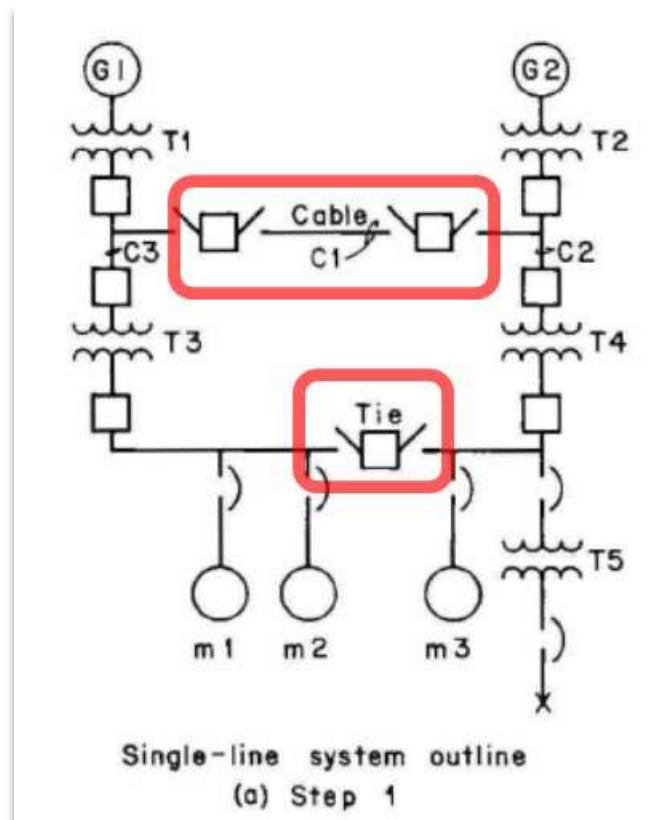
Ex. 1014 (*Roe*) p. 9 (Fig. 2.1) (annotated).



Ex. 1015 (*EE-Reference*) p. 35-2 (Fig. 35.1) (annotated).

H. MAIN – TIE – MAIN CONNECTION (INTERCONNECTION)

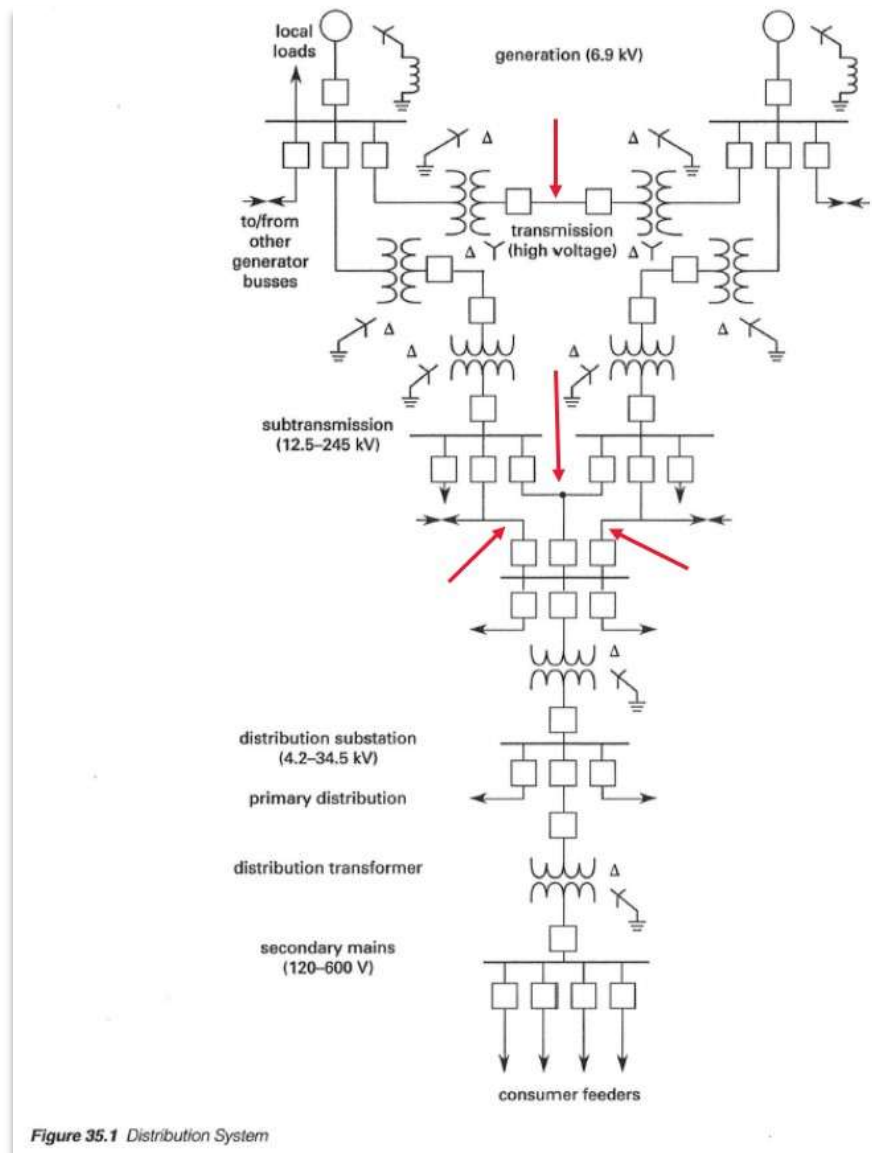
72. It was general engineering knowledge that a main-tie-main system or interconnection between generators is one in which two switchgear (or buses) are electrically coupled together through a tie (sometimes called tie breaker). A “tie” or “interconnection” is a connection between buses or switchgear without any load directly tied to the connection. It has been a common method of allowing multiple power sources to share a load. An example of a main-tie-main (annotated in red) is show below in Roe, from an industrial power system:



Ex. 1014 (*Roe*) p. 117 (Fig. 9.4) (annotated).

In the above figure from *Roe*, two generators (labeled G1 and G2) share a load (such as motors labeled m1, m2, and m3). In Figure 9.4 of *Roe*, a secondary (low voltage) main – tie – main system is shown using the breaker marked “tie” between m2 and m3. A primary (high voltage) tie breaker includes a cable C1, which, based on the equipment described in Chapter 2 of *Roe*, is indicative of a transmission line when G1 and G2 are separated by long distance.

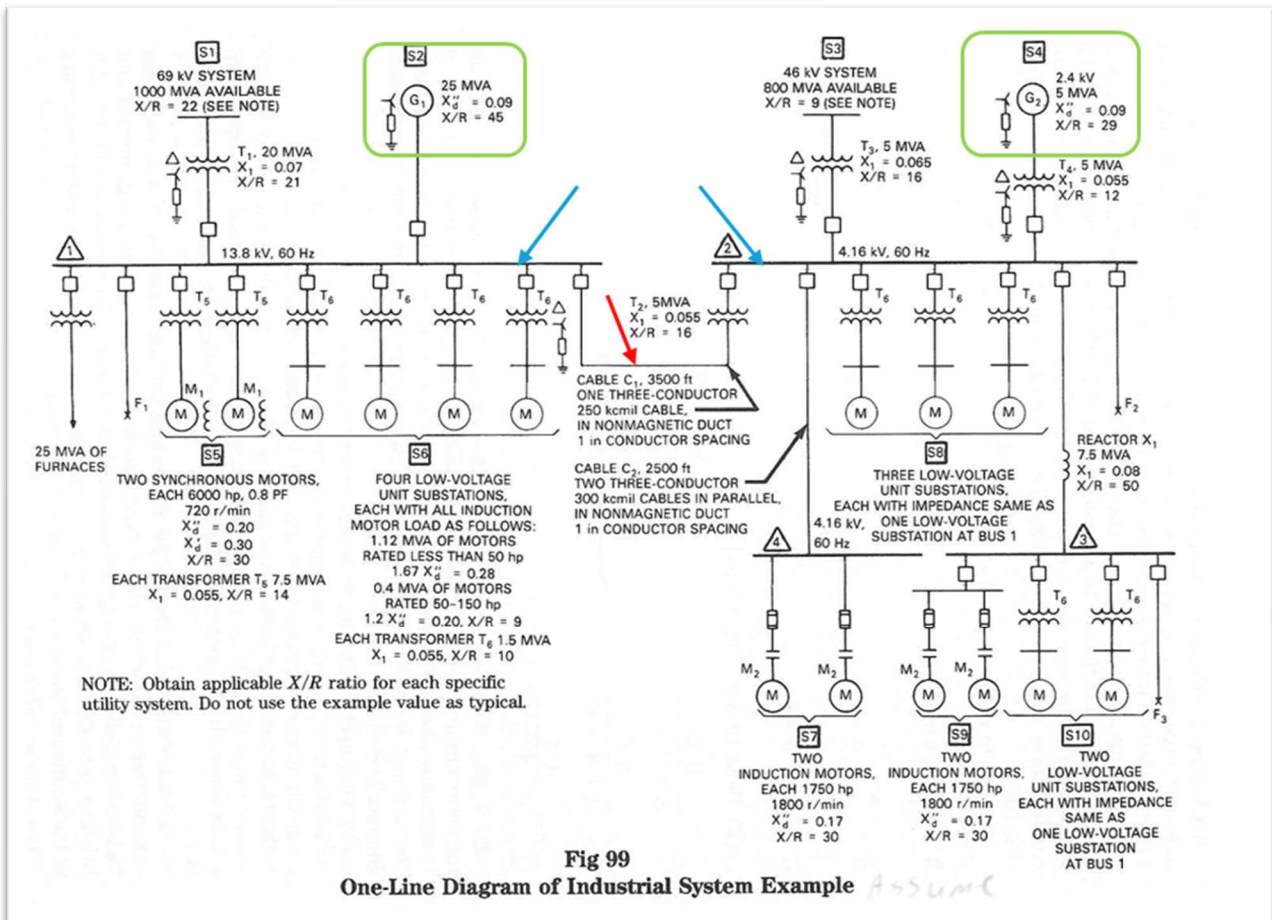
73. As another example, a transmission line used as a “tie” is explicitly shown and identified in Figure 35.1 of *EE-Reference*. Other “tie” systems are shown in various breaker configurations.



Ex. 1015 (*EE-Reference*) p. 35-2 (Fig. 35.1) (annotated with red arrows).

74. As a further example, *IEEE Red Book* contains a detailed example of a main-tie-main system with a cable acting as a the tie bus in an industrial setting. Figure 99 of *IEEE Red Book* discloses a one line diagram of an industrial system that contains two main switchgear busses (blue arrows), each with a generator

(annotated in green) and a cable interconnecting or tying the main busses together (red arrow).



Ex. 1005 (*IEEE Red Book*) Fig. 99 (annotated)

75. A further example of the widespread use of tie breakers is contained in U.S. Patent 1,743,771 (filed in 1926). This patent describes a “system of electric distribution” containing “an automatic switching arrangement for controlling the

connections between a plurality of sources and a plurality of distribution circuits.”⁴⁵

Hall describes “two distribution busses which are adapted to be connected together by a tie breaker,” which is an example of a main-tie-main power system configuration.⁴⁶

I. ALTERNATING CURRENT (AC) SYSTEMS

76. It was general engineering knowledge that Alternating Current (AC or a.c.) power systems are those in which “Alternating waveforms have currents and voltages that vary with time in a symmetrical manner ... for the most part, the variations are sinusoidal in time.”⁴⁷ The use of the term alternating current indicates “that the current is produced by the application of a sinusoidal voltage. This means that the flow of electrons changes directions, unlike DC circuits where the flow of electrons is unidirectional”⁴⁸

77. Single-phase AC systems are those in which there is a single voltage source driving the current. For single-phase systems, at least two connections to the load are needed in order for current to flow. These are generally referred to as “hot” and “neutral” connections, or “L1” and “L2” when used with motor connections. A

⁴⁵ Ex. 1017 (*Hall*) p. 1 lines 1-5.

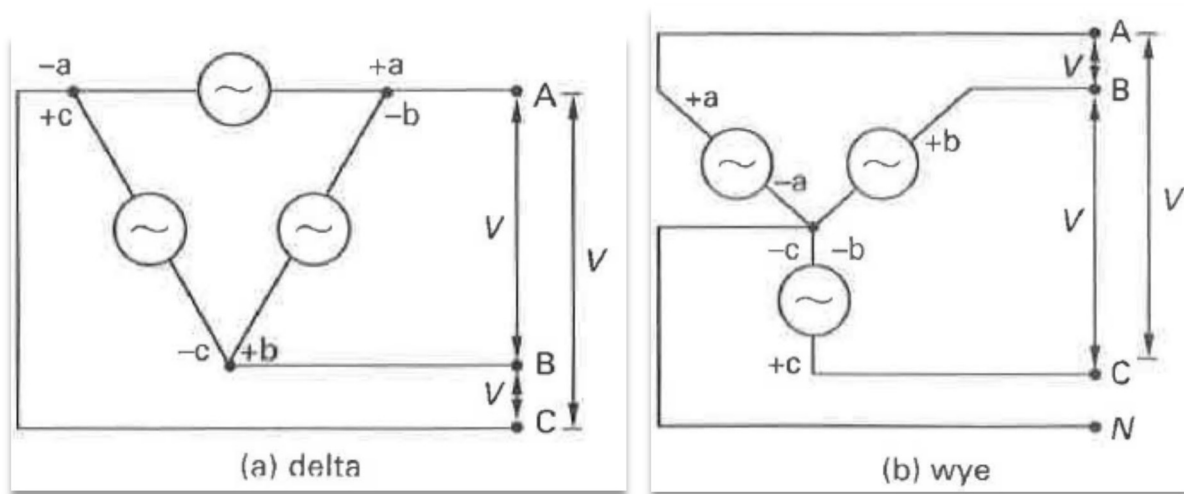
⁴⁶ Ex. 1017 (*Hall*) p. 1 lines 37-38.

⁴⁷ Ex. 1015 (*EE-Reference*) p. 27-1.

⁴⁸ Ex. 1015 (*EE-Reference*) p. 27-1.

separate ground wire is often used to provide personnel and equipment protection and to allow protective devices to operate effectively.

78. Three-phase AC systems are those in which there are three voltage sources driving current. Those three sources can be provided by a single physical structure such as an “AC generator that produces three equal sinusoidal voltages,” which “are 120° apart in phase.”⁴⁹ As described in *EE-Reference*, “a six conductor transmission line could be used to transmit the three voltages” by treating them as three separate single phase voltages, but “it is more efficient to interconnect the windings.”⁵⁰ Two connection types are delta and wye, as shown in Figure 34.2 from *EE Reference*.



Ex. 1015 (*EE-Reference*) p. 34-2.

⁴⁹ Ex. 1015 (*EE-Reference*) p. 34-1.

⁵⁰ Ex. 1015 (*EE-Reference*) p. 34-2.

79. Delta-connected power systems require three-phase phase-wires (plus a ground if required). Wye-connected power systems require three-phase wires plus a neutral (plus a ground if required).⁵¹ The neutral wire carries any imbalance from the loads back to the source.

80. It was general engineering knowledge that there are several benefits to using three-phase systems over single-phase systems, particularly in the context of large electrical loads such as large electric motors.⁵²

Three-phase energy distribution systems use fewer and smaller conductors and, therefore, are more efficient than multiple single-phase systems providing the same power. Three-phase motors provide a uniform torque, not a pulsating torque as do single-phase motor. Three-phase induction motors do not require additional starting windings or associated switches. When rectified [converted to DC], three-phase voltage has a smoother waveform and less ripple to be filtered out.

This is due to the difference in power relationships between single-phase and three-phase systems. As discussed in Section X.F, the power relationship for single-phase systems is:

$$P = V \cdot I$$

while the power relationship for three-phase systems is:

⁵¹ Certain balanced three phase wye connected system are operated with only three wires, though this is limited in application primarily to single loads, such as a three-phase motor.

⁵² Ex. 1015 (*EE-Reference*) p. 34-1.

$$P = \sqrt{3} \cdot V \cdot I^*$$

Thus, for a three-phase system, current is reduced by a factor of $\sqrt{3}$ (~1.73) as compared to a single-phase system. This allows for smaller conductors, decreased losses and increased efficiency. As a result, nearly all larger power systems are configured as three-phase systems.

J. ELECTRIC MOTORS

81. It was general engineering knowledge that electric motors are a subset of rotating electric machinery (rotating machines) in which electric power is converted to rotational mechanical energy.⁵³

Rotating machines are broadly categorized as AC and DC machines. Both categories include machines that use [electric] power (i.e. motors) and those that generate [electric] power (alternators and generators). Most machines can be constructed in either single-phase or polyphase [three-phase] configurations, although single-phase machines may be outclassed in terms of economics and efficiency. . . . Large AC motors are almost always three-phase.

82. Electric motors have been manufactured to one or more standards, depending on the application and size. As an example, motors up to 500 horsepower (HP) are manufactured at least to the specifications of National Electrical

⁵³ Ex. 1015 (EE-Reference) p. 40-1.

Manufacturers' Association (NEMA) Standard MG-1.⁵⁴ Severe duty motors larger than 500 HP used in oil & gas applications are manufactured to the specifications of the American Petroleum Institute (API) standard 541.

83. The National Electrical Manufacturer's Association (NEMA) was founded in the 1920s and is an ANSI- (American National Standards Institute) accredited Standards Developing Organization (SDO) made up of business leaders, electrical experts, engineers, scientists, and technicians. NEMA convenes a neutral forum for Members to discuss industry-wide concerns and objectives under a legal umbrella by trained NEMA Staff.

84. It is inherent that electric motors have a plurality of connections to the power source in order to operate. As in all electric circuits, there must be a complete path between the power source (e.g., generator) and the load (motor) in order for current to flow and for the electric equipment (motor) to operate. The complete path requires a minimum of two connections for each load, generally designated as L1 and L2 for single phase or DC motors and L1, L2 and L3 for three phase motors.

⁵⁴ Severe duty motors smaller than 500 Hp used in oil & gas applications are manufactured to the specifications of IEEE 841, one of the IEEE standards for which I am responsible.

K. ADJUSTABLE SPEED DRIVES / VARIABLE FREQUENCY DRIVES

85. By way of background, a Variable Frequency Drive (VFD) is another term for and type of Adjustable Speed Drive (ASD). ASD is the preferred term. Nevertheless, based on my experience, the term VFD has been commonly used, so I also use the terms interchangeably in this declaration. Some practitioners also use the term Variable Speed Drive (VSD) to reference the same equipment.

86. *Standard Handbook for Electrical Engineers* from 1993 describes the basic operation of an ASD (VFD) as follows⁵⁵:

In order to supply an adjustable frequency to an ac motor, the incoming constant-frequency [fixed frequency] voltage or current must first be rectified to a dc current or voltage. This dc voltage or current is then inverted to an adjustable frequency output. This is accomplished by power semi-conductor devices.

These devices allow current to flow in only one direction. They act as electronic switches. Various types can be fired on and off at certain times in the cycle. This selected firing allows control of the resultant voltage or current.

Exhibit 1018 contains true and correct copies of pages from the *Fink* reference. As an additional example, *Horikoshi* (filed in 2011) describes that such an ASD (VFD) was known for three-phase AC power as well:⁵⁶

Providing a motor driving apparatus, which is connected to a three-phase AC power supply and which comprises an AC/DC converter for converting three-phase AC power supplied from the three-phase AC

⁵⁵ Ex. 1018 (*Fink*) p. 20-85.

⁵⁶ Ex. 1019 (*Horikoshi*) ¶[0004].

power supply into DC power and a DC/AC converter for converting the DC power output from the AC/DC converter into three-phase AC power for supply to a motor, is known.

The outgoing DC-AC converter modifies the frequency and/or voltage of the waveform in order to control the speed and torque delivered by the motor.

87. One of the more common ASD topologies, particularly for larger motors, is a “pulse-width modulated (PWM)” drive topology. PWM drives have a number of advantages over other drive topologies including “high line-side power factor (near unity),” and the “distortion seen by the electrical network is ... reduced.” Additionally, “high dynamic performance can also be realized. Full torque can be maintained and controlled throughout the speed range – even at zero speed.”⁵⁷

88. One of the methods of determining the power of a rotating piece of equipment (e.g. a motor) is the well-known relationship: Power = (Torque) x (rotational speed). This formula is expressed as: $P = \tau \cdot \omega$. Thus, by controlling the speed and torque (inherently a function of PWM drives), the drive is also controlling the power of a motor, and maintaining that power within the operating range of the motor.

⁵⁷ Ex. 1018 (*Fink*) p. 20-89.

L. EQUIPMENT SIZING AND RATING

89. It was well known to a POSITA that electrical equipment was chosen based on the voltage and current requirements that they were intended to handle. As an example, the National Electrical Code, which outlines the requirements for a safe electrical installation, in its 2017 version required that electrical equipment be chosen based on “Classification by type, size, voltage current capacity, and specific use.”⁵⁸ Further, the NEC requires that “the voltage rating of electrical equipment shall not be less than the nominal voltage of a circuit to which it is connected.”⁵⁹ *Roe* discloses that the different current and voltage ratings of equipment affect the physical size of the system: “The actual size of the equipment will vary with the amount of voltage and power it is required to handle. For example, a circuit breaker can be as small as a cigarette package, or it can be large enough to walk around in. In either case, it serves the same basic function.”⁶⁰

90. As another example, the “*IEEE Red Book*” is the “IEEE Recommended Practice for Electric Power Distribution for Industrial Plants”. *IEEE Red Book* was published in 1985 and approved as an American National Standard in 1986. *IEEE Red Book* contains teachings which would have been familiar to a POSITA regarding

⁵⁸ Ex. 1020 (NEC) article 110.3.

⁵⁹ Ex. 1020 (NEC) article 110.4.

⁶⁰ Ex. 1014 (*Roe*) p. 9.

topics such as System Planning, Voltage Considerations, Surge Voltage Protection, Grounding, Fault Calculations, and Power Switching, Transformation and Motor Control Apparatus.⁶¹

91. Chapter 2 is titled “System Planning” and outlines the procedures for designing and planning power systems. Chapter 2 includes a “Planning Guide for Distribution Design” which “will guide the engineer in the design of an electric distribution system for any industrial plant”.⁶² This planning guide teaches the engineer to “determine the approximate total plant load in kilowatts or kilovolt-amperes” (kVA).⁶³ This could include:

- Demand (the sum of the electrical ratings of each piece of equipment)
- Peak load (the maximum load consumed or produced by a unit or group of units)
- Maximum demand (the greatest of all demands that have or could occur)
- Load factor (the ratio of the average load to the peak load).

⁶¹ Ex. 1005 (*IEEE Red Book*) Table of Contents.

⁶² Ex. 1005 (*IEEE Red Book*) pg. 43.

⁶³ Ex. 1005 (*IEEE Red Book*) pg. 43. Kilowatts (kW) are units of power, which is the product of the voltage and current and the power factor. Kilovolt amperes (kVA) is a unit of apparent power, which is the product of the voltage and current, without taking into account the power factor. kVA is generally larger than kW for any given system. At most kW is equal to kVA. By considering voltage and kVA, the *IEEE Red Book* discloses the consideration of current, which must be known to calculate kW or kVA.

Further, *IEEE Red Book* teaches that:⁶⁴

Information on these factors for the various loads and groups of loads is useful in designing the system. For example, the sum of the connected loads on a feeder, multiplied by the demand factor of these loads, will give the maximum demand that the feeder must carry. The sum of the individual maximum demands on the circuits associated with a load center or panelboard [switchgear], divided by the diversity factor of those circuits, will give the maximum demand at the load center and on the circuit supplying it. The sum of the individual maximum demands on the circuits from a transformer, divided by the diversity factor of those circuits, will give the maximum demand on the distribution transformer. The sum of the maximum demands on all distribution transformers, divided by the diversity factor of the transformer loads, will give the maximum demand on their primary feeder. By the use of the proper factors, as outlined, the maximum demands on the various parts of the system from the load circuits to the power source [e.g., generators] can be estimated.

92. Further, in planning the system, *IEEE Red Book* teaches to consider information such as “plant load in kilowatts and maximum demand in kilovolt-amperes” (i.e., current requirements of the load), “preferred service voltage,” “anticipated power factor,” and the “nature of connected load.”⁶⁵ When including generation, *IEEE Red Book* teaches that at least generator ratings must be considered, including “Generator load in kilovolt-amperes” and “generator voltage”.⁶⁶

⁶⁴ Ex. 1005 (*IEEE Red Book*) pg 44.

⁶⁵ Ex. 1005 (*IEEE Red Book*) pg. 52.

⁶⁶ Ex. 1005 (*IEEE Red Book*) pg. 52.

93. *IEEE Red Book* further teaches “a complete one-line or single-line diagram [] should present sufficient data to plan and evaluate the electric power system.”⁶⁷ The one line should include at least the following:⁶⁸

- Power sources [e.g., generators] including voltages and available short circuit currents.
- Size, type, ampacities [i.e., current carrying capacity], and number of all conductors [including busses and ties] in kilovolt-ampere rating. [both voltage and current]
- Capacities [kVA], voltages, impedance, connections and grounding methods of transformers.
- Identification and quantity of protective devices (relays, fuses, and circuit breakers).
- Identification of all loads

Based on the information contained in the one line, including the voltage and current requirements of the loads, switchgear, conductors (including busses), generators and all other electric equipment, the equipment is sized and the system planned and designed. The sizing of equipment to support the voltage and current requirements of the loads, the transformer, and the sources [e.g. generators] is common practice and required on all properly designed electrical power systems.

⁶⁷ Ex. 1005 (*IEEE Red Book*) pg. 53.

⁶⁸ Ex. 1005 (*IEEE Red Book*) pg. 53.

XI. OVERVIEW OF THE PRIOR ART

A. RECKELS

1. Status of *Reckels* (Ex. 1005)

94. WO2018/071738 A1 (“*Reckels*”) was filed October 13, 2017, and published April 19, 2018, before the earliest possible priority date (June 15, 2018) of the ’801 Patent. Thus, *Reckels* is prior art to the ’801 Patent.

2. Overview of Disclosure of *Reckels*

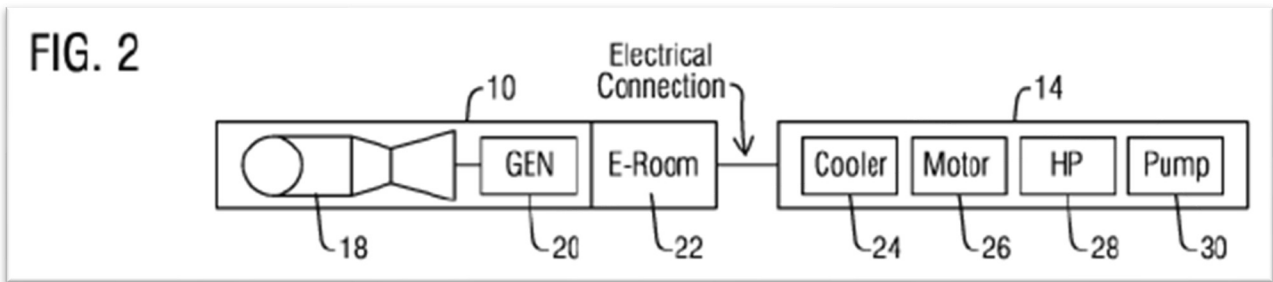
95. *Reckels* generally discloses an “electric fracturing pump wellsite configuration,” wherein an electric power generation system is used to generate power for use by one or more electric fracturing pumps.⁶⁹ *Reckels* discloses “a power generation trailer 10 [that] includes a gas turbine assembly 18” that is “connected to a generator 20,” which “is then connected to an electric room 22, which may include transformers, switchgear, variable frequency drives, and other electrical components needed to drive high power electric motors.”⁷⁰ A second trailer 14, which includes hydraulic pump 28 and high pressure fracturing fluid pump 30, “receives electrical power from the power generation trailer 10” to drive the pumps.⁷¹ Figures 2 and 3

⁶⁹ Ex. 1004 (*Reckels*), [0015].

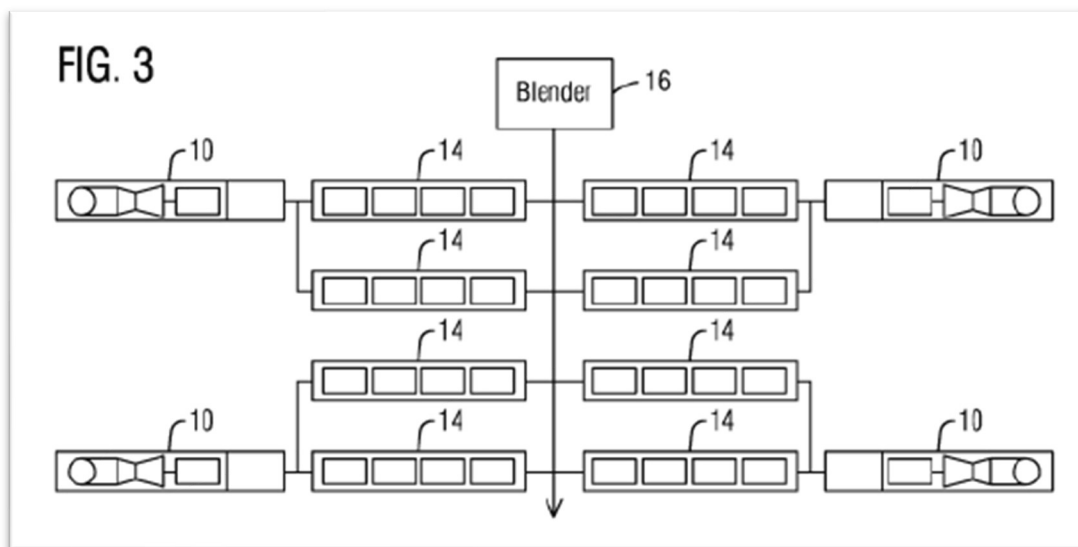
⁷⁰ Ex. 1004 (*Reckels*), [0018].

⁷¹ Ex. 1004 (*Reckels*), [0018].

of *Reckels*, copied below, depict this configuration, where Figure 3 shows that one power generation trailer 10 is coupled to two second trailers 14.



Ex. 1004 (Reckels), Fig. 2.



Ex. 1004 (Reckels), Fig. 3.

96. *Reckels* further provides that “[g]enerally, the gas turbines and the pumps can also be connected to a common bus bar, so that the gas turbines can run at different loads, e.g. one at 100% and the other at 50%.”⁷²

97. *Reckels* is in the same field of endeavor—electrical power supply and distribution in industrial systems—as the ’801 Patent.

B. IEEE RED BOOK (EX. 1005)

1. Status of *IEEE Red Book*

98. *IEEE Red Book* is the 1986 revision of the IEEE Recommended Practice for Electric Power Distribution for Industrial Plants, and is an American National Standard. *IEEE Red Book* was published in 1986 by the Institute of Electrical and Electronics Engineers, Inc., and has ISBN: 0-471-85687-8. I have reviewed the declaration of Dr. Sylvia Hall-Ellis, which confirms that *IEEE Red Book* was accessible to the public and indexed at the library by at least July 30, 1987, and accordingly would have been searchable and obtainable by the public by at least July 30, 1987.⁷³ Further, I have had a copy of *IEEE Red Book*, which bears a red cover (hence the “Red Book” moniker), since at least 1992 when it was used in a

⁷² Ex. 1004 (*Reckels*), [0015].

⁷³ Ex. 1013 (Hall-Ellis Declaration), ¶¶34-41, 49.

Power Systems class in my graduate studies. *IEEE Red Book* was therefore as prior art as a printed publication to the '801 Patent.

2. Overview of Disclosure of *IEEE Red Book*

99. *IEEE Red Book* discloses the process of planning and designing an electric distribution system, including the determination of current and voltage requirements of a system's load to plan the characteristics of the system's sources and distribution components.⁷⁴

100. *IEEE Red Book* is in the same field of art—electrical power supply and distribution in industrial systems—as the '801 Patent.

C. OEHRING178(Ex. 1007)

1. Status of *Oehring178*

101. U.S. Patent Pub. No. 2017/0030178 to Oehring and Hinderliter ("*Oehring178*") was filed on October 12, 2016, and was published on February 2, 2017, before the earliest possible priority date (June 15, 2018) of the '801 Patent. Thus, *Oehring178* is prior art to the '801 Patent.

⁷⁴ See, e.g., Ex. 1005 (*IEEE Red Book*), 43-44, 53-55.

2. Overview of Disclosure of *Oehring178*

102. *Oehring178* discloses an electric hydraulic fracturing system with turbine generators, switchgear, transformers, electric motor-driven pumps, and variable frequency drives (VFDs), where VFDs and motor control centers (MCCs) are located on a mobile trailer on which fracturing pumps are located.⁷⁵

103. *Oehring178* is in the same field of art—electrical power supply and distribution in industrial systems—as the '801 Patent.

D. SOLAR TURBINES (EX. 1008)

1. Status of *Solar Turbines*

104. *Solar Turbines* is a selection guide for industrial gas turbine products manufactured by Solar® Turbines (a Caterpillar company). According to the Internet Archive, *Solar Turbines* was publicly available on the internet as of at least May 12, 2016.⁷⁶ This is consistent with indicia in the document itself. For example, the *Solar Turbines* lists a copyright date of “© 2016 Solar Turbines Incorporated.”⁷⁷ Further, a POSITA exercising reasonable diligence would have located *Solar Turbines*. Solar® Turbines, a Caterpillar company, is a turbine generator manufacturer used in the oil and gas industry that would have been well-known to a

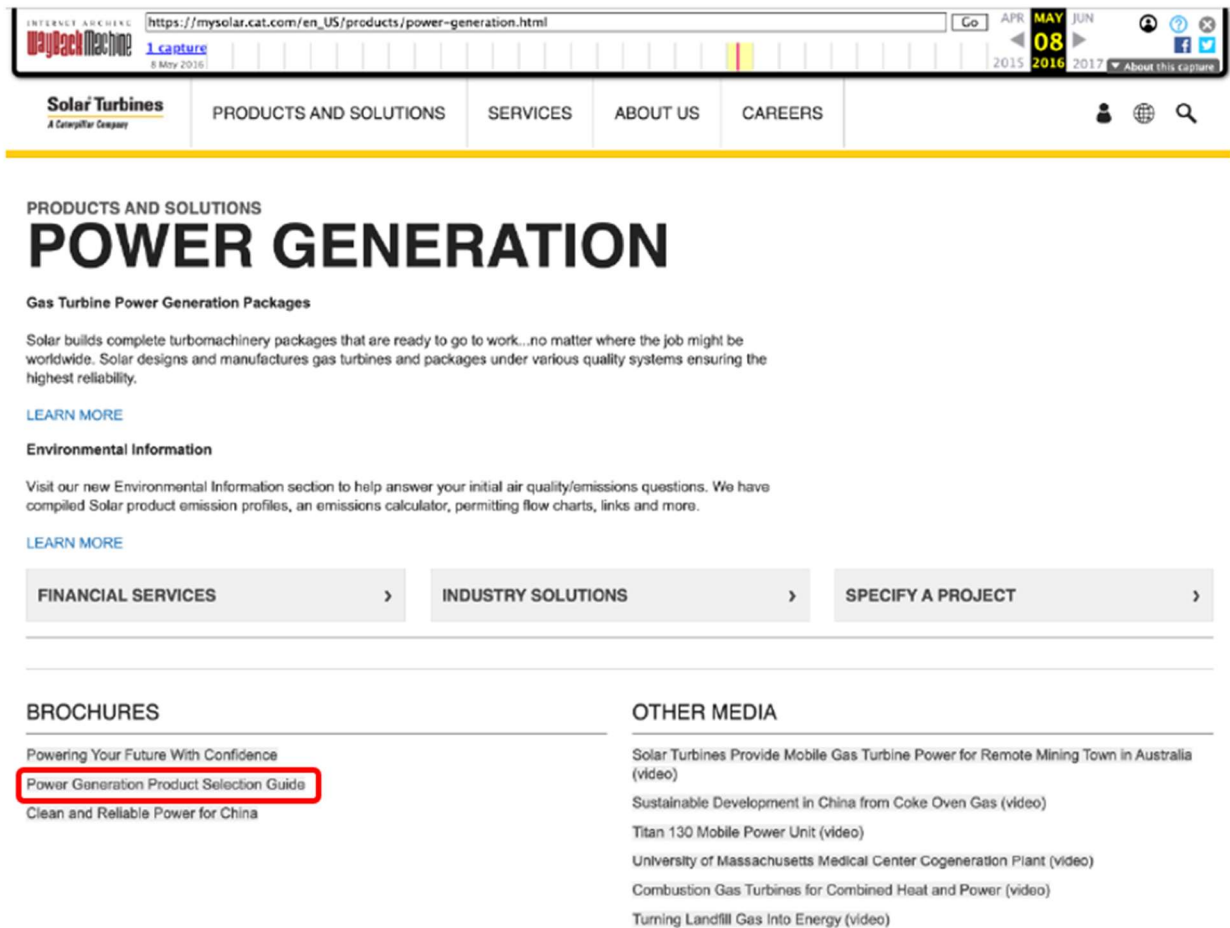
⁷⁵ Ex. 1007 (*Oehring178*), [0029], [0038], Fig. 4.

⁷⁶ Ex. 1012 (Ching Declaration), 1, 19-23

⁷⁷ Ex. 1008, 4.

POSITA.⁷⁸ An archived version of the Solar® Turbines website shows that users may view the “PRODUCTS AND SOLUTIONS” offered by Solar Turbines—selecting the “POWER GENERATION” option takes users to a webpage from which *Solar Turbines* may be retrieved (by selecting the “Power Generation Product Selection Guide” as annotated below). I have known of and specified Solar Turbines in oil and gas applications during my career. A POSITA interested in learning more about the generator sets provided by Solar® Turbines (e.g., a POSITA implementing a power generation and distribution system looking for particular generators to power such a system) would have reasonably navigated to this webpage and retrieved *Solar Turbines*.

⁷⁸ See, e.g., EX1022 (noting Solar Turbines’ packages for use in the oil and gas industry); EX1021 (providing description of Solar Turbines products as used in oil and gas applications); see also EX1012, 17-19, 32-44.



Ex. 1023; *see also* Ex. 1012, 15-16.

105. *Solar Turbines* thus qualifies as a prior art printed publication under at least 35 U.S.C. § 102(a)(1).

2. Overview of Disclosure of *Solar Turbines*

106. *Solar Turbines* lists specifications of particular products within the Solar® Turbines industrial gas turbine product line, including those of the Centaur™

50. Solar Turbines was a well-known turbine generator manufacturer used in the oil

and gas industry, such that *Solar Turbines* is in the same field of art—electrical power supply and distribution in industrial systems—as the ’801 Patent

E. COLI(Ex. 1009)

1. Status of *Coli*

107. U.S. Patent Application Publication No. 2012/0255734 to *Coli* (“*Coli*”) was filed on April 6, 2012, and published on October 11, 2012, before the earliest possible priority date (June 15, 2018) of the ’801 Patent. Thus, *Coli* is prior art to the ’801 Patent.

2. Overview of Disclosure of *Coli*

108. *Coli* discloses the use of turbine generators to power electric motors that drive hydraulic fracturing pumps, and provides examples of such generators and pumps, such as the “SWGS-2500 Well Service Pump sold by Gardner Denver, Inc.” and the “TM2500+ turbine generator sold by General Electric.” EX1009, [0044], [0046].

109. *Coli* is in the same field of art—electrical power supply and distribution in industrial systems—as the ’801 Patent.

F. KUMAR(Ex. 1010)**1. Status of *Kumar***

110. “Harmonics in Offshore Electrical Power System” by B. Kumar *et al.* (“*Kumar*”) is a paper prepared for presentation at the 2005 Offshore Technology Conference held in Houston, Texas on May 2-5, 2005. *Kumar* bears a copyright date of 2005. The OnePetro webpage from which *Kumar* may be retrieved (<https://onepetro.org/OTCONF/proceedings-abstract/05OTC/05OTC/OTC-17095-MS/29600?redirectedFrom=PDF>)—provides that *Kumar* was “Published” on May 2, 2005).⁷⁹ I have reviewed the declaration of Dr. Sylvia Hall-Ellis, which confirms that *Kumar* was accessible to the public and indexed at the library by at least May 11, 2005, and accordingly would have been searchable and obtainable by the public by at least May 11, 2005.⁸⁰ *Kumar* was therefore qualifies as prior art as a printed publication to the ’801 Patent.

2. Overview of Disclosure of *Kumar*

111. *Kumar* discloses the use of isolation transformers to limit the effects of harmonics in oil and gas systems, such as those that arise from variable frequency drives (VFDs) that power electric motors.⁸¹

⁷⁹ See Ex. 1013 (Hall-Ellis Declaration), fn. 19.

⁸⁰ Ex. 1013 (Hall-Ellis Declaration), ¶¶ 42-49.

⁸¹ Ex. 1010 (*Kumar*), 2-4.

112. *Kumar* is in the same field of art—electrical power supply and distribution in industrial systems—as the '801 Patent. If *Kumar* is found to not be in the same field of art as the '801 Patent, *Kumar* is analogous art because it is reasonably pertinent to the problem faced by the inventors the '801 Patent, which describes using an isolation transformer “for filtering out harmonics between the power source (generators) and the load (fracturing equipment in FP 704a,b) with or without changing the voltage.”⁸²

XII. GROUND 1: OBVIOUSNESS OVER RECKELS IN VIEW OF IEEE RED BOOK

113. It is my opinion that *Reckels* in view of *IEEE Red Book* renders Claims 1-4, 6, 8-10, 12-14, 16, 18, and 19 of the '801 Patent obvious.

A. MOTIVATION TO COMBINE THE REFERENCES

114. *Reckels* generally discloses an “electric fracturing pump wellsite configuration,” wherein an electric power generation system is used to generate power for use by one or more electric fracturing pumps.⁸³ *Reckels* discloses general configurations for supplying power from the power generation system to the electric fracturing pumps. In a first configuration, which is depicted in Figure 1 of *Reckels*,

⁸² Ex. 1001 ('801 Patent), 11:50-54.

⁸³ See Ex. 1004 (*Reckels*), [0015].

the power generation system features “four separate generators, each generator mounted on its own independent semi-trailer” (highlighted in red in Fig. 1 below).⁸⁴ *Reckels* explains that the “each generator includes a gas turbine based system, whereby a gas generator rotates a power a power turbine couples to a generator either directly or through a gearbox.”⁸⁵ The generators are then paired into two groups, where each group of two generators then “feed[s] a common switchgear trailer and are electrically connected thereto,” (highlighted in blue below) and each switchgear trailer “is also electrically connected to four high pressure electrically driven fluid pumping trailers 14 [highlighted in green below].”⁸⁶ “The high pressure pump trailers 14 are connected to high pressure fluid lines that feed into the wellbore (not shown).”⁸⁷ *Reckels* further provides that in the Figure 1 embodiment, “each generator is configured to supply electrical power to two of the high pressure electric pump trailers 14.”⁸⁸ Figure 1 of *Reckels* is copied and annotated below:

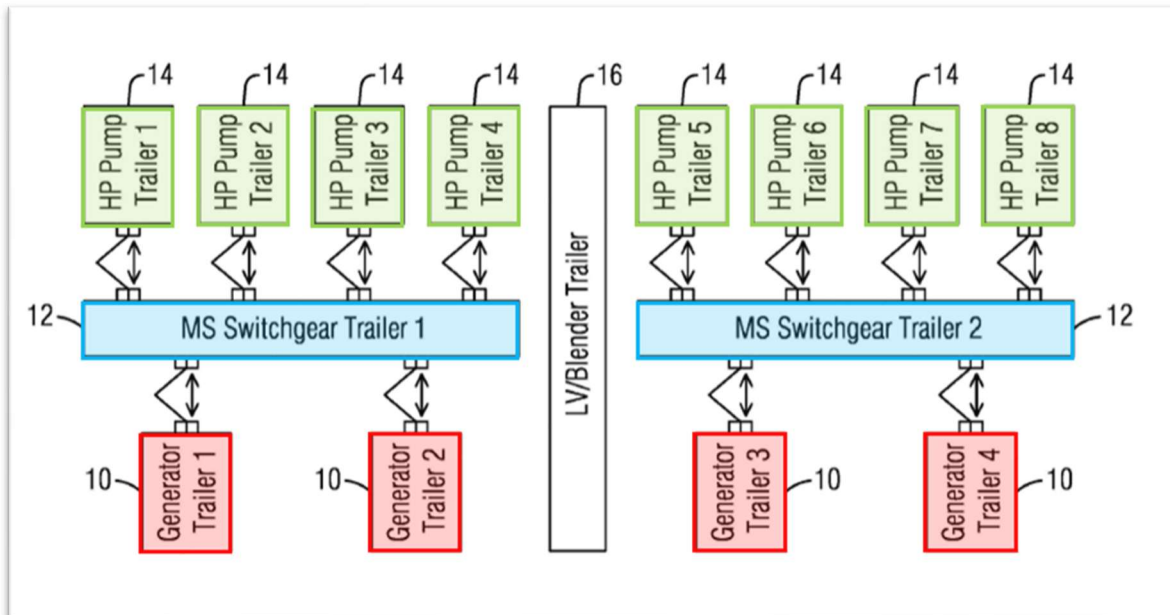
⁸⁴ See Ex. 1004 (*Reckels*), [0015].

⁸⁵ See Ex. 1004 (*Reckels*), [0015].

⁸⁶ See Ex. 1004 (*Reckels*), [0015].

⁸⁷ See Ex. 1004 (*Reckels*), [0015].

⁸⁸ See Ex. 1004 (*Reckels*), [0015].

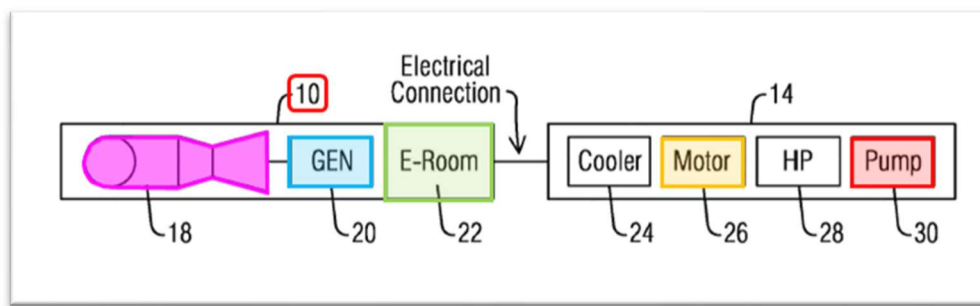


Ex. 1004 (Reckels), Fig. 1.

115. In a second configuration, depicted by Figure 2 of Reckels below, power generation trailer 10 (annotated in red) includes a “gas turbine assembly 18” (highlighted in magenta) that is “connected to a generator 20,” (highlighted in blue) which “is then connected to an electric room 22 [highlighted in green], which may include transformers, switchgear, variable frequency drives, and other electrical components needed to drive high power electric motors.”⁸⁹ A second trailer 14, which includes motor 26 (highlighted in orange) which drives hydraulic pump 28 and high pressure fracturing fluid pump 30 (highlighted in red), “receives electrical

⁸⁹ See Ex. 1004 (Reckels), [0018].

power from the power generation trailer 10.”⁹⁰ “The hydraulic pump 28[] generates hydraulic fluid pressure that is used to rotate and control the flowrate of the high pressure fracturing fluid pump 30. The high pressure fracturing fluid pump 30 receives the fracturing liquids and pressurizes them for subsequent injection into the wellbore and formation.”⁹¹ Figure 2 of *Reckels* is copied and annotated below:



Ex. 1004 (*Reckels*) Fig. 2 (annotated)

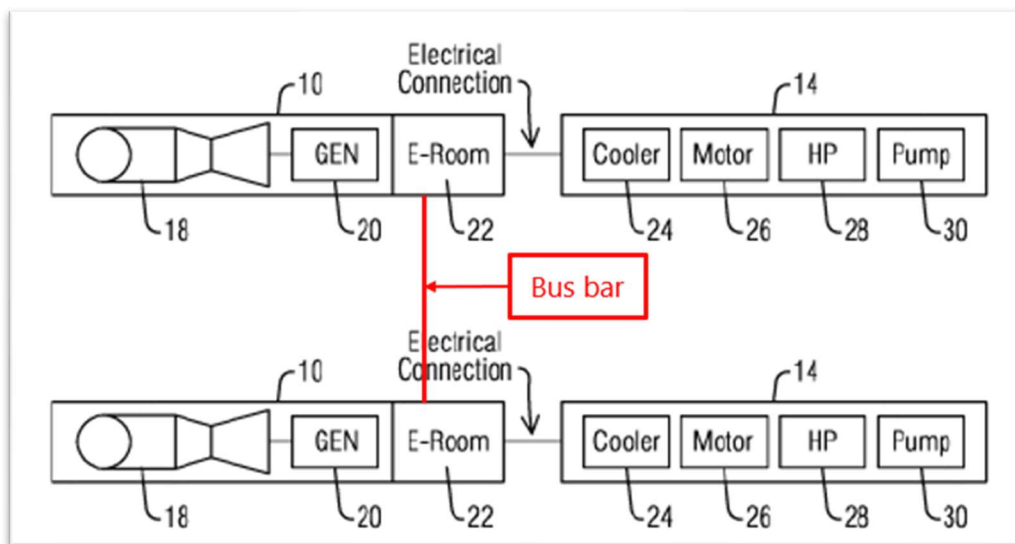
116. Apart from these particular configurations, *Reckels* provides that “[g]enerally, the gas turbines and the pumps can also be connected to a common bus bar, so that the gas turbines can run at different loads, e.g., one at 100% and the other at 50%.”⁹² A POSITA would have understood that in such a configuration, the Figure 2 embodiment of *Reckels*, wherein trailer 10 comprises gas turbine assembly 18, generator 20, and electric room 22, which includes transformers and switchgear,

⁹⁰ See Ex. 1004 (*Reckels*), [0018].

⁹¹ See Ex. 1004 (*Reckels*), [0018].

⁹² Ex. 1004 (*Reckels*), [0015].

would have been modified, for example, to employ a main-tie-main system with a bus bar between the switchgears of the respective generator trailers acting as the tie or interconnect (e.g., as discussed above in Section X.H) to electrically incorporate *Reckels* teachings of a “common bus bar.”⁹³ An annotated copy of Figure 2 is provided below and depicts how a POSITA would have understood to implement the “common bus bar” described by Reckels to couple the power generation systems as described by Reckels’ Figure 2 embodiment.



Ex. 1004 (Reckels), Fig. 2 (annotated)

117. *IEEE Red Book* discloses that “switchgear” contains a busbar: “the thermal ratings of the supply (transformer), the main circuit breaker, and the

⁹³ See Ex. 1004 (Reckels), [0018]; see also Section XI.H above.

switchgear main bus bar must be equal.”⁹⁴ Further, bus bars were a very well-known structure for carrying electric power.⁹⁵ Accordingly, any place where switchgear occurs, whether in the primary, secondary or load switchgear, a busbar would have at least been an obvious configuration.

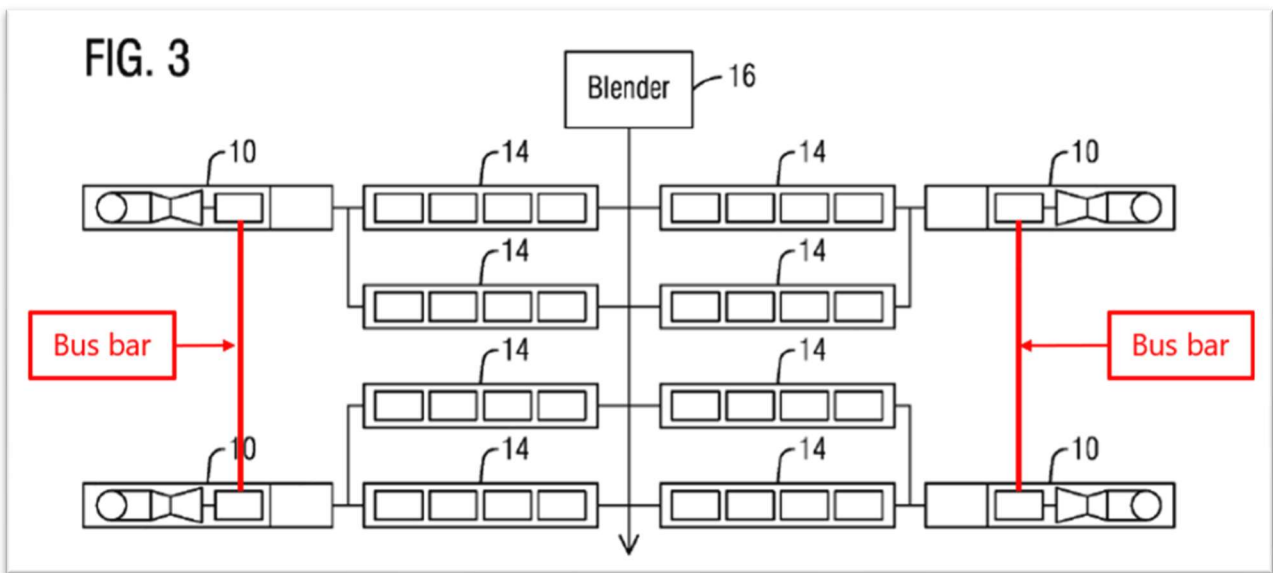
118. In this configuration, a POSITA would have understood that internal buses of the respective switchgears would be electrically coupled to the “common bus bar” such that the respective generators each provide power to the common bus bar. Further, a POSITA would have understood that the respective electrical connections of each power generation trailer 10-second trailer 14 combination would also be electrically coupled to the common bus bar, so that each generator can power the components of both second trailers 14.

119. A POSITA would have understood that the common bus bar would be similarly incorporated into other embodiments of *Reckels*. For example, modifying the Figure 3 embodiment, where single power generation trailers 14 are coupled to two second trailers 14, to incorporate a “common bus bar” between two power generation trailers 14 would be effectuated as discussed above (i.e., employing a

⁹⁴ Ex. 1005 (*IEEE Red Book*), pp. 55-56, emphasis added

⁹⁵ See, e.g, Ex. 1005 (*IEEE Red Book*) pg. 529 describing the use of busbars in busways to “simplify electrical connections for electric motor driving machines.” See also Table 85 pg 539 showing standard voltage drop for various busbar configurations.

main-tie-main system with a bus bar between the switchgears of the respective generator trailers acting as the tie or interconnect (e.g., as discussed above in Section X.H)). Such a configuration would be depicted as shown below in annotated Figure 3:



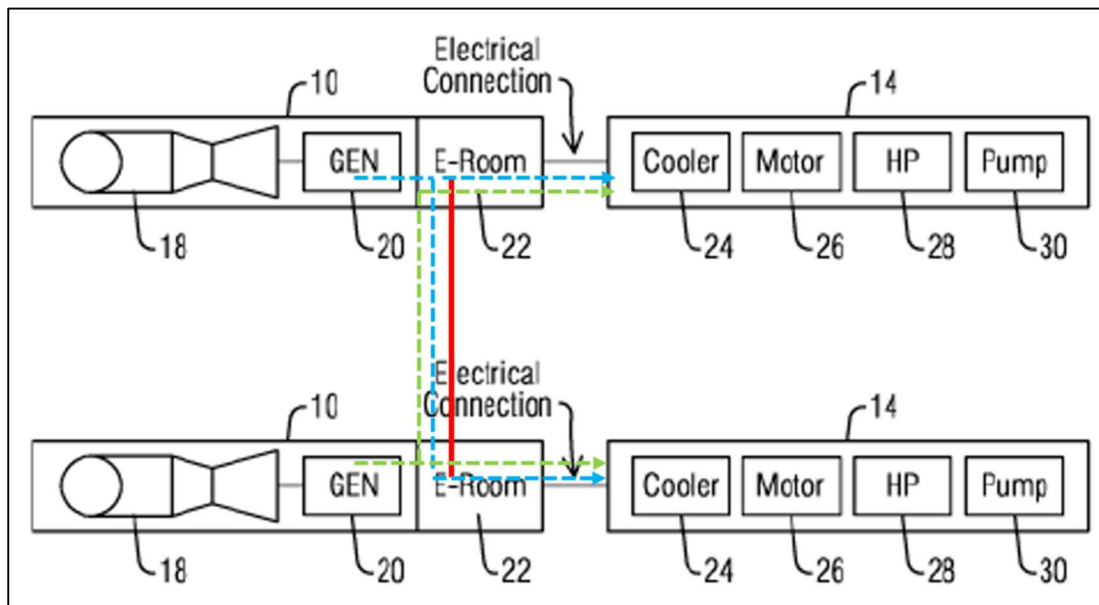
Ex. 1004 (Reckels), Fig. 3 (annotated)

120. *Reckels* teaches that the various configurations taught by *Reckels* “may be combined in any combination of ways, i.e., any element from one exemplary embodiment may be used in any other exemplary embodiment, without departing from the scope of the disclosure.”⁹⁶ Accordingly, a POSITA would have been motivated to combine elements of the various configurations in order to gain the

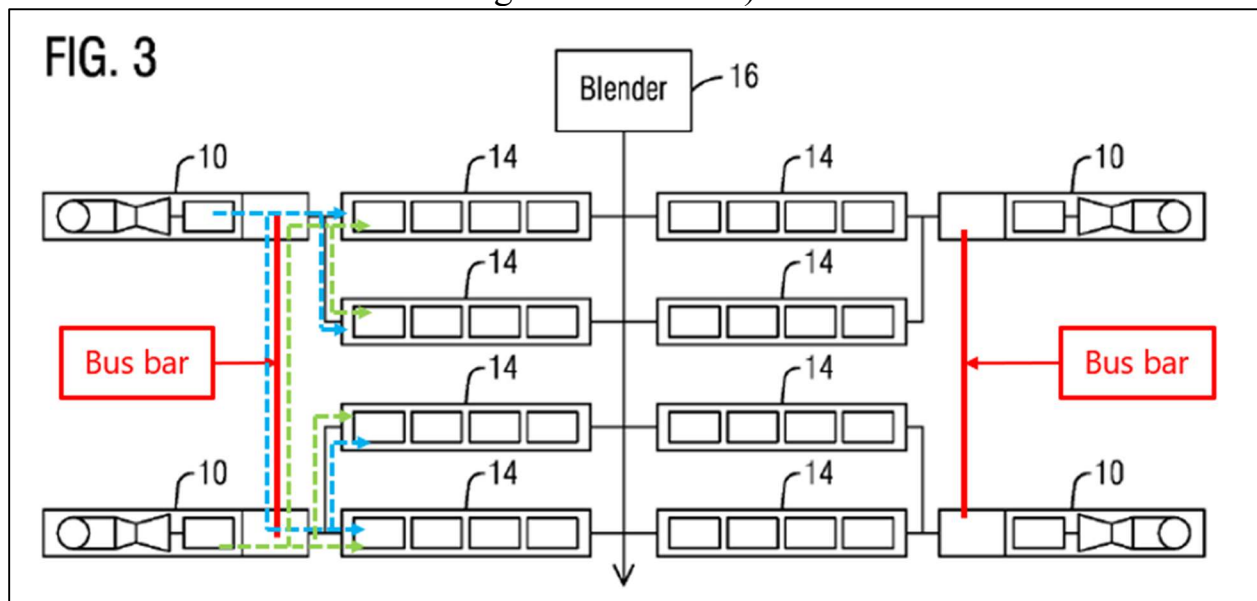
⁹⁶ Ex. 1004 (Reckels) [0013].

benefits provided by those elements, as taught by *Reckels*. A POSITA, based on the teachings of *Reckels* and the general knowledge of a POSITA as summarized in section X above, would have had a reasonable expectation of success in combining the various elements and configurations of *Reckels*, as such a combination would merely be combining prior art elements according to known methods to yield predictable results. A combination of elements would also be merely applying a known technique to a known system, ready for improvement, to yield predictable results. In either case, the results would be a properly functioning electric power distribution system with the elements disclosed by *Reckels*.

121. Annotated copies of Figures 2 and 3 of *Reckels*, which have been modified to incorporate the common bus bar as described above, show how power from the respective generators would flow to the second trailers 14 coupled to the common bus bar:



Ex. 1004 (*Reckels*), Fig. 2 (annotated, depicting power from a first generation trailer 10 provided to both second trailers 14 in blue annotation and depicting power from a second generation trailer 10 provided to both second trailers 14 in green annotation).

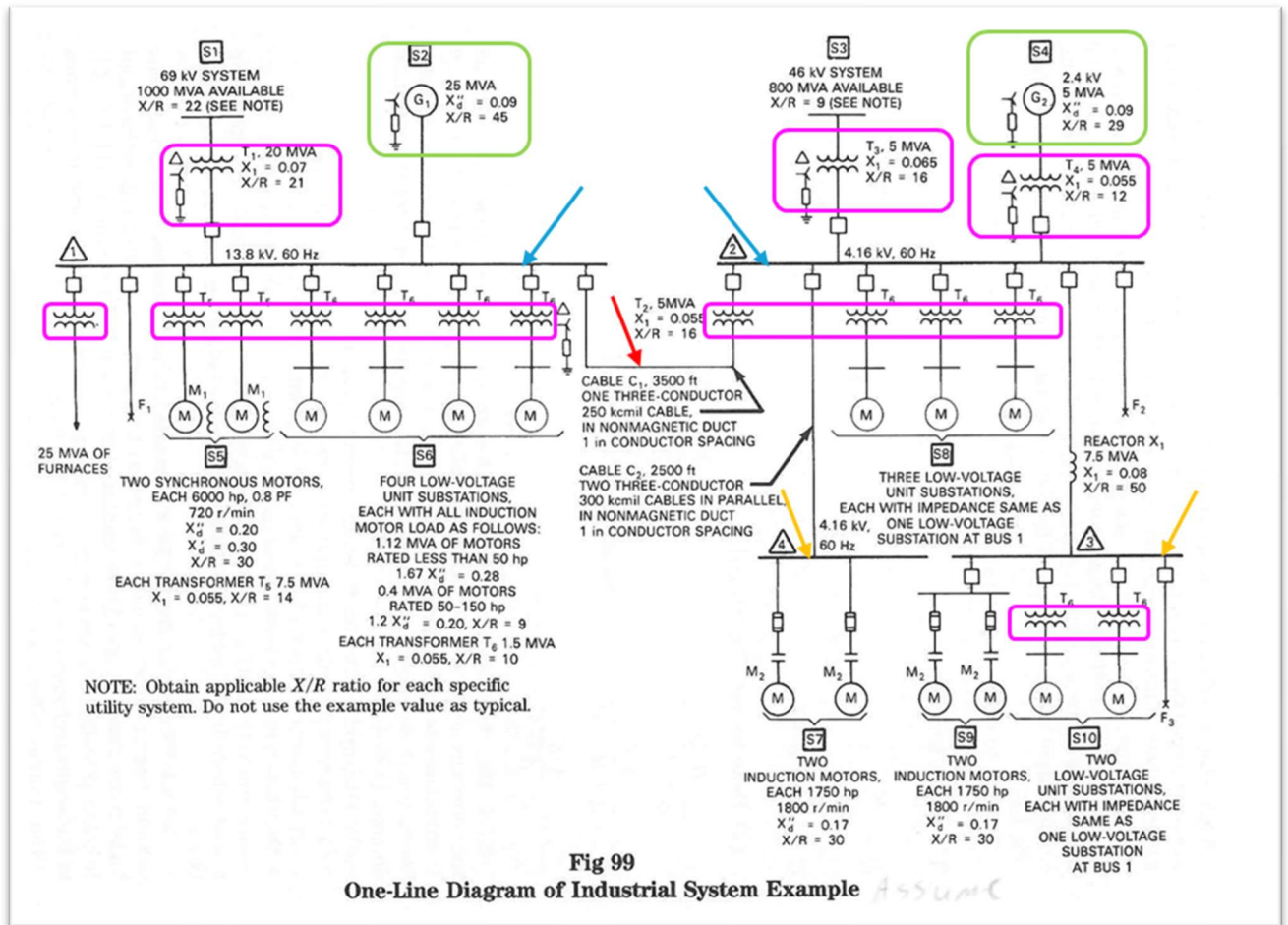


Ex. 1004 (*Reckels*), Fig. 3 (annotated, depicting power from first generation trailer 10 provided to all second trailers 14 in left-half of figure in blue annotation and depicting power from second generation trailer 10 provided to all second trailers 14 in left-half of figure in green annotation).

122. In addition, it would have been obvious to a POSITA to modify *Reckels* to include a bus bar that connects the generation systems of *Reckels*' trailers 10 in view of *IEEE Red Book*. *IEEE Red Book* discloses a detailed example of an industrial main-tie-main system with a cable acting as the tie bus, for example. Figure 99 of *IEEE Red Book*, annotated below, discloses a one-line diagram of an industrial system that contains two main switchgear busses (e.g. busbars, blue arrows), each with a generator (annotated in green) and a cable interconnecting or tying the main busses together (red arrow).⁹⁷ Further, transformers are provided to step up or step down the voltage as needed (annotated in magenta). In this example, the cable is serving the same function as the "common bus bar" disclosed in *Reckels*—connecting two power sources (e.g., generators G1 and G2 as shown in Figure 99 of *IEEE Red Book*) to provide load sharing functionality. Further, *IEEE Red Book* discloses busbars on the downstream side of at least one switchgear for distribution of loads at a location external to the switchgear (orange arrows).

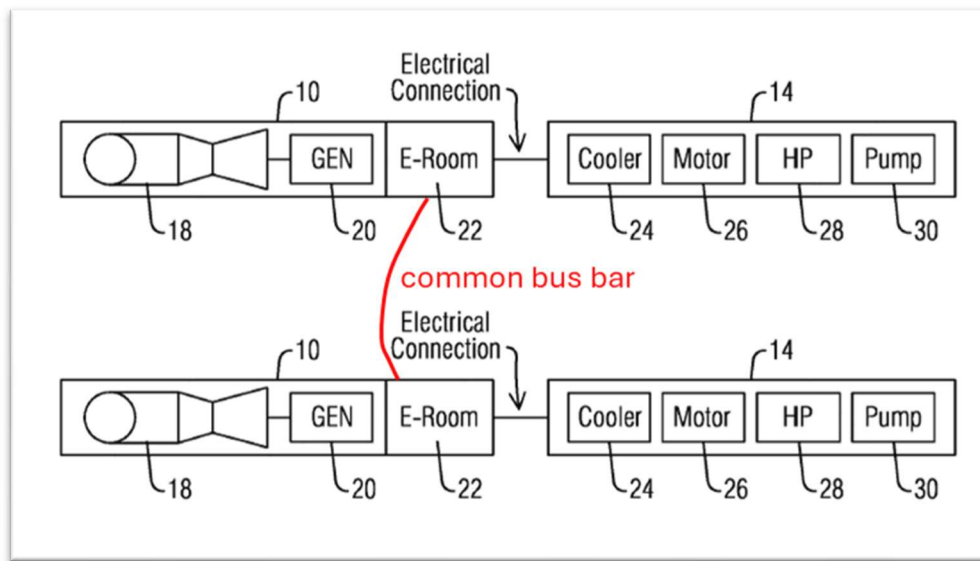
⁹⁷ The one-line diagram shown in Figure 99 uses standard power system symbology to represent generators, circuit breakers, transformers, buses, etc. Some of this standard terminology as would have been understood by a POSITA, is outlined in Ex. 1015 (*EE Reference*) pg 35-3.

Transformer T2, shown being attached to switchgear bus 2 would not be needed should the two sets of switchgear are operated at the same voltage.

Ex. 1006 (*IEEE Red Book*) Fig. 99 (annotated)

123. A POSITA would have understood that in the disclosure of *Reckels* described in paragraph [0018] and shown in Figure 2 (i.e., wherein a single power generation trailer 10 is connected to a single trailer 14 that includes a single high pressure fracturing fluid pump 30), as more pumps are needed (such as in the system shown in Fig. 1 of *Reckels*, wherein 8 pump trailers 14 are depicted), multiple generator/pump trailer pairs would be required. In the combination of the teachings of *Reckels* alone regarding a common busbar, or in combination with the *IEEE Red*

Book's teaching of a cable tie between two generator busses, the system would incorporate at least two trailer pairs as shown in Fig. 2 of *Reckels*, with a bus bar serving as, and creating, a common bus between the trailers, as shown in the annotated copy of Figure 2 of *Reckels* below:



Ex. 1004 (*Reckels*), Fig. 2 (annotated).

124. A POSITA would have been motivated to combine *Reckels* with the teachings of *IEEE Red Book* to gain the additional disclosure of the configuration of electrical distribution systems taught by *IEEE Red Book*. When implementing *Reckels'* teaching of using a “common bus bar” to connect gas turbines with the pumps, a POSITA would have been motivated to look to other references that provide additional details describing how to build a power distribution system that implements a mechanism for coupling multiple power generation sources. The *IEEE*

Red Book is one such reference. The *IEEE Red Book* is a well-known professional publication that “provides a recommended practice for the electrical design of industrial facilities,” and a POSITA would have been aware of this reference as a resource for helping plan and build the electrical system taught by Reckels.⁹⁸ Further, *IEEE Red Book* is a Standard for the *IEEE* and an American National Standard and has been at least since 1986.⁹⁹ I have had my copy of *IEEE Red Book* since at least 1992 when it was used in a Power Systems class in my graduate studies. Although Reckels discloses the use of a “common bus bar” to connect its generators and *IEEE Red Book* describes the “common bus bar” function as a cable tie connecting its generators, a POSITA would have understood that the fundamental operation of the bus bar and cable tie is the same—distributing current within an electrical system—such that *IEEE Red Book*’s teachings would be informative and useful in the implementation of *Reckels*’ system.

125. Further a POSITA would have been motivated to modify the Figure 2 and Figure 3 embodiments of *Reckels* to incorporate a common bus bar to connect multiple power generation trailers, as taught by *Reckels* and rendered obvious by *IEEE Red Book*, because this configuration allows for load sharing functionality—

⁹⁸ See Ex. 1005 (*IEEE Red Book*), 1.

⁹⁹ See Ex. 1005 (*IEEE Red Book*), 1.

i.e., where multiple power sources are used to power the same load(s)—which offers several benefits to *Reckels*' power generation system. For example, as Reckels explains, implementing a “common bus bar” to connect multiple generator systems and multiple fracturing pumps means “that the gas turbines can run at different loads, e.g., one at 100% and the other at 50%.”¹⁰⁰ This means that the power generation systems can flexibly adapt their power output to meet the demands of the load, which can improve overall system efficiency. Further, the common bus bar introduces redundancy into the system, such that if one of the power generation systems (i.e., the generator of one power generation trailer 10) fails or is powered off for maintenance, for example, other power generation systems coupled to the common bus bar can continue powering the loads without loss of service.

126. Further, incorporating *IEEE Red Book*'s teachings of a cable tie in a main-tie-main load sharing arrangement is applying a known technique (a main-tie-main configuration for coupling multiple power sources, as taught by *IEEE Red Book*) to improve similar devices (*Reckel*'s power distribution system) in the same way. The results of the combination would be predictable: a power distribution system as taught by *Reckels* that can combine and share power generated by different power generation trailers to drive one or more pumps on second trailers 14. And as

¹⁰⁰ Ex. 1004 (Reckels),

discussed above, both *Reckels* and *IEEE Red Book* are in the same field of endeavor—electrical power supply and distribution in industrial systems—such that a POSITA would have been motivated to combine these references and would have reasonably expected success in doing so.¹⁰¹

127. *IEEE Red Book* also discloses fundamental teachings regarding the process of planning and designing an electric distribution system, including determining load voltage and current requirements and planning the distribution system and sources (e.g., generators and transformer(s)) to support those requirements.¹⁰² When implementing *Reckels*' power distribution system, a POSITA would have been motivated to search for other references that guide the planning and development of such a system, including the selection of source and distribution system components necessary to support the desired loads, and would have turned to *IEEE Red Book* as one such source.

128. Further, combining *Reckels* with *IEEE Red Book* is merely combining prior art elements (*i.e.*, designing power source and distribution system components to support voltage and current requirements of the loads) with known methods (*i.e.*, *Reckels*' power distribution system) to yield predictable results (*i.e.*, a robust power

¹⁰¹ See Sections XI.A, B above.

¹⁰² See, e.g., Ex. 1005 (*IEEE Red Book*), 43-44, 53-55.

distribution system that can support load requirements). Accordingly, a POSITA would have been motivated to combine *IEEE Red Book*'s fundamental teachings regarding electric power distribution system design with *Buckley*'s power distribution system, and would have reasonably expected success in doing so.

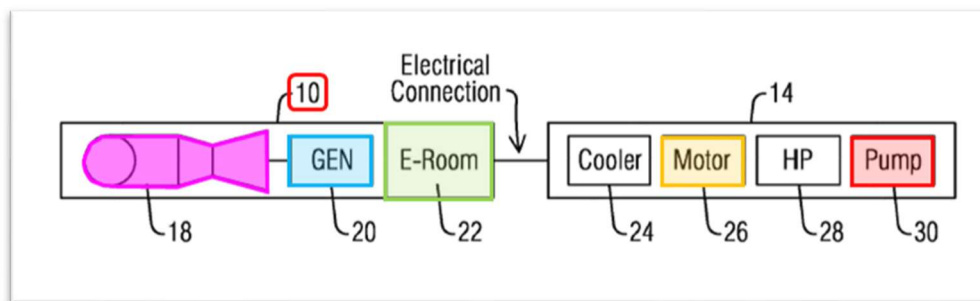
B. INDEPENDENT CLAIM 1

129. It is my opinion that the combination of *Reckels* and *IEEE Red Book* would have rendered Claim 1 obvious. The combined teachings of *Reckels* and *IEEE Red Book* disclose, or at least suggest, each and every limitation of Claim 1, as discussed in the sections below.

1. 1[p]: "1. A system comprising:"

130. To the extent the preamble is limiting, *Reckels* discloses an "hydraulic fracturing pump system includes two individual trailers, wherein a first trailer 10 includes a power generation system and a second trailer includes a hydraulic pumping system 14. The power generation trailer 10, which is shown on the left side of figure 2, [annotated in red] includes a gas turbine assembly 18 [highlighted in magenta], which includes a gas generator and a power turbine configured to convert the high pressure and high velocity gas into rotational shaft work. [] The generator 20 [highlighted in blue] is then connected to an electric room 22 [highlighted in green], which may include transformers, switchgear, variable frequency drives, and

other electrical components needed to drive high power electric motors. The second trailer 14, which is shown on the right side of figure 2, includes a cooling unit 24, a fixed speed electric motor 26 [highlighted in orange], a hydraulic pump 28 connected to the electric motor, and a high pressure pump connected to the hydraulic pump 30 [highlighted in red]. As such, the second trailer 14 receives electrical power from the power generation trailer 10. The electrical power is provided to the fixed speed electric motor 26, which rotates the hydraulic pump 28. The hydraulic pump 28 generates hydraulic fluid pressure that is used to rotate and control the flowrate of the high pressure fracturing fluid pump 30. The high pressure fracturing fluid pump 30 receives the fracturing liquids and pressurizes them for subsequent injection into the wellbore and formation.”¹⁰³



Ex. 1004 (Reckels) Fig. 2 annotated

¹⁰³ Ex. 1004 (*Reckels*) [0018].

131. *Reckels* discloses at least four different configurations of an electric hydraulic fracturing system, each configuration with its own benefits and tradeoffs.¹⁰⁴ Accordingly, *Reckels* discloses a system as claimed in the preamble.

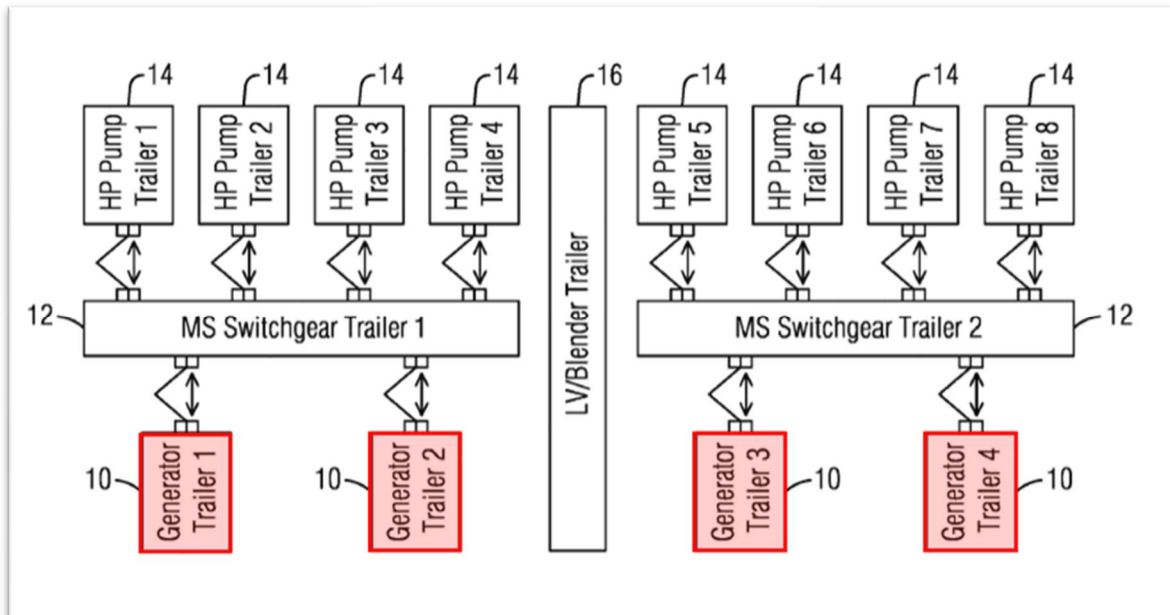
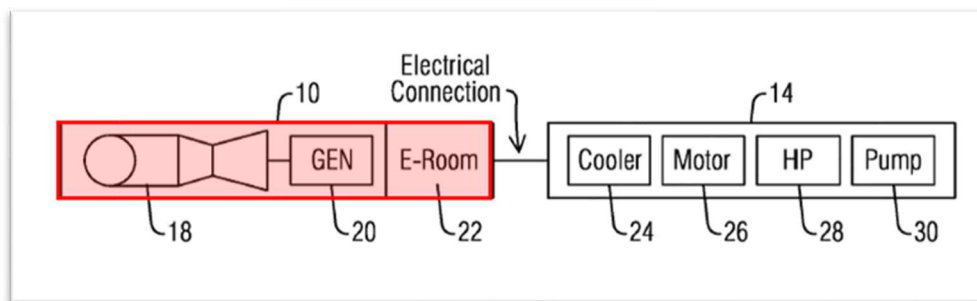
2. 1[a]: “A first mobile unit:”

132. *Reckels* discloses a first mobile unit in its disclosure of a “first trailer 10 [that] includes a power generation system.”¹⁰⁵ *Reckels* explains that the trailer may be a “semi-trailer.”¹⁰⁶ This mobile unit contains all of the equipment claimed in the subsequent limitations, and the equipment is configured in the manner claimed, as outlined below. Examples of trailer 10, which have been annotated in red, are provided in Figures 1 and 2 of *Reckels*, copied below:

¹⁰⁴ See, e.g., Ex. 1004 (*Reckels*), [0015], [0018], [0019], [0022].

¹⁰⁵ Ex. 1004 (*Reckels*) [0018].

¹⁰⁶ Ex. 1004 (*Reckels*), Abstract.

Ex. 1004 (*Reckels*), Fig. 1 (annotated).Ex. 1004 (*Reckels*), Fig. 2 (annotated).

133. Accordingly, *Reckels* discloses a first trailer 10, which may be a semi-trailer, as the first mobile unit as claimed in 1[a]. A POSITA would have understood that the trailer (e.g., semi-trailer) is configured to be transported to different locations via a semi-truck, for example, such that the trailer 10 is “mobile.” This understanding

is consistent with the '801 Patent, which lists a trailer as an example of a mobile unit.¹⁰⁷

3. 1[b]: “at least one switch gear to be associated with at least one transformer, an interconnect, and a bus bar; and”

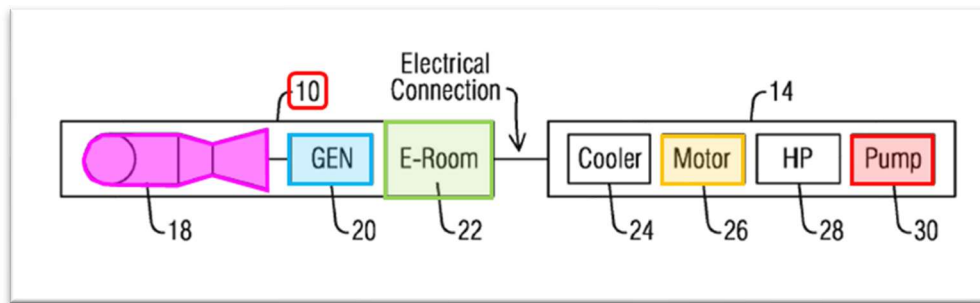
134. *Reckels* discloses, or at least renders obvious in view of *IEEE Red Book*, at least one switch gear to be associated with at least one transformer, an interconnect, and a bus bar, as claimed in limitation 1[b]. With respect to Figure 2, *Reckels* teaches that power generation trailer 10 includes a “gas turbine assembly 18” (highlighted in magenta) that is “connected to a generator 20,” (highlighted in blue) which “is then connected to an electric room 22, [highlighted in green] which may include *transformers*, *switchgear*, variable frequency drives, and other electrical components needed to drive high power electric motors.”¹⁰⁸ A second trailer 14, which includes hydraulic pump 28 and high pressure fracturing fluid pump 30, “receives electrical power from the power generation trailer 10.”¹⁰⁹ A copy of

¹⁰⁷ See, e.g., Ex. 1001 ('801 Patent), 6:6-10 (“In an example, the turbine is part of a Mobile Power Unit (MPU) or platform. The MPU may be a trailerized, bodyload, or skid mounted electrical power generation unit which can use the turbine or reciprocating engine for power generation.”); 6:12-16 (“The MPU can comprise of one or more trailers, composed of the generator, the electrical switching gear, a prime mover (engine), auxiliary loads (cooling, heating, lubricating, diagnostics and control equipment), and fire suppression equipment.”).

¹⁰⁸ Ex. 1004 (*Reckels*) [0018] (emphasis added).

¹⁰⁹ Ex. 1004 (*Reckels*) [0018]

Figure 2, depicting the generator 20 and electric room 22 as components of the trailer 14, is depicted below:

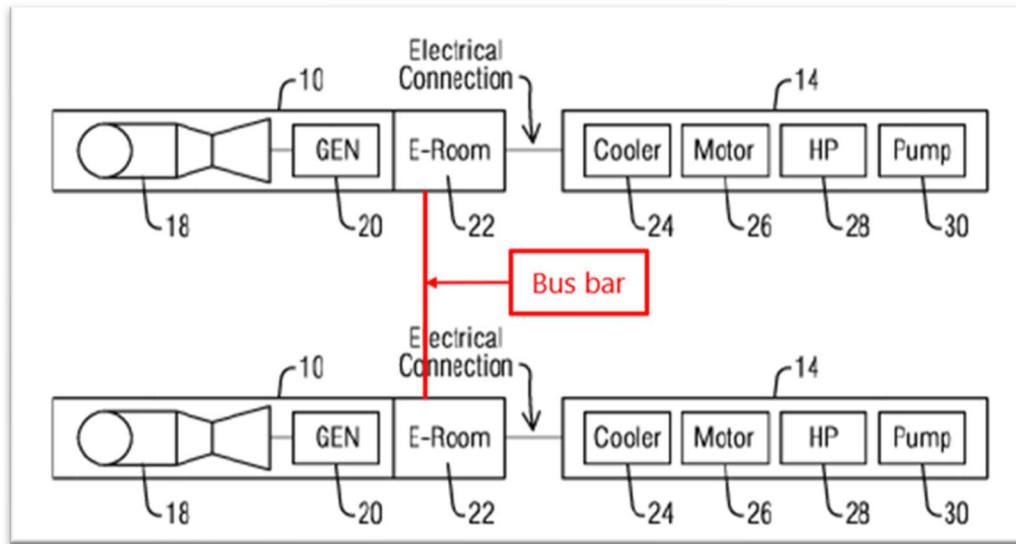
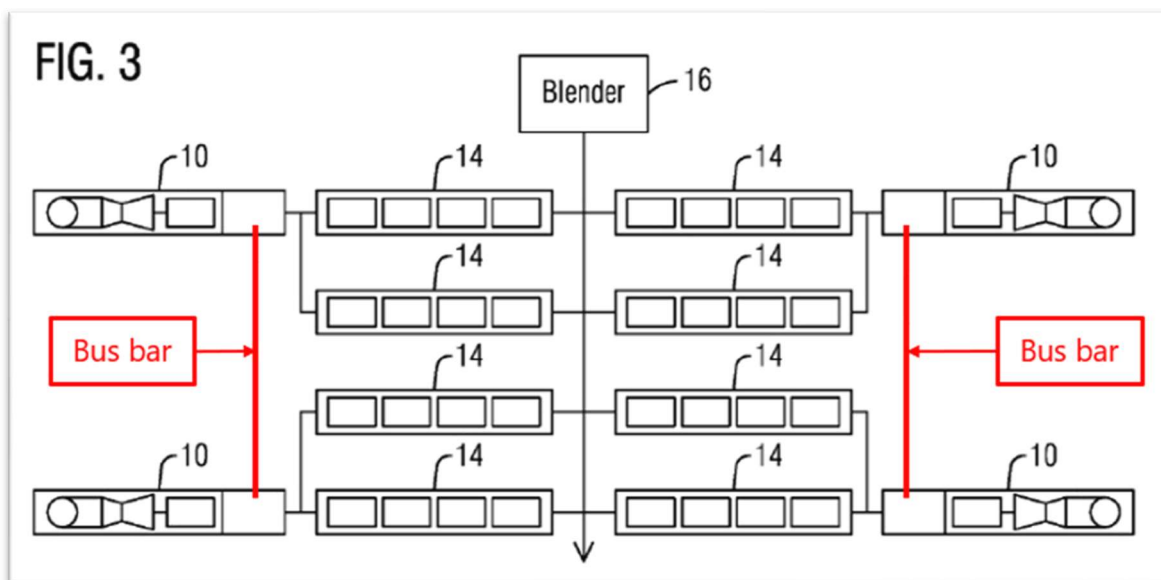


Ex. 1004 (Reckels), Fig. 2 (annotated).

135. *Reckels* further discloses that “the gas turbines and the pumps can also be connected to a common bus bar, so that the gas turbines can run at different loads, e.g. one at 100% and the other at 50%.”¹¹⁰ As discussed above in Section XII.A, *Reckels* discloses, or at least renders obvious in view of *IEEE Red Book*, a modified implementation of the Figure 2 and Figure 3 configurations wherein at least two of *Reckels*’ power generation trailers 10 are connected via a “common bus bar.”¹¹¹ An example of this configuration is depicted below:

¹¹⁰ Ex. 1004 (Reckels) [0015].

¹¹¹ See Section XII.A above.

Ex. 1004 (*Reckels*), Fig. 2 (annotated).Ex. 1004 (*Reckels*), Fig. 3 (annotated).

136. In this configuration, a POSITA would have understood that internal buses of the respective sets of switchgear would be coupled to the “common bus bar” such that the respective generators each provide power to the common bus bar.

Further, a POSITA would have understood that the respective electrical connections of each power generation trailer 10-second trailer 14 combination would also be coupled to the common bus bar, such each generator can power the components of the second trailers 14. And as shown, a switchgear of an electrical room 22 is associated with a transformer of the same electrical room 22.¹¹²

137. Further, *IEEE Red Book* discloses that “switchgear” contains a busbar: “the thermal ratings of the supply (transformer), the main circuit breaker, and the *switchgear main bus bar* must be equal.”¹¹³ Further, bus bars were a very well-known structure for carrying electric power.¹¹⁴ Accordingly, any place where switchgear occurs, whether in the primary, secondary or load switchgear, a busbar would have at least been an obvious configuration.

138. According to the ’801 Patent, the term “interconnect” is used consistent with its plain and ordinary meaning and refers simply to cables connecting two equipment trailers.¹¹⁵ Accordingly, the “electrical connection” shown in Figure 2 of

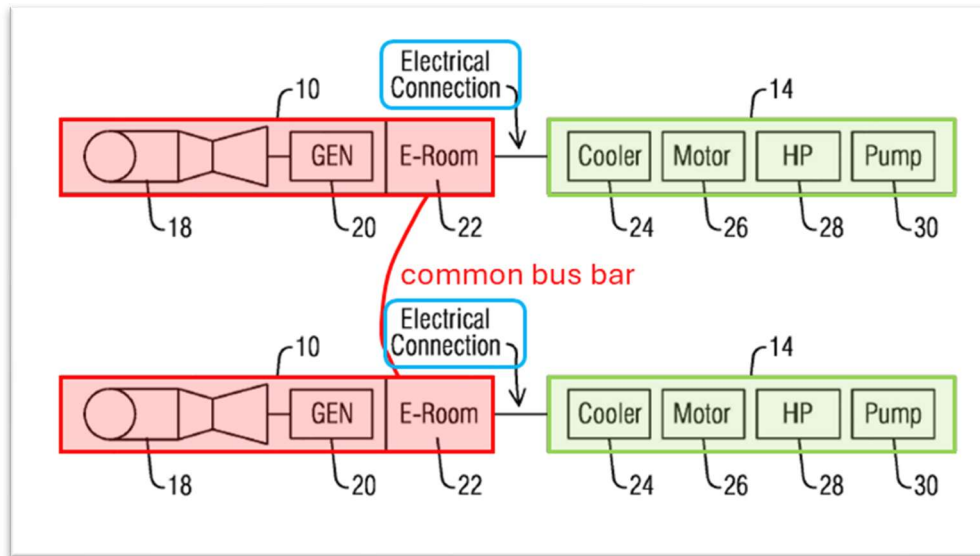
¹¹² Ex. 1004 (Reckels), [0018] (explaining that electrical room 22 includes transformers and switchgear).

¹¹³ Ex. 1005 (*IEEE Red Book*) pg 55, emphasis added

¹¹⁴ See, e.g., Ex. 1005 (*IEEE Red Book*) pg. 529 describing the use of busbars in busways to “simplify electrical connections for electric motor driving machines.” See also Table 85 pg 539 showing standard voltage drop for various busbar configurations.

¹¹⁵ See, e.g., Ex. 1001 (’801 Patent), 4:7-11; 6:54-59; 10:23-31; 10:41-49; 11:7-11; 11:21-33; 11:57-12:7; 12:40-13:3; 13:53-60; 14:52-58.

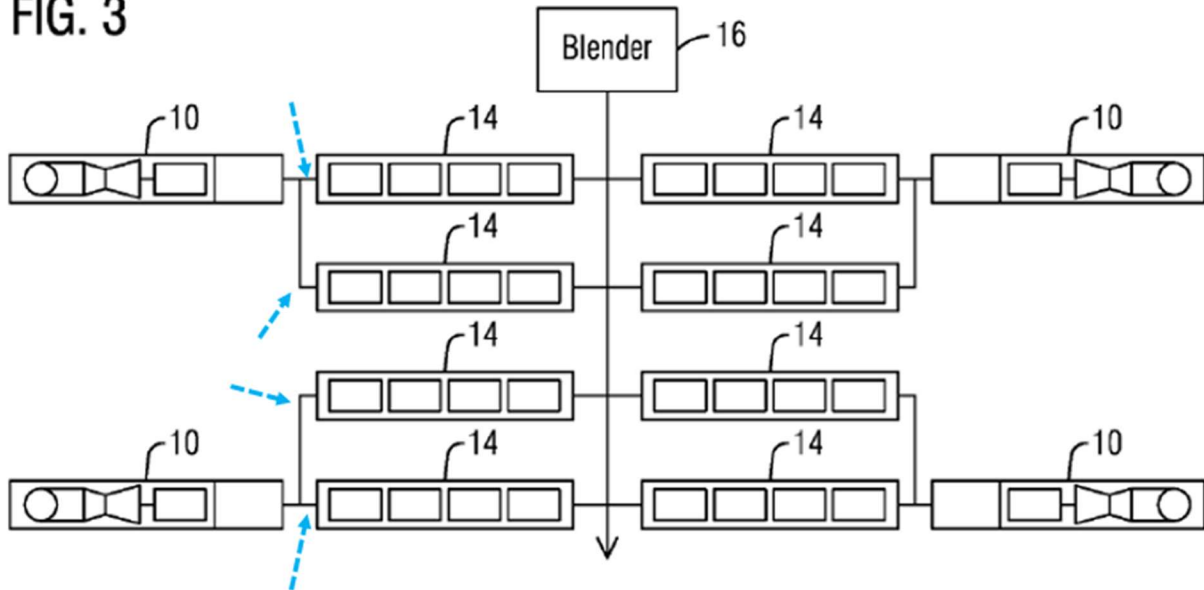
Reckels (annotated in blue) is an interconnect associated with the switchgear of generator trailer 10 (highlighted in red) and pump trailer 14 (highlighted in green).



Ex. 1004 (*Reckels*) Fig. 2.

139. Similar electrical connections (*i.e.*, “*interconnects*”) are depicted in Figure 3 of *Reckels*, annotated below:

FIG. 3



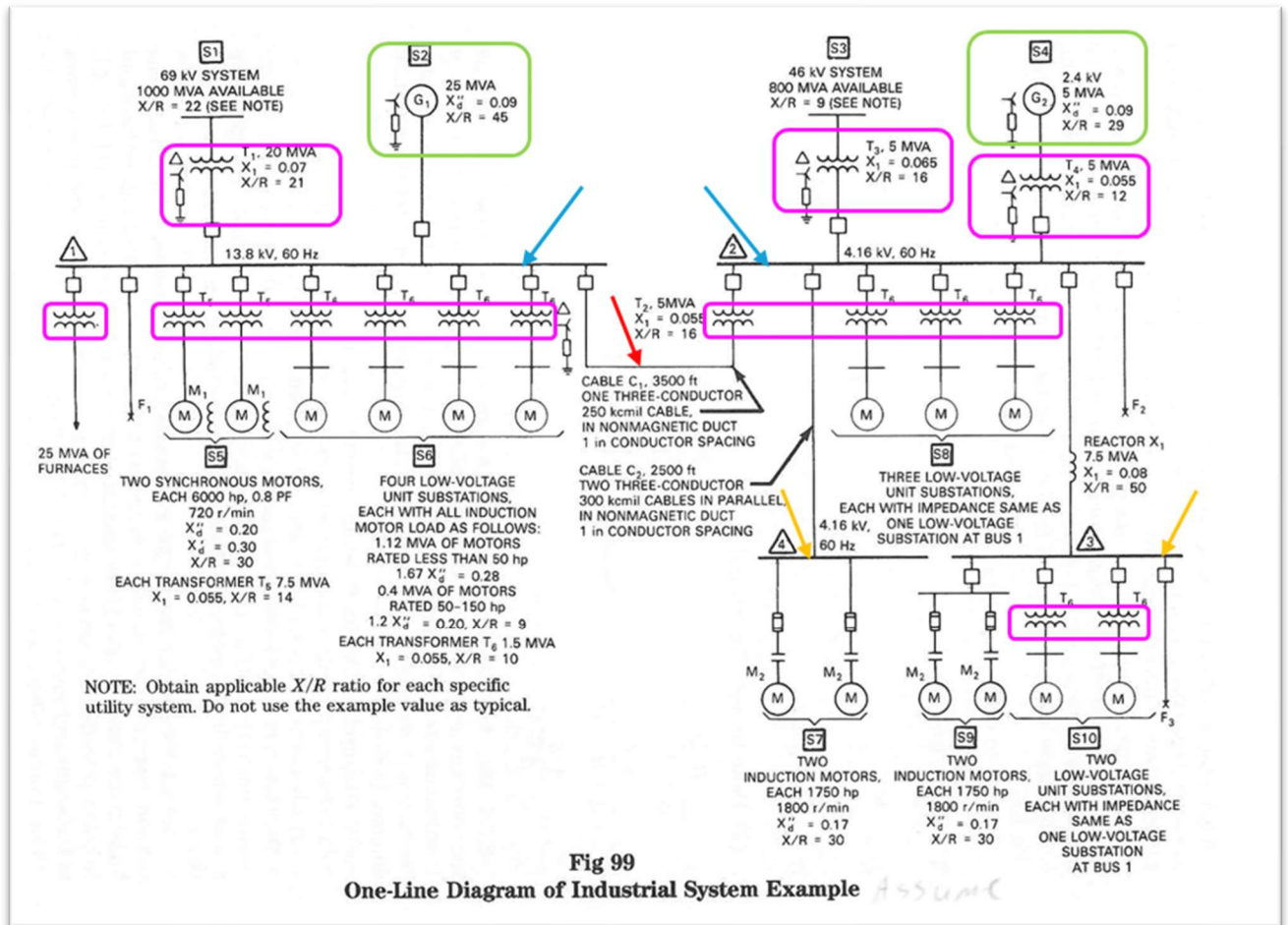
Ex. 1004 (*Reckels*), Fig. 3 (annotated, showing electrical connections with blue arrows).

140. Further, the “common bus bar” is another example of an interconnect that electrically ties the two generator trailers together.

141. Accordingly, *Reckels* discloses, or at least renders obvious in view of *IEEE Red Book*, a switchgear (*e.g.*, a switchgear of a first e-room 22) associated with a transformer (*e.g.*, a transformer of the first e-room 22), interconnect (*e.g.*, an electrical connection connecting the components of the e-room 22 to a first second trailer 14, and the common bus bar), and bus bar (*e.g.*, the common bus bar coupling the components of the first e-room 22 with the components of a second e-room 22, and the internal bus bar of the switchgear of the first e-room 22) as claimed.

142. As described by *IEEE Red Book*, for any locations with switchgear buses (e.g., blue arrows, orange arrows), a busbar would have at least been obvious. Accordingly, it would have been obvious, based on the teachings of *IEEE Red Book*, to incorporate a busbar in both the main switchgear buses (blue arrows) and the load switchgear buses (orange arrows).¹¹⁶

¹¹⁶ The one-line diagram shown in Figure 99 uses standard power system symbology to represent generators, circuit breakers, transformers, buses, etc. Some of this standard terminology as would have been understood by a POSITA, is outlined in Ex. 1015 (*EE Reference*) pg 35-3.

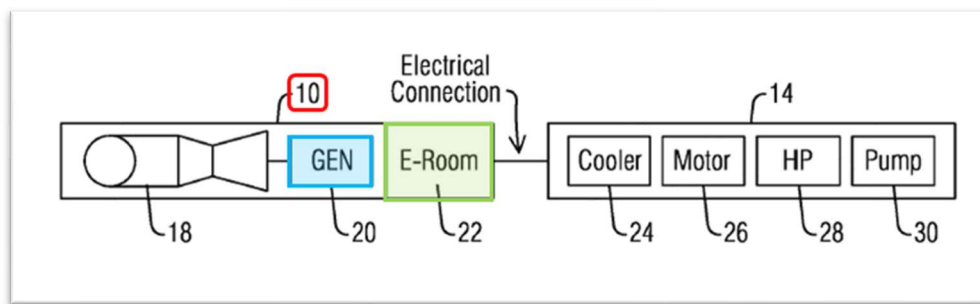
Ex. 1005 (*IEEE Red Book*) Fig. 99 (annotated)

143. Accordingly, *Reckels* discloses limitation 1[b], or at least renders it obvious when combined with the teachings of *IEEE Red Book*.

4. 1[c]: “at least one first generator coupled to the at least one switch gear and located on the first mobile unit with the at least one switch gear,”

144. *Reckels* discloses at least one generator coupled to the at least one switch gear and located on the first mobile unit with the at least one switch gear, as

claimed in limitation 1[b]. As discussed above, *Reckels* teaches that a power generation trailer 10 comprises a “gas turbine assembly 18” that is “connected to a generator 20,” which “is then connected to an electric room 22, which may include transformers, switchgear, variable frequency drives, and other electrical components needed to drive high power electric motors.”¹¹⁷ As shown in Figure 2 of *Reckels*, power generator trailer 10 (first mobile unit) (annotated in red) contains both generator 20 (highlighted in blue) and E-room 22 (highlighted in green). As disclosed by *Reckels*, E-room 22 includes switchgear.



Ex. 1004 (*Reckels*) Fig. 2 (annotated)

145. Further, in the modified version of *Reckels*' Figure 3 embodiment, wherein a common bus bar couples two power generation trailers 10 and associated second trailers 14, a POSITA would have understood that each power generation trailer 10 (*i.e.*, “mobile unit”) includes a generator coupled to a switchgear (which is

¹¹⁷ Ex. 1004 (*Reckels*) [0018].

located in the respective power generation trailer 10's e-room 22), including the "first mobile unit" as identified above with respect to Limitation 1[a].

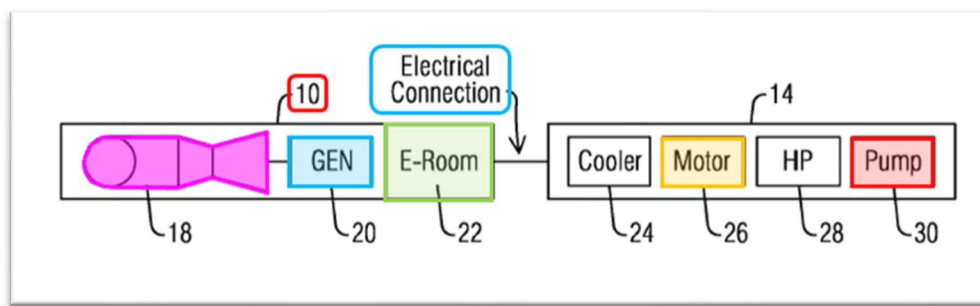
146. Accordingly, *Reckels* discloses the limitations of 1[c].

5. 1[d]: "the first mobile unit configured to provide power generated by the at least one first generator using electrical buses of the at least one switchgear and using the at least one transformer, the interconnect, and the bus bar, the power for loads on one or more external mobile units,"

147. *Reckels* discloses, or at least renders obvious in view of *IEEE Red Book*, the first mobile unit configured to provide power generated by the at least one first generator using electrical buses of the at least one switchgear and using the at least one transformer, the interconnect, and the bus bar.

148. *Reckels* discloses that "The generator 20 [highlighted in blue] is then connected to an electric room 22, [highlighted in green] which may include transformers, switchgear, variable frequency drives, and other electrical components needed to drive high power electric motors. The second trailer 14, which is shown on the right side of Fig. 2, includes a cooling unit 24, a fixed speed electric motor 26 [highlighted in orange], a hydraulic pump 28 connected to the electric motor, and a high pressure pump connected to the hydraulic pump 30 [highlighted in red]. As such, the second trailer 14 receives electrical power from the power generation trailer 10. The electrical power is provided to the fixed speed electric motor 26,

which rotates the hydraulic pump 28. The hydraulic pump 28 generates hydraulic fluid pressure that is used to rotate and control the flowrate of the high pressure fracturing fluid pump 30. The high pressure fracturing fluid pump 30 receives the fracturing liquids and pressurizes them for subsequent injection into the wellbore and formation.”¹¹⁸



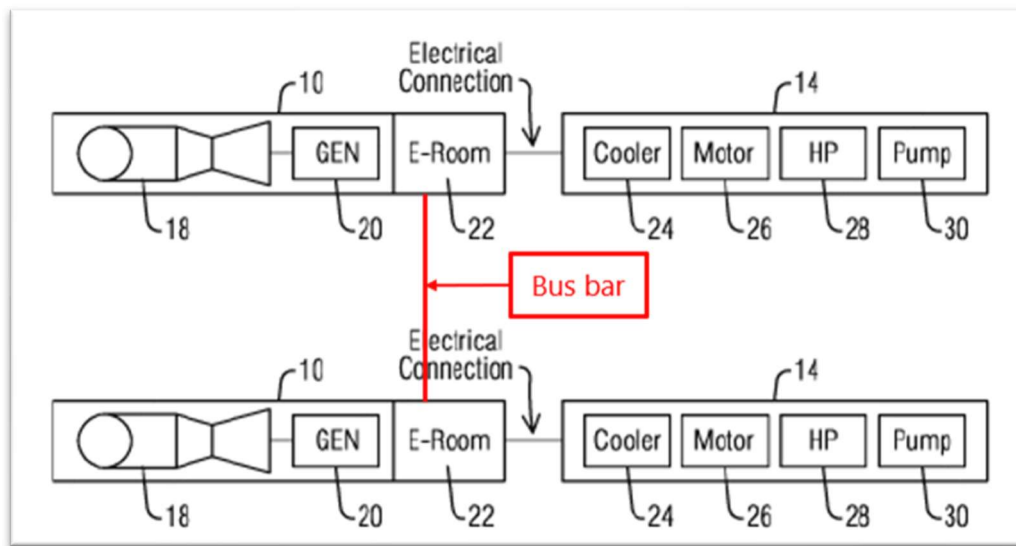
Ex. 1004 (Reckels) Fig. 2 (annotated)

149. A POSITA would have understood that “second trailer 14” containing a cooler, motor, and pump comprises “loads on one or more external mobile units.” As shown, second trailers 14 are separate from power generation trailers 10, such that second trailers 14 are “external” units. And as discussed above for Limitation 1[a], a POSITA would have understood that these trailers are “mobile” because they are designed to be transported via semi-trucks and because the ’801 Patent lists trailers as examples of mobile units.¹¹⁹

¹¹⁸ Ex. 1004 (Reckels) [0018]

¹¹⁹ See Section XII.B.2 above.

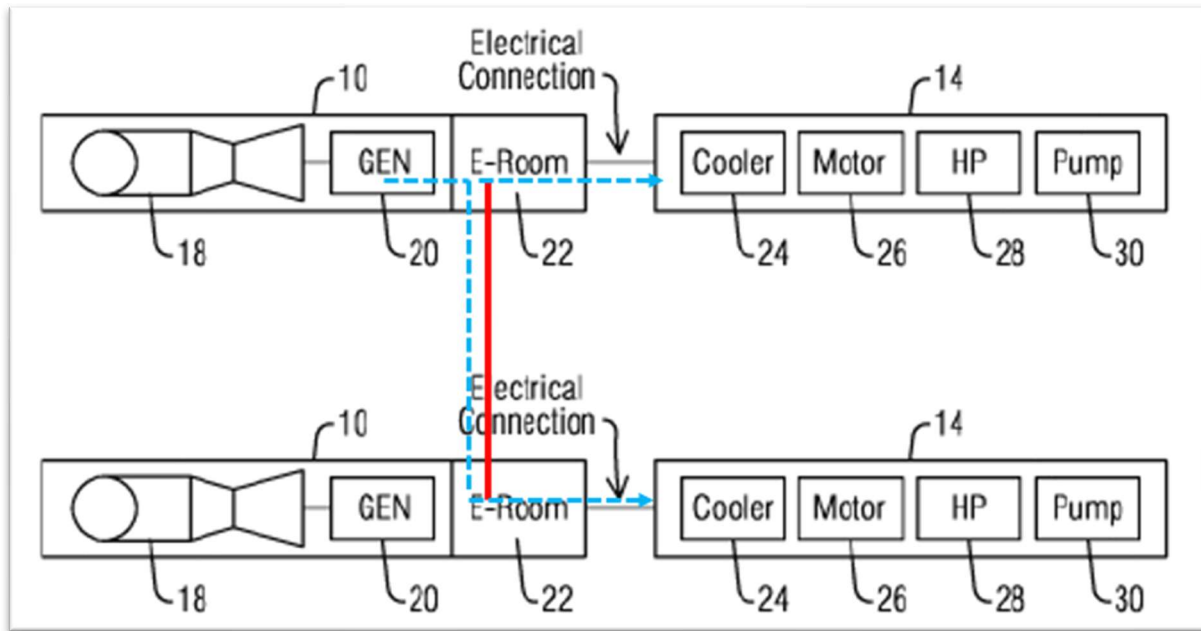
150. Further, in the load sharing system that results from the combination of embodiments of *Reckels*, alone or with the combination with *IEEE Red Book*, the power would be provided to the second trailers 14 from the combined generator trailers 10.



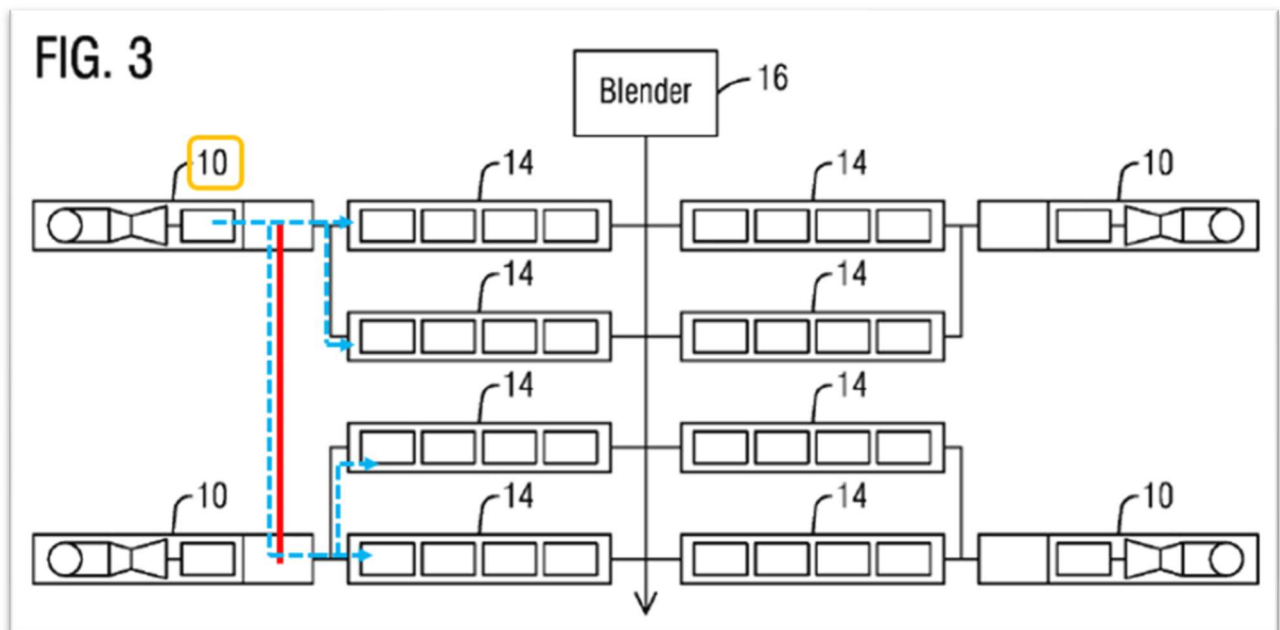
Ex. 1004 (Reckels) Fig. 2 (annotated)

151. As discussed above regarding limitation 1[b], the distribution system that results from combining the teachings of *Reckels* and *IEEE Red Book* uses electrical buses of the switchgear, the transformer, the interconnect and the bus bar to power the loads on at least two second trailers 14 (i.e., “external mobile units”). The annotated copies of Figures 2 and 3 below, which incorporate the common bus bar as disclosed by *Reckles* and rendered obvious by *IEEE Red Book*, shows how

power is delivered from the generator to the second trailers 14 to power the associated pumps:



Ex. 1004 (*Reckels*), Fig. 2 (annotated)



Ex. 1004, Fig. 3 (*annotated*)

152. As shown, power generated by the generator 20 of the first power generation trailer 14 (i.e., power generation trailer with orange annotations in annotated Figure 3) is passed to the E-room 22 of the first power generation trailer, where it is conditioned by a transformer and distributed to a switchgear bus within the e-room 22, before it is passed to the common bus bar and distributed to the secondary trailers 14 via the respective electrical connections (i.e., the “interconnections”). As such, *Reckels* discloses, and renders obvious in view of *IEEE Red Book*, that the first power generation trailer 14 is configured to provide power via its component generator 20 (“*the first mobile unit configured to provide power generated by the at least one first generator*”) using electrical busses of its component switchgear and the transformer included in its e-room 22 (“*using electrical buses of the at least one switchgear and using the at least one transformer*”), the electrical connections to the second trailers 14 and the common bus bar (“*using...the interconnect*”), and the common bus bar and the internal bus bars of the switchgear (“*using...the bus bar*”), and that the generated power is for fracturing pumps on the second trailers 14 (“*the power for loads on one or more external mobile units*”). Thus, *Reckels* discloses, and renders obvious in view of *IEEE Red Book*, Limitation 1[d].

6. 1[e]: “the at least one switchgear, the electrical buses, the interconnect, and the bus bar sized to support voltage and current requirements of the loads and to support voltage and current outputs of the at least one transformer with the at least one first generator in a load sharing arrangement with a second generator of a second mobile unit.”

153. The combined teachings of *Reckels* and *IEEE Red Book* disclose the at least one switchgear, the electrical buses, the interconnect, and the bus bar sized to support voltage and current requirements of the loads and to support voltage and current outputs of the at least one transformer with the at least one first generator in a load sharing arrangement with a second generator of a second mobile unit.

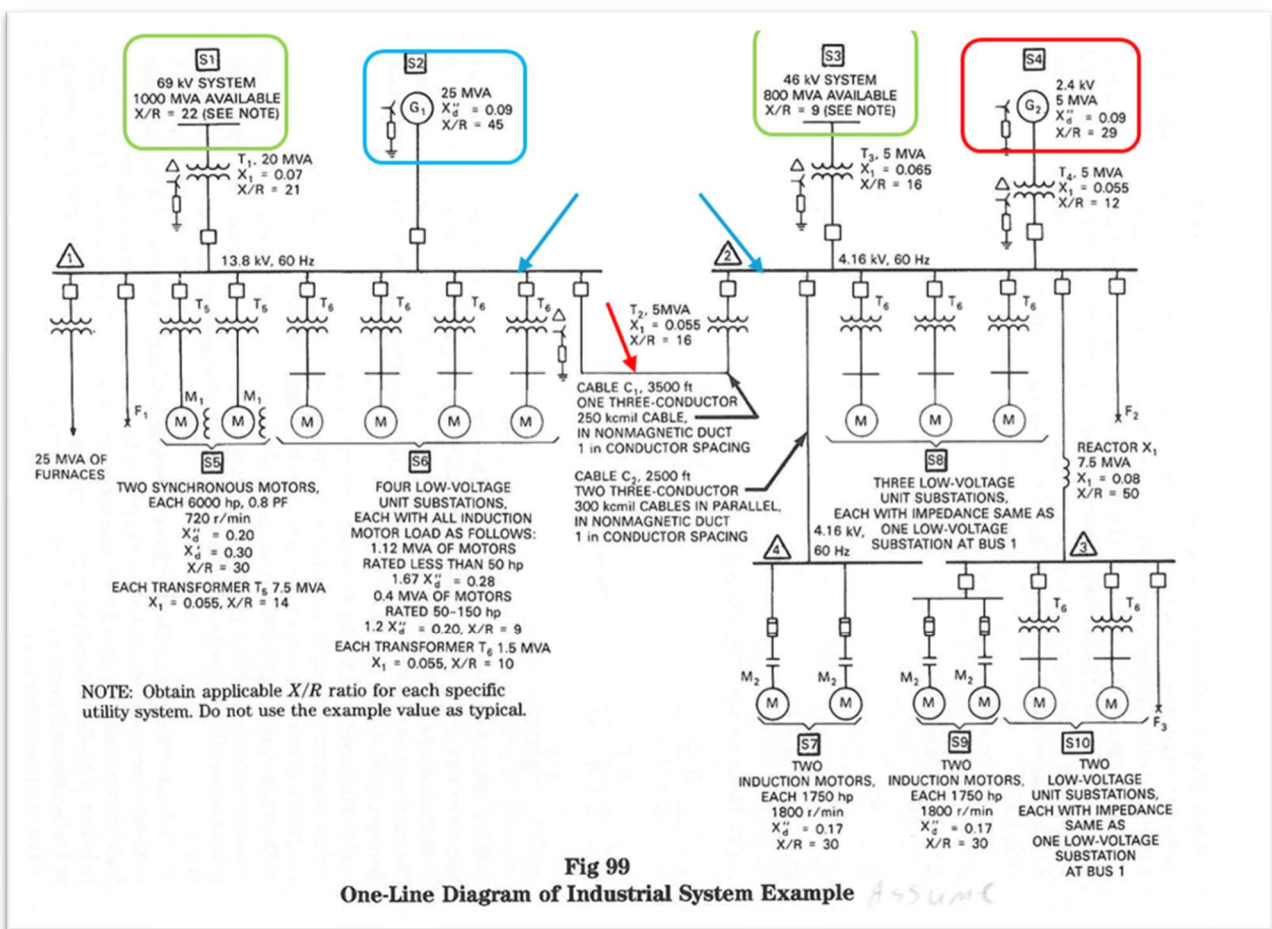
154. *IEEE Red Book* discloses that “switchgear” contains a busbar, and the busbar has ratings: “the thermal ratings of the supply (transformer), the main circuit breaker, and the *switchgear main bus bar* must be equal.”¹²⁰

155. As discussed above regarding limitations 1[b] and 1[d], *Reckels* discloses a load sharing arrangement where generators share load from multiple pump trailers, i.e., “the gas turbines and the pumps can also be connected to a common bus bar, so that the gas turbines can run at different loads, e.g. one at 100% and the other at 50%.”¹²¹ A POSITA would have also understood that, in the example power system disclosed by *the IEEE Red Book*, the generators are arranged in a load-

¹²⁰ Ex. 1005 (*IEEE Red Book*) pp. 55-56, emphasis added

¹²¹ Ex. 1004 (*Reckels*) [0015].

sharing arrangement. That is, the 5 MVA S4 generator (red box) picks up a portion of the load not supplied by the utility connections S1 and S3 (green boxes), and the 25 MVA generator S2 picks up a portion of the load. Accordingly, the load is “shared” between the two generators using the main buses (blue arrows) and the cable tie interconnect (red arrow).



Ex. 1006 (*IEEE Red Book*)

156. Further, a POSITA would have recognized that the distribution system components (switchgear, electric buses, interconnect, busbar, etc.) must be sized to

support the voltage and current requirements of the loads and the transformer. This is required by the National Electrical Code as discussed in Section X.L above. Further, *IEEE Red Book* explains the process of planning and designing a distribution system, which begins with determining the loads and then planning the distribution system and sources (e.g., generators and transformer) to match these.

157. Chapter 2 of *IEEE Red Book* is titled “System Planning” and outlines the procedures for designing and planning power systems. Chapter 2 includes a “Planning Guide for Distribution Design” which “will guide the engineer in the design of an electric distribution system for any industrial plant”.¹²² This planning guide teaches the engineer to “determine the approximate total plant load in kilowatts or kilovolt-amperes” (kVA).¹²³ This could include:

- Demand (the sum of the electrical ratings of each piece of equipment)
- Peak load (the maximum load consumed or produced by a unit or group of units)
- Maximum demand (the greatest of all demands that have or could occur)

¹²² Ex. 1005 (*IEEE Red Book*) pg. 43.

¹²³ Ex. 1005 (*IEEE Red Book*) pg. 43. Kilowatts (kW) are units of power, which is the product of the voltage and current and the power factor. Kilovolt amperes (kVA) is a unit of apparent power, which is the product of the voltage and current, without taking into account the power factor. kVA is generally larger than kW for any given system. At most kW is equal to kVA. By considering voltage and kVA, the *IEEE Red Book* discloses the consideration of current, which must be known to calculate kW or kVA.

- Load factor (the ratio of the average load to the peak load).¹²⁴

Further, *IEEE Red Book* teaches that:¹²⁵

Information on these factors for the various loads and groups of loads is useful in designing the system. For example, the sum of the connected loads on a feeder, multiplied by the demand factor of these loads, will give the maximum demand that the feeder must carry. The sum of the individual maximum demands on the circuits associated with a load center or panelboard [switchgear], divided by the diversity factor of those circuits, will give the maximum demand at the load center and on the circuit supplying it. The sum of the individual maximum demands on the circuits from a transformer, divided by the diversity factor of those circuits, will give the maximum demand on the distribution transformer. The sum of the maximum demands on all distribution transformers, divided by the diversity factor of the transformer loads, will give the maximum demand on their primary feeder. By the use of the proper factors, as outlined, the maximum demands on the various parts of the system from the load circuits to the power source [e.g., generators] can be estimated.

158. Further, in planning the system, *IEEE Red Book* teaches to consider information such as “plant load in kilowatts and maximum demand in kilovolt-amperes” (i.e., current requirements of the load), “preferred service voltage,” “anticipated power factor,” and the “nature of connected load.”¹²⁶ When including

¹²⁴ Ex. 1005 (*IEEE Red Book*) pp. 43-44.

¹²⁵ Ex. 1005 (*IEEE Red Book*) pg 44.

¹²⁶ Ex. 1006 (*IEEE Red Book*) pg. 52.

generation, *IEEE Red Book* teaches that at least generator ratings must be considered including “Generator load in kilovolt-amperes” and “generator voltage”.¹²⁷

159. *IEEE Red Book* further teaches “a complete one-line or single-line diagram [] should present sufficient data to plan and evaluate the electric power system.”¹²⁸ The one line should include at least the following:¹²⁹

- Power sources [generators] including voltages and available short circuit currents.
- Size, type, ampacities [current carrying capacity], and number of all conductors [including busses and ties] in kilovolt-ampere rating. [both voltage and current]
- Capacities [kVA], voltages, impedance, connections and grounding methods of transformers.
- Identification and quantity of protective devices (relays, fuses, and circuit breakers).
- Identification of all loads

160. The information contained in the one line, including the voltage and current requirements of the loads, switchgear, conductors (including buses), generators, and all other electric equipment, is used to size the equipment and plan and design the system.

¹²⁷ Ex. 1006 (*IEEE Red Book*) pg. 52.

¹²⁸ Ex. 1006 (*IEEE Red Book*) pg. 53.

¹²⁹ Ex. 1006 (*IEEE Red Book*) pg. 53.

161. Further, *IEEE Red Book* explicitly discloses that “[s]electing the number of main distribution buses and the method of interconnecting them is not an arbitrary decision. Instead, many factors must be considered, such as the sizes of the immediate and ultimate plant loads, the primary distribution voltage, the availability of suitable supply lines, and other factors.”¹³⁰ Further, *IEEE Red Book* discloses that “[t]he supply voltages available to an industrial plant depend upon whether the plant is connected to the distribution transformer, the primary distribution system, or the transmission system, which, in turn, depends on the size of the plant load.”¹³¹ As another example, *IEEE Red Book* teaches that “to maximize the firm capability of this arrangement requires that the thermal ratings of the supply (transformer), the main circuit breaker, and the switchgear main bus bar must be equal. While later discussions will more thoroughly consider specific ratings, precisely matching all of these thermal capacities is extremely difficult and is rarely achieved. Therefore, the usual occurrence is one in which either the supply transformer or the switchgear, main breaker, or bus bars are limiting.”¹³² The claim language merely claims the scenario in which the limiting factor is the supply transformer, a known configuration as demonstrated by *IEEE Red Book*.

¹³⁰ Ex. 1006 (*IEEE Red Book*) pg. 55.

¹³¹ Ex. 1006 (*IEEE Red Book*) pg. 70.

¹³² Ex. 1006 (*IEEE Red Book*) pg. 55-56.

162. The sizing of equipment to support the voltage and current requirements of the loads, the transformer, and the sources [e.g., generators] is common practice and required on all properly designed electrical power systems.

163. Accordingly, the combination of *Reckels* and *IEEE Red Book* renders limitation 1[e] obvious.

C. DEPENDENT CLAIM 2: “2. THE SYSTEM OF CLAIM 1, WHEREIN THE SYSTEM IS PART OF A HYDRAULIC FRACTURING SYSTEM THAT CONSUMES THE POWER AND THAT COMPRISES A WELLBORE AND AT LEAST ONE PRESSURING SYSTEM TO CREATE FRACTURES IN A SUBTERRANEAN FORMATION THAT SURROUNDS THE WELLBORE.”

164. Claim 2 depends from Claim 1. The combination of *Reckels* and *IEEE Red Book* render Claim 1 obvious as discussed above in Section XII.B, and incorporated herein by reference. The combined teachings of *Reckels* and *IEEE Red Book* further disclose that the system of Claim 1 is part of a hydraulic fracturing system that consumes the power and that comprises a wellbore and at least one pressuring system to create fractures in a subterranean formation that surrounds the wellbore.

165. *Reckels* discloses that “[f]igure 2 illustrates an exemplary hydraulic fracturing pump system of the present disclosure. The hydraulic fracturing pump system includes two individual trailers, wherein a first trailer 10 includes a power

generation system and a second trailer includes a hydraulic pumping system 14.”¹³³

Further, *Reckels* discloses the basics of a hydraulic fracturing system:¹³⁴

Hydraulic fracturing is a process used to stimulate production from oil and gas wells. Hydraulic fracturing generally involves pumping a high pressure fluid mixture that includes particles/proppants and optional chemicals ***at high pressure through the wellbore into a formation***. As the high-pressure fluid mixture enters the formation, ***it fractures the formation and creates fissures***. When the fluid pressure is released from the wellbore and formation, the fractures or fissures settle, but are at least partially held open by the particles/proppants carried in the fluid mixture. Holding the fractures open allows for the extraction of oil and gas from the formation.

Accordingly, *Reckels* discloses a hydraulic fracturing system that comprises a wellbore and at least one pressuring system to create fractures in a subterranean formation that surrounds the wellbore.

166. *Reckels* further discloses that the distribution system described above in Claim 1 is connected to “second trailer 14, which is shown on the right side of figure 2, includes a cooling unit 24, a fixed speed electric motor 26, a hydraulic pump 28 connected to the electric motor, and a high pressure pump connected to the hydraulic pump 30. As such, the second trailer 14 receives electrical power from the power generation trailer 10. The electrical power is provided to the fixed speed electric motor 26, which rotates the hydraulic pump 28. The hydraulic pump 28

¹³³ Ex. 1004 (Reckels) [0018].

¹³⁴ Ex. 1004 (Reckels) [0001], emphasis added.

generates hydraulic fluid pressure that is used to rotate and control the flowrate of the high pressure fracturing fluid pump 30. The high pressure fracturing fluid pump 30 receives the fracturing liquids and pressurizes them for subsequent injection into the wellbore and formation.”¹³⁵ The “pressuring system” disclosed is the system on pump trailers 14, which consumes the power delivered by the distribution system described above regarding Claim 1, and uses that power to pressurize the wellbore to create fractures in the formation that surrounds the wellbore.

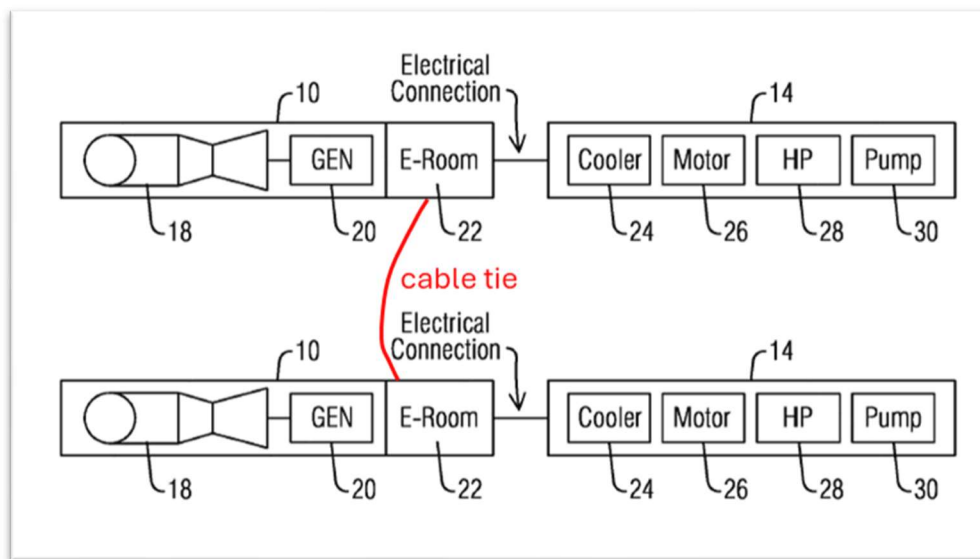
167. Accordingly, the combination of *Reckels* and *IEEE Red Book* discloses Claim 2.

D. DEPENDENT CLAIM 3: “3. THE SYSTEM OF CLAIM 1, FURTHER COMPRISING: AT LEAST ONE FRACTURING PUMP (FP) MOBILE UNIT OF THE ONE OR MORE EXTERNAL MOBILE UNITS, THE AT LEAST ONE FP MOBILE UNIT PHYSICALLY EXTERNAL RELATIVE TO THE FIRST MOBILE UNIT, WHEREIN THE AT LEAST ONE TRANSFORMER IS PROVIDED TO CONDITION THE POWER SUPPLIED TO THE AT LEAST ONE FP MOBILE UNIT.”

168. Claim 3 depends from Claim 1. The combination of *Reckels* and *IEEE Red Book* render Claim 1 obvious as discussed above in Section XII.B, and incorporated herein by reference. Further, the combination of *Reckels* and *IEEE Red Book* discloses the additional limitations of Claim 3.

¹³⁵ Ex. 1004 (*Reckels*) [0018].

169. As discussed above regarding limitation 1[d], the distribution system discussed above regarding Claim 1 delivers power to “second trailer 14, which is shown on the right side of figure 2, includes a cooling unit 24, a fixed speed electric motor 26, a hydraulic pump 28 connected to the electric motor, and a high pressure pump connected to the hydraulic pump 30. As such, the second trailer 14 receives electrical power from the power generation trailer 10.”¹³⁶



Ex. 1004 (Reckels) Fig. 2 (annotated)

170. A POSITA would have immediately recognized “second trailer 14” to be a “fracturing pump mobile unit”, and that the disclosure that it is a “second trailer” teaches that the fracturing pump trailer is “physically external relative to the first mobile unit [first trailer 10]”.

¹³⁶ Ex. 1004 (*Reckels*) [0018]

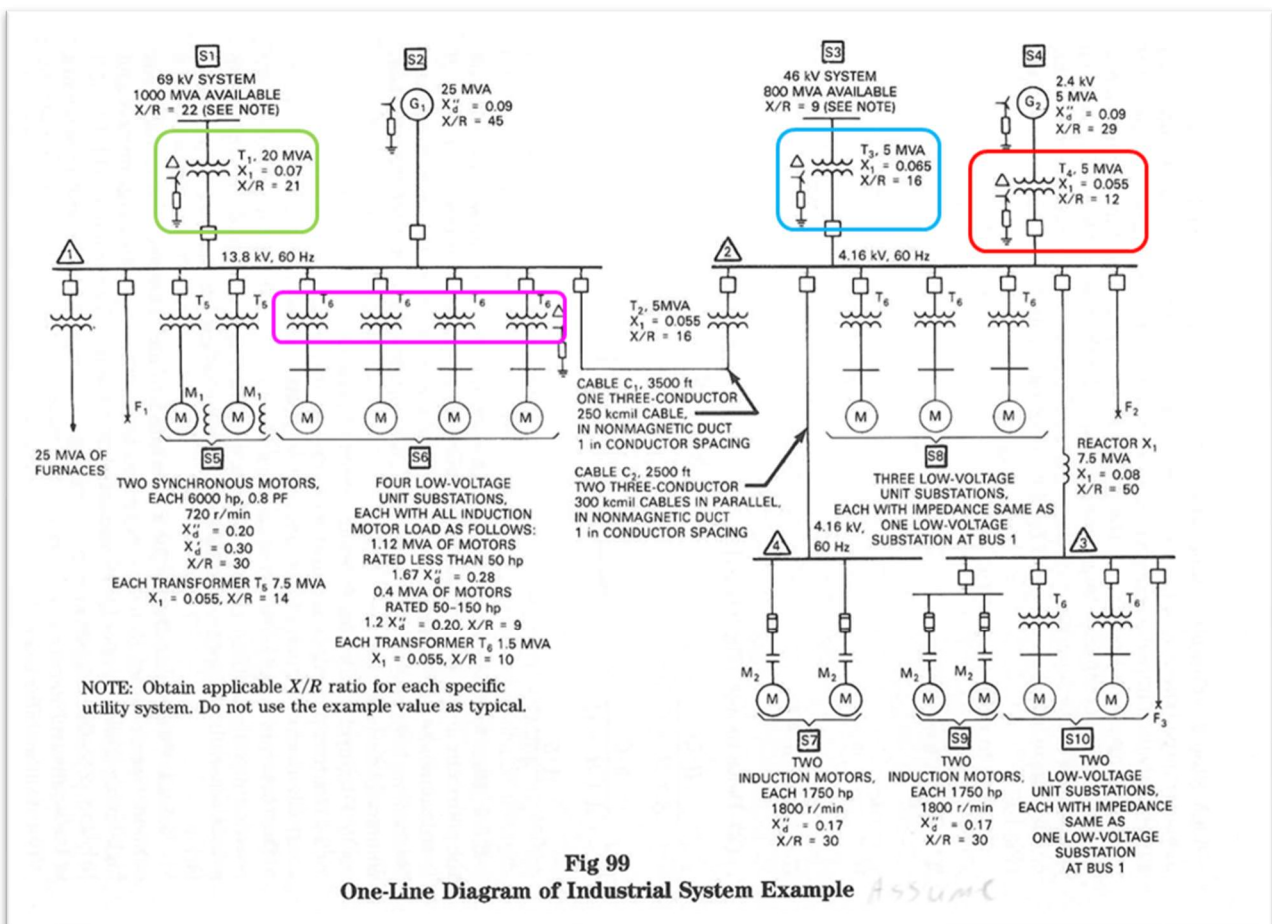
171. Further, as discussed above regarding Claim 1, the distribution system resulting from the combined teachings of *Reckels* and *IEEE Red Book* contains at least one transformer provided to condition the power supplied to the at least one fracturing pump mobile unit. *Reckels* teaches that “[t]he generator 20 is then connected to an electric room 22, which may include transformers, switchgear, variable frequency drives, and other electrical components needed to drive high power electric motors. The second trailer 14, which is shown on the right side of figure 2, includes a cooling unit 24, a fixed speed electric motor 26, a hydraulic pump 28 connected to the electric motor, and a high pressure pump connected to the hydraulic pump 30. As such, the second trailer 14 receives electrical power from the power generation trailer 10. The electrical power is provided to the fixed speed electric motor 26, which rotates the hydraulic pump 28.”¹³⁷ A POSITA would have understood, from this disclosure, that the transformer is “needed to drive high power electric motors” and that a transformer’s function is to “condition the power”, such as by stepping up or stepping down the voltage to the load.¹³⁸

172. Further, *IEEE Red Book* Figure 99 shows several transformers that are used to condition the power being delivered to loads. For example, transformer T1

¹³⁷ Ex. 1004 (*Reckels*) [0018].

¹³⁸ See, Section X.F above.

(green box) conditions the power by stepping down the voltage from 69 kV to 13.8 kV. Transformer T3 (blue box) conditions the power by stepping down the voltage from 46 kV to 4.16 kV. Transformer T4 (red box) conditions the power by stepping up the voltage from 2.4 kV to 4.16 kV. Transformers T6 (magenta box) condition the power by stepping it down from 13.8 kV to “low voltage”. Accordingly, *IEEE Red Book* discloses that transformers condition the power.



Ex. 1006 (*IEEE Red Book*) Fig. 99 (annotated)

173. Accordingly, the combined teachings of *Reckels* and *IEEE Red Book* render claim 3 obvious.

E. DEPENDENT CLAIM 4: “4. THE SYSTEM OF CLAIM 1, FURTHER COMPRISING: A PREDETERMINED NUMBER OF FP MOBILE UNITS COMPRISED IN THE ONE OR MORE EXTERNAL MOBILE UNITS, THE PREDETERMINED NUMBER OF FP MOBILE UNITS DETERMINED BY A MAXIMUM OF THE POWER AVAILABLE FROM THE AT LEAST ONE FIRST GENERATOR AND HANDLED BY THE AT LEAST ONE SWITCH GEAR.”

174. Claim 4 depends from Claim 1. The combination of *Reckels* and *IEEE Red Book* render Claim 1 obvious as discussed above in Section XII.B, and incorporated herein by reference. Further, the combination of *Reckels* and *IEEE Red Book* discloses the additional limitations of Claim 4.

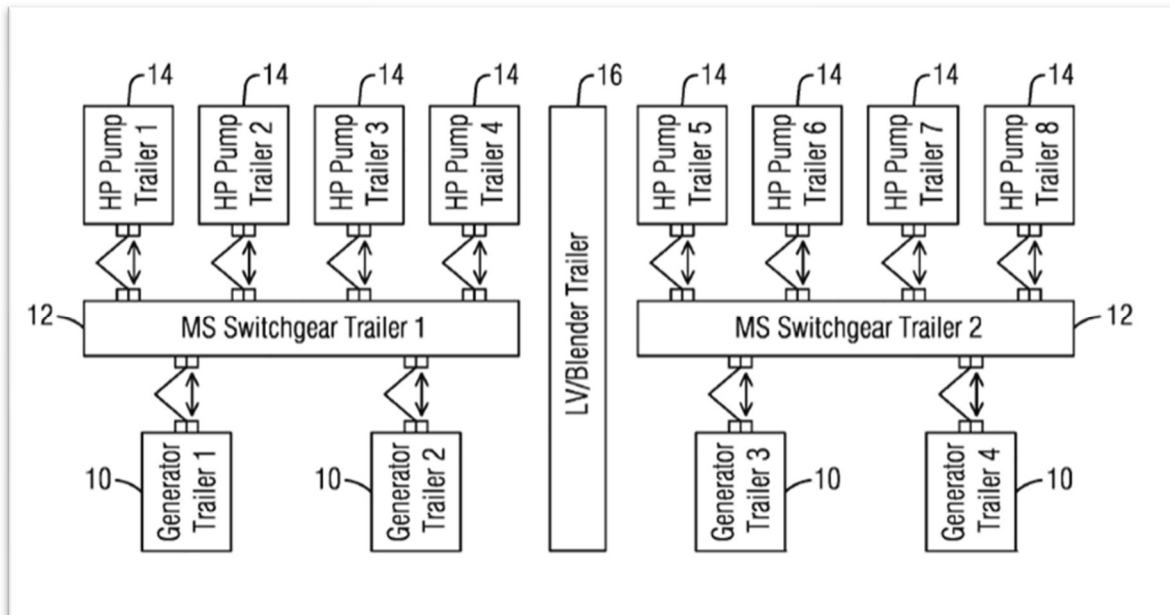
175. *Reckels* teaches that there are a predetermined number of FP mobile units comprised in the one or more external mobile units, the predetermined number of FP mobile units determined by a maximum of the power available from the at least one first generator and handled by the at least one switch gear. Initially, *Reckels* discloses that second trailer 14 comprises the fracturing pump (FP) mobile units and that second trailer 14 are “external” mobile units, as discussed above regarding Claim 3 and incorporated herein by reference.

176. Further, *Reckels* discloses, while referring to Fig. 1, “in the present exemplary embodiment, each generator is configured to supply electrical power to

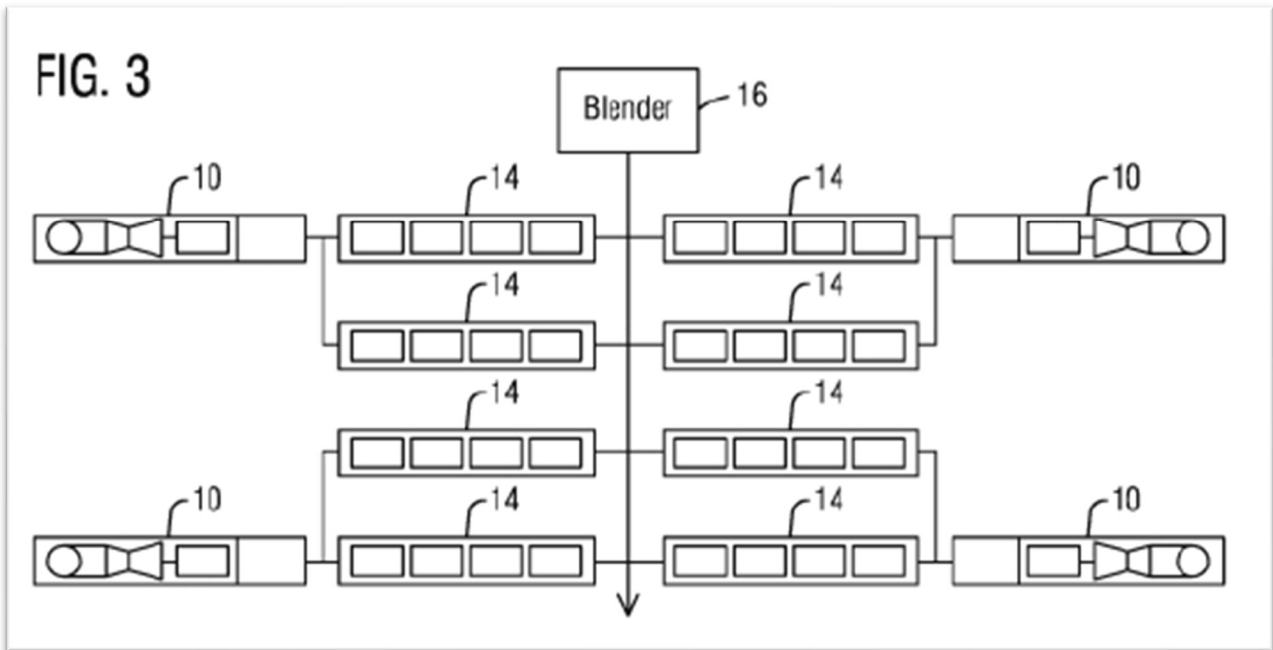
two of the high pressure electric pump trailers 14. Generally, the gas turbines and the pumps can also be connected to a common bus bar, so that the gas turbines can run at different loads, e.g., one at 100% and the other at 50%. The high pressure pump trailers 14 are connected to high pressure fluid lines that feed into the wellbore (not shown).”¹³⁹ *Reckels* further discloses “The embodiment illustrated in figure 1 includes a set or quadrant of equipment on the left side of the figure, where in the quadrant of equipment includes two generators 10, a switchgear trailer 12, and four pumps 14. A second quadrant of equipment is shown on the right-hand side of the figure and is essentially a mirror image of the first quadrant of equipment. In other embodiments, two additional quadrants of equipment could be added opposing the two quadrants shown in figure 1, i.e., extending upward from the high pressure lines there could be two additional quadrants of generators 10, switchgear 12, and pumps 14. In these four-quadrant systems, higher flow volumes and pressures may be obtained for the hydraulic fracturing operation.”¹⁴⁰

¹³⁹ Ex. 1004 (Reckels) [0015].

¹⁴⁰ Ex. 1004 (Reckels) [0016].

Ex. 1004 (*Reckels*) Fig. 1

177. In this embodiment, the generators are sized so that each generator powers two fracturing pump trailers 14, and the “predetermined” number of fracturing pump trailers 14 (FP Mobile Units) is determined by the number of generators available. The sum of the ratings of the generators is the “maximum of the power available” from the generators and determines the number of fracturing pump trailers 14 that can be operated in a two pump to one generator formula as shown in Figure 1. A similar two pump to one generator formula is depicted in Figure 3 of *Reckels*, which again shows two second trailers 14 for every power generation trailer 10:



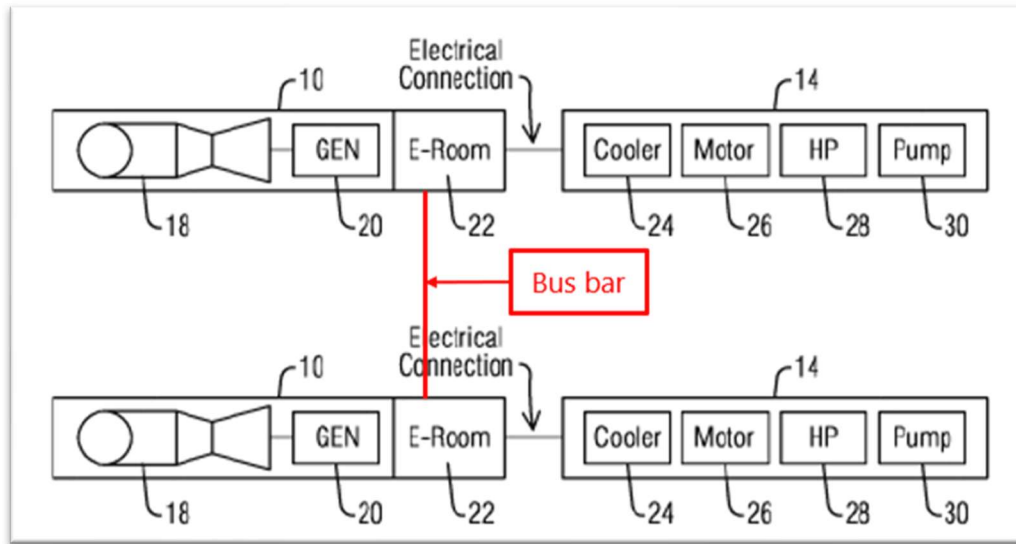
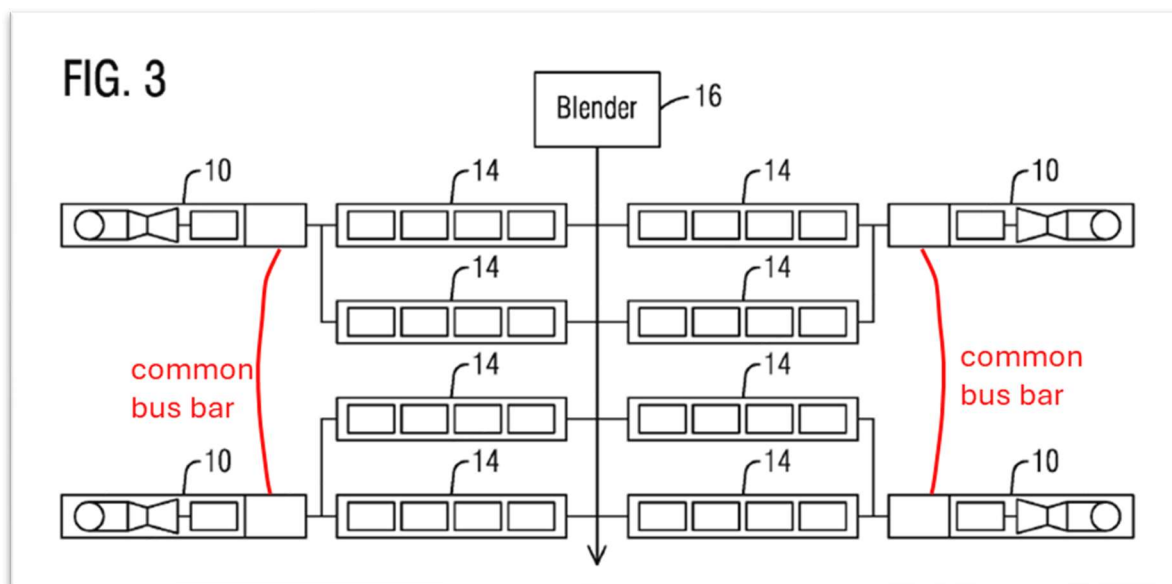
Ex. 1004 (Reckels), Fig. 3.

178. Accordingly, a POSITA would have understood that each power generation trailer 10 can support the maximum loads of up to two second trailers 14 at any given time, such that there is a “*predetermined*” number of second trailers 14 (*i.e.*, “*FP mobile units*”) that can be incorporated into *Reckels*’ system at a given time. As discussed above with reference to Limitation 1[e], it is common practice and a requirement of all properly designed electrical power systems that the power requirements of a system’s load must be supported by the system’s power sources (*e.g.*, generators) and distribution system components (*e.g.*, switchgears).¹⁴¹ In

¹⁴¹ See section XII.B.6 above.

Reckels' system, where the load elements (e.g., cooling units, motors, and pumps) are located on the second trailers 14 (*i.e.*, the “*FP mobile units*”), a POSITA would have known that the number of second trailers 14 coupled to one or more power generation trailers 10 cannot result in a load power requirement that exceeds the maximum amount of power that can be generated by associated generators and handled by associated switchgears, or else the system would become overloaded and fail. Accordingly, the number of second trailers 14 available to *Reckels'* power distribution system is “*predetermined*” to be equal to or less than the number of second trailers that can be supported by the maximum amount of power that can be generated by available generators and handled by associated switchgear.

179. For example, in the system that results from the combination of *Reckels* and *IEEE Red Book*, the generators are sized to power a single fracturing pump trailer 14 in the modified Figure 2 configuration (as annotated below), and the generators are sized to power two fracturing pump trailers 14 in the modified Figure 3 configuration (as annotated below).

Ex. 1004 (*Reckels*) Figure 2 annotated.Ex. 1004 (*Reckels*), Figure 3 annotated.

180. The sum of the ratings of generators 20 is the “maximum of the power available” from the generators and determines the number of fracturing pump trailers 14 that can be operated in a one pump to one generator configuration (e.g., as shown

in the modified Figure 2 configuration) and in a two pump to one generator configuration (e.g., as shown in the modified Figure 3 configuration). Accordingly, a POSITA would have understood in the modified Figure 3 configuration, where a common bus bar couples two power generation trailers 10 and four second trailers 14, each power generation trailer 10 can support the maximum loads of up to two second trailers 14 at any given time (and up to four second trailers 14 can be supported by the summed power of the two generators of the connected power generation trailers 10), such that there is a “*predetermined*” number of second trailers 14 (*i.e.*, “*FP mobile units*”) that can be incorporated into *Reckels*’ system at a given time.

181. As *Reckels* teaches this configuration in a patent which would have been referenced by a POSITA prior to actually building or operating a fracturing pump system disclosed by the combination of *Reckels* and *IEEE Red Book*, the number of pumps is predetermined. Further, a POSITA would have found it obvious to “predetermine” the number of pumps based on the pumping needs of the fracturing system and the size of the generating capability at the location.

182. Accordingly, the combination of *Reckels* and *IEEE Red Book* renders Claim 5 obvious.

F. DEPENDENT CLAIM 6: “6. THE SYSTEM OF CLAIM 1, FURTHER COMPRISING: THE AT LEAST ONE SWITCHGEAR BEING PHYSICALLY ARRANGED TO REPLACE AN ELECTRONIC EQUIPMENT ROOM (EER) OF AT LEAST ONE OF THE ONE OR MORE EXTERNAL MOBILE UNITS THAT IS DESIGNED TO COMPRISE THE EER.”

183. Claim 6 depends from Claim 1. The combination of *Reckels* and *IEEE Red Book* render Claim 1 obvious as discussed above in Section XII.B, and incorporated herein by reference. Further, the combination of *Reckels* and *IEEE Red Book* disclose the additional limitations of Claim 6.

184. In describing the embodiment shown in Fig. 3, *Reckels* discloses “In the hydraulic fracturing system illustrated in figure 3, the switchgear equipment is either eliminated or incorporated into the electric room 22 that is mounted integrally with the gas turbine generator equipment.”¹⁴²

185. As discussed above with reference to Claim 1, *Reckels*’ power generation trailer 10 includes an “electric room 22, which may include transformers, switchgear, variable frequency drives, and other electrical components needed to drive high power electric motors.”¹⁴³ A POSITA would have understood *Reckels*’ electric room 22 disclose an “*electric equipment room (EER)*” as claimed, because the “*equipment*” in the electric room 22 are “*electrical components*.” This is

¹⁴² Ex. 1004 (*Reckels*) [0020].

¹⁴³ See section XII.B.3 above; Ex. 1004 (*Reckels*) [0018].

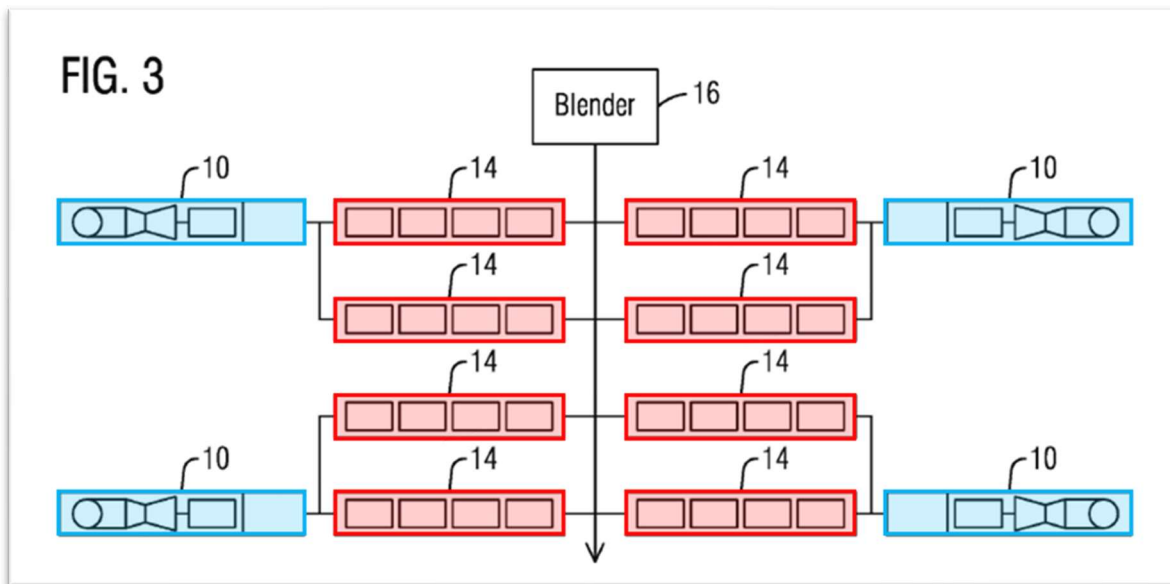
consistent with the '801 Patent, which discloses an EER that includes the same electrical equipment.¹⁴⁴

186. And discussed above with reference to Claim 1, *Reckels* discloses different embodiments for pairing a power generation with one or more second trailers 14 (on which the system's load—cooling units, motors, and pumps—are located), including the Figure 2 embodiment where one power generation trailer 10 is paired with one second trailer 14 and the Figure 3 embodiment where one power generation trailer 10 is paired with two second trailers 14.¹⁴⁵ *Reckels* further discloses “[i]n the hydraulic fracturing system illustrated in figure 3 the switchgear equipment is either eliminated or *incorporated into the electric room 22 that is mounted integrally with the gas turbine generator equipment*. In this configuration, a quadrant of equipment for a wellsite fracturing operation would require a total of 6 semitrailers to support for hydraulic fracturing pumps. These six semi-trailers include four trailers 14 [highlighted and red] having hydraulic pumps mounted there on that are electrically connected to two semi-trailers 10 [highlighted in blue] having

¹⁴⁴ See, e.g., Ex. 1001 ('801 Patent), 8:23-29 (identifying “switch gear” and “transformers” as components included in an EER).

¹⁴⁵ See Section XII.B.2 above.

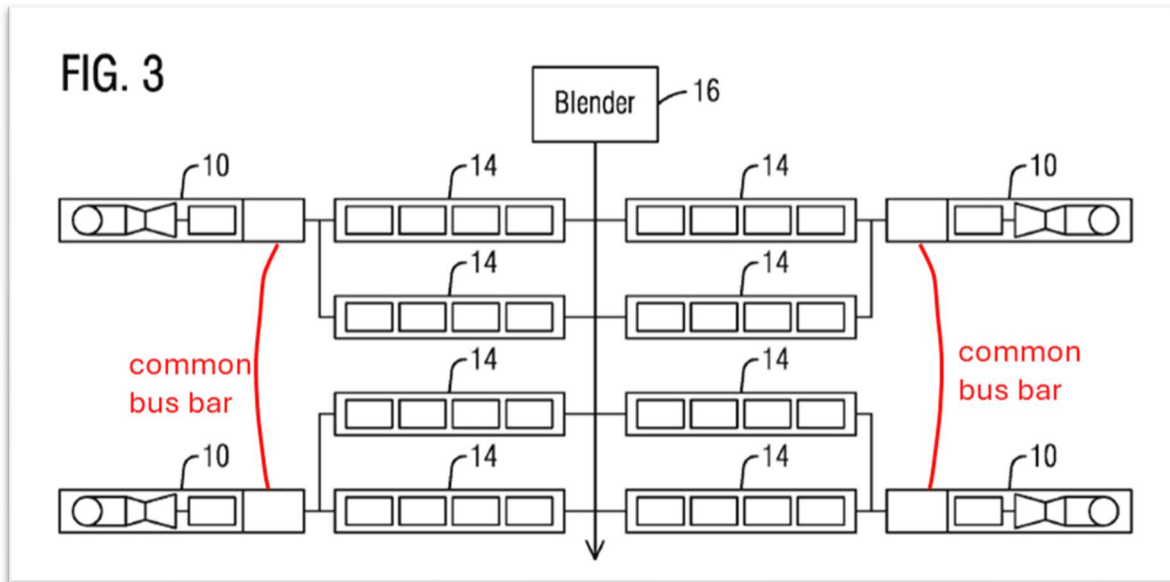
gas turbine generators thereon for a total of six trailers to supply a four pump quadrant of equipment.”¹⁴⁶



Ex. 1004 (Reckels) Fig. 3 (annotated)

187. Incorporating the teachings of *Reckels* and *IEEE Red Book* discussed above regarding Claim 1, the system of Fig. 3 would have, at least, a common busbar as shown in the annotated figure 3 below.

¹⁴⁶ Ex. 1004 (*Reckels*) [0020] emphasis added.

Ex. 1004 (*Reckels*) Fig. 3 (annotated)

188. A POSITA would have understood that each generator trailer 10 would have one electric room 22 (EER), at least similar to those described in Fig. 2, and discussed above regarding Claim 1. Using the physical arrangement disclosed in Figure 3, there would be two EERs for each four fracturing pump trailers. A POSITA would have understood that in order to power the load of two second trailers 14 (e.g., as done in the Figure 1 and Figure 3 configurations) using the Figure 2 embodiment, two power generation trailers 10 would be required, because the Figure 2 embodiment teaches a one-to-one relationship for power generation trailers 10 and second trailers 14.¹⁴⁷ Accordingly, a POSITA would have recognized that powering

¹⁴⁷ See Ex. 1004 (*Reckels*) [0018].

the loads of two second trailers 14 using the Figure 3 embodiment, where one power generation trailer 10 is used to power the loads of two second trailers 14, eliminates the need of one power generation trailer 10 (and its associated electric room 22) when compared to using the Figure 2 embodiment.

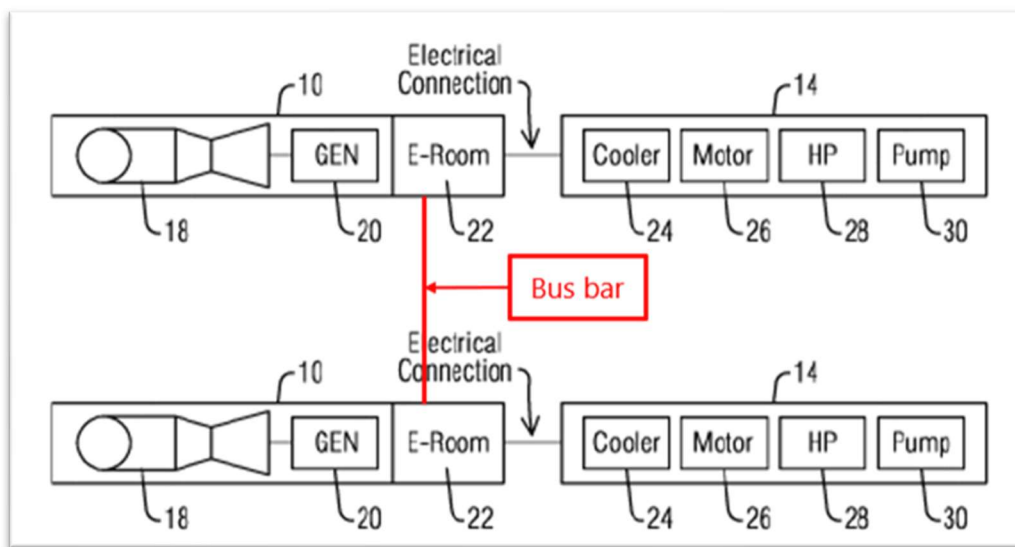
189. Accordingly, the Figure 3 embodiment of *Reckels* teaches a switchgear that is arranged to replace an electric room 22 (*i.e.*, “*electronic equipment room (EER)*”) of an external mobile unit (*i.e.*, a different power generation trailer 10) when compared to the Figure 2 embodiment of *Reckels*.

G. DEPENDENT CLAIM 8: “8. THE SYSTEM OF CLAIM 1, FURTHER COMPRISING: THE INTERCONNECT CONFIGURED TO COUPLE THE FIRST MOBILE UNIT WITH THE SECOND MOBILE UNIT, THE SECOND MOBILE UNIT HAVING AT LEAST ONE SECOND SWITCH GEAR IN ADDITION TO THE SECOND GENERATOR, THE INTERCONNECT TO TRANSMIT POWER IN SUPPORT OF REDUNDANCY IN ADDITION TO THE LOAD SHARING ARRANGEMENT BETWEEN THE FIRST MOBILE UNIT AND THE SECOND MOBILE UNIT.”

190. Claim 8 depends from Claim 1. The combination of *Reckels* and *IEEE Red Book* render Claim 1 obvious as discussed above in Section XII.B, and incorporated herein by reference. Further, the combination of *Reckels* and *IEEE Red Book* renders obvious the additional limitations of Claim 8.

191. In the physical arrangement disclosed by either Figure 2 or Figure 3, and modified with at least an interconnect (e.g., common bus bar) between the generator trailers, according to the teachings of *Reckels* and *IEEE Red Book*, the

second generator trailer 10 comprises both an additional switchgear and a second generator. *Reckels* discloses, with regard to the embodiment shown in Fig. 2 “The generator 20 is then connected to an electric room 22, which may include transformers, switchgear, variable frequency drives, and other electrical components needed to drive high power electric motors.”¹⁴⁸

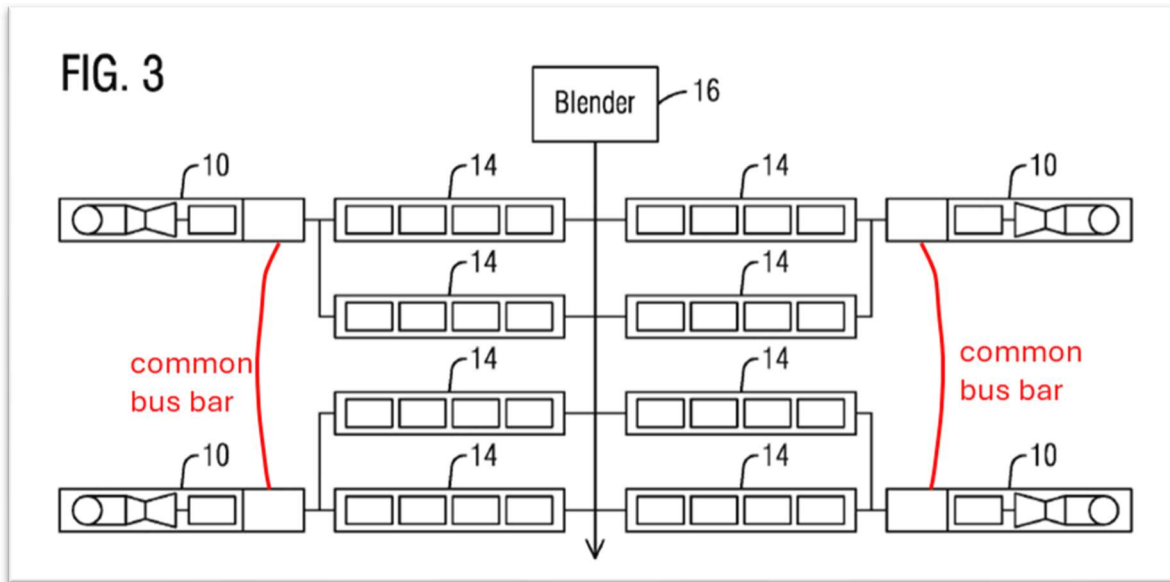


Ex. 1004 (*Reckels*) Figure 2 annotated.

Additionally, in describing the embodiment shown in Fig. 3, *Reckels* discloses “In the hydraulic fracturing system illustrated in figure 3, the switchgear equipment is either eliminated or incorporated into the electric room 22 that is mounted integrally with the gas turbine generator equipment.”¹⁴⁹

¹⁴⁸ Ex. 1004 (*Reckels*) [0018].

¹⁴⁹ Ex. 1004 (*Reckels*) [0020].

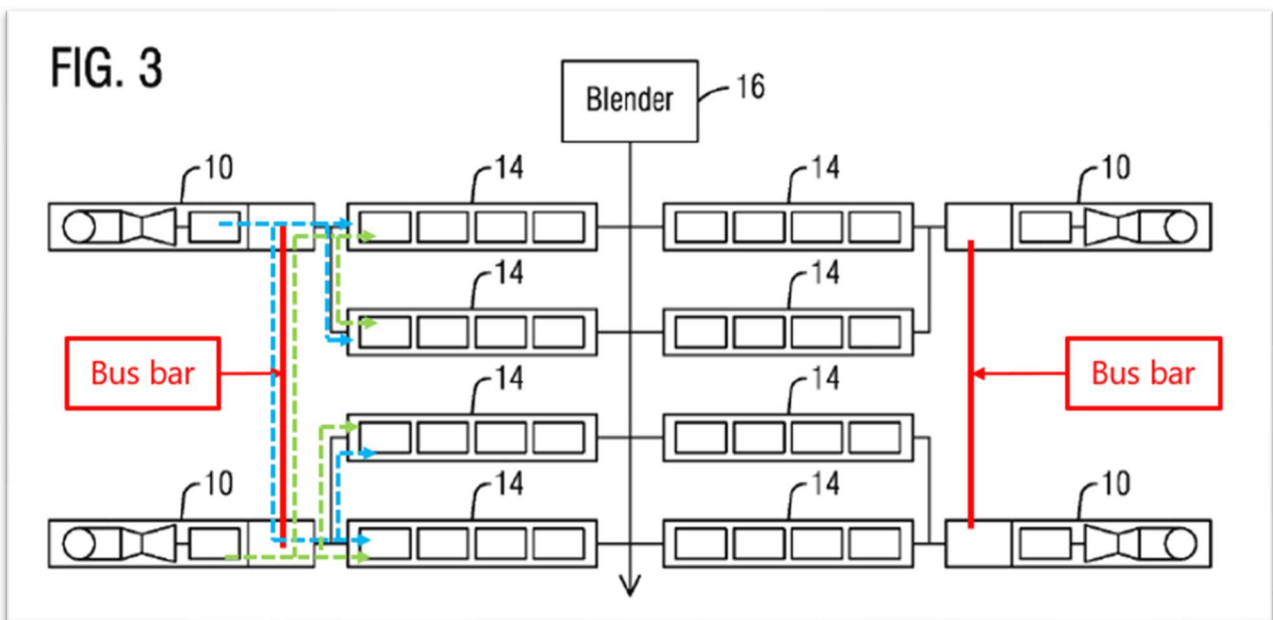


Ex. 1004 (Reckels) Fig. 3 (annotated)

192. In either case the interconnect (busbar) would support redundancy. The '801 patent describes redundancy as providing excess power from a turbine generator being redistributed to other equipment.¹⁵⁰ The modified system that incorporates the teachings of *Reckels* and *IEEE Red Book* has the same capability. In the case of excess power generated from either of the interconnected generators, the power can be redistributed to other pumps connected to the other generator. For example, should one of the pumps connected to the top generator (in either the modified Fig. 2 or Fig. 3) be offline, the excess power can be redistributed across the busbar (interconnect) to pump(s) connected to the bottom generator, particularly

¹⁵⁰ See Ex. 1001 ('801 Patent) 4:21-33.

in the case of the bottom generator being offline. The opposite is also true (pumps connected to the bottom generator offline, excess power from bottom generator being redirected to pump(s) connected to the top generator. Thus, redundant power supplies to the pumps are enabled (supported) by the interconnect (common busbar). An annotated copy of Figure 3, provided below, shows how power would flow from the generators 20 of coupled power generation trailers 10 to the second trailers 14:



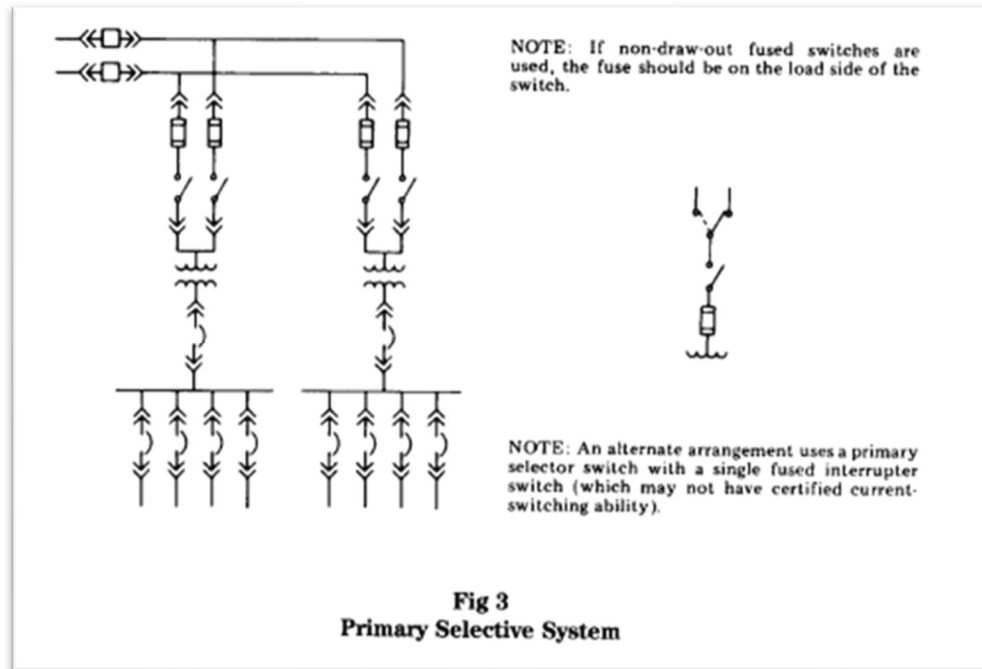
Ex. 1004 (Reckels), Fig. 3 (annotated).

193. *IEEE Red Book* directly discloses designing the power system for redundancy. For example, *IEEE Red Book* teaches that “[a] need for circuit redundancy may exist in continuous-process industries to allow equipment maintenance. Although the reliability of electric power distribution equipment is

high, optimum reliability and safety of operation require routine maintenance. A system that cannot be maintained because of the needs of a continuous process is improperly designed. Far more can be accomplished by the proper selection of the circuit arrangement than by economizing on equipment details.”¹⁵¹ *IEEE Red Book* discloses several different arrangements of equipment that provide “protection against loss of a primary supply” (i.e., redundancy). One such system is a Primary Selective System. *IEEE Red Book* discloses “Protection against loss of a primary supply can be gained through use of a primary selective system. Each unit substation is connected to two separate primary feeders through switching equipment to provide a normal and an alternate source. Upon failure of the normal source, the distribution transformer is switched to the alternate source. Switching can be either manual or automatic, but there will be an interruption until load is transferred to the alternate source. If the two sources can be paralleled during switching, some maintenance of primary cable and, in certain configurations, switching equipment may be performed with little or no interruption of service.”¹⁵² A simple one-line of a primary selective system is shown in Fig. 3, duplicated below.

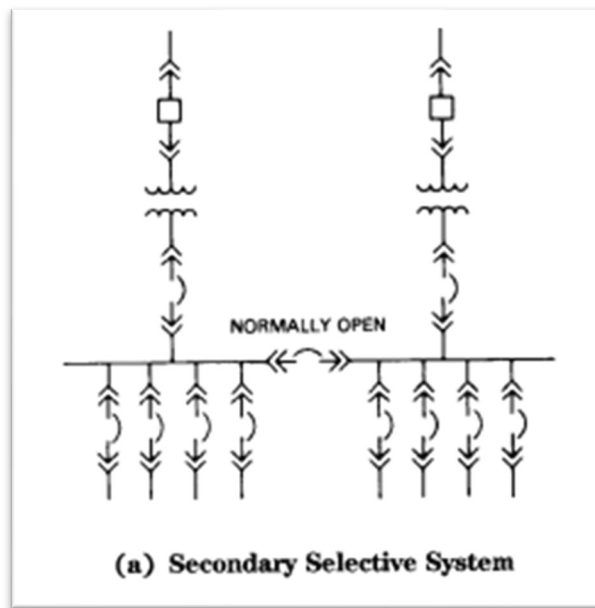
¹⁵¹ Ex. 1005 (*IEEE Red Book*) pg. 45.

¹⁵² Ex. 1005 (*IEEE Red Book*) pg. 46.

Ex. 1006 (*IEEE Red Book*) Fig. 3

194. *IEEE Red Book* also teaches a Secondary Selective System, which is, generally, the type system disclosed in Figure 99 of *IEEE Red Book*. A secondary selective system is described as "If pairs of unit substations [i.e., switchgear] are connected through a normally open secondary tie circuit breaker, the result is a secondary selective system. If the primary feeder or a transformer fails, the main secondary circuit breaker on the affected transformer is opened and the tie circuit breaker closed. Operation may be manual or automatic. Normally the stations operate as radial systems. Maintenance of primary feeders, transformer, and main secondary circuit breakers is possible with only momentary power interruption or no interruption if the stations may be operated in parallel during switching, although

complete station maintenance will require a shutdown. With the loss of one primary circuit or transformer, the total substation load may be supplied by one transformer.”¹⁵³ This system is shown in *IEEE Red Book*’s Fig. 5(a).

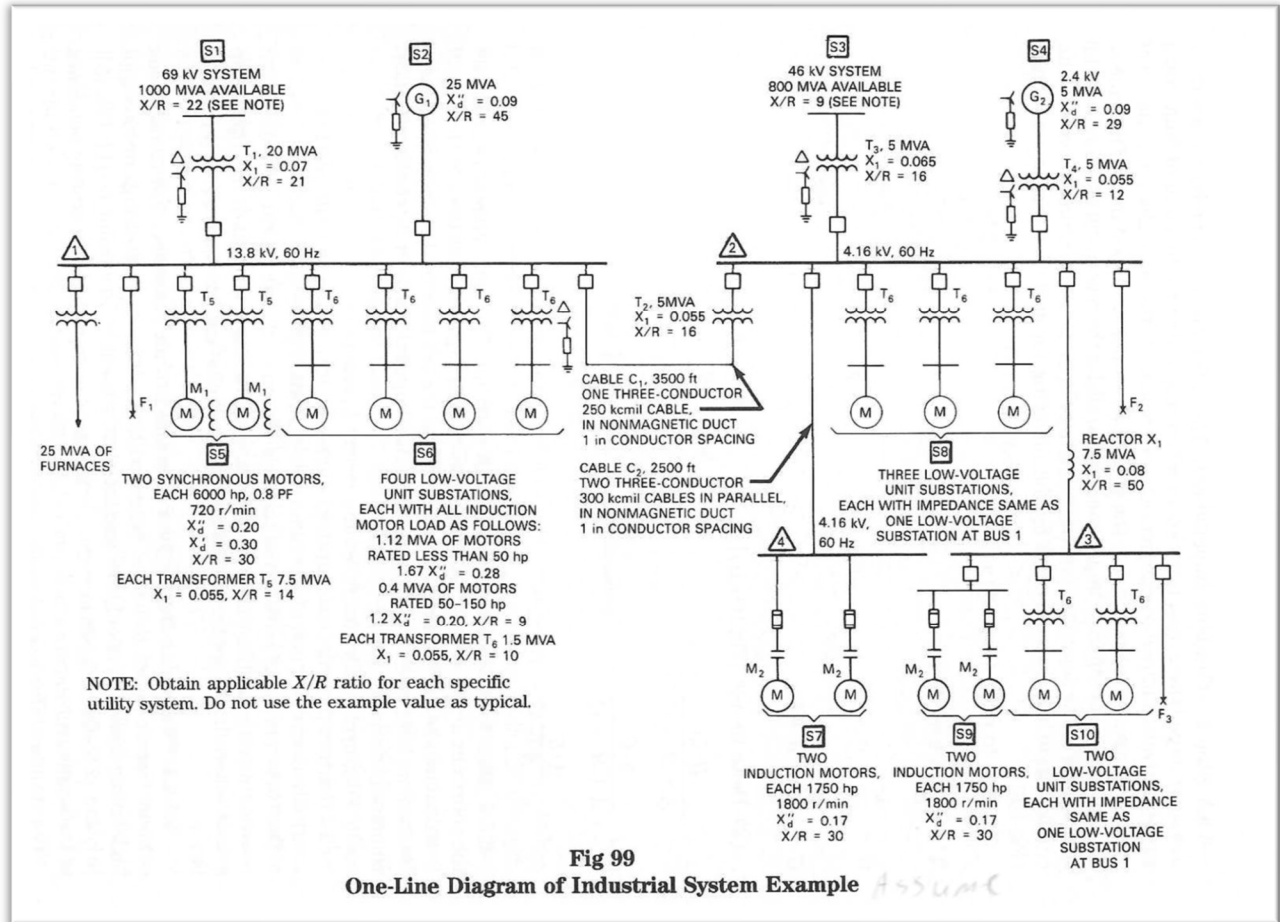


Ex. 1006 (*IEEE Red Book*) Fig. 5(a)

195. *IEEE Red Book* further discloses that “A distributed secondary selective system has pairs of unit substations [i.e., switchgear] in different locations connected by a tie cable and a normally open circuit breaker in each substation [switchgear].”¹⁵⁴ This system is shown in *IEEE Red Book*’s Fig. 99.

¹⁵³ Ex. 1006 (*IEEE Red Book*) pg. 48.

¹⁵⁴ Ex. 1006 (*IEEE Red Book*) pg. 48.

Ex. 1006 (*IEEE Red Book*) Fig. 99

196. Accordingly, the combination of *Reckels* and *IEEE Red Book* renders Claim 8 obvious.

H. DEPENDENT CLAIM 9

197. Claim 9 depends from Claim 1. The combination of *Reckels* and *IEEE Red Book* render Claim 1 obvious as discussed above in Section XII.B, and incorporated herein by reference. Further, the combination of *Reckels* and *IEEE Red Book* discloses the additional limitations of Claim 9. The two limitations of Claim 9

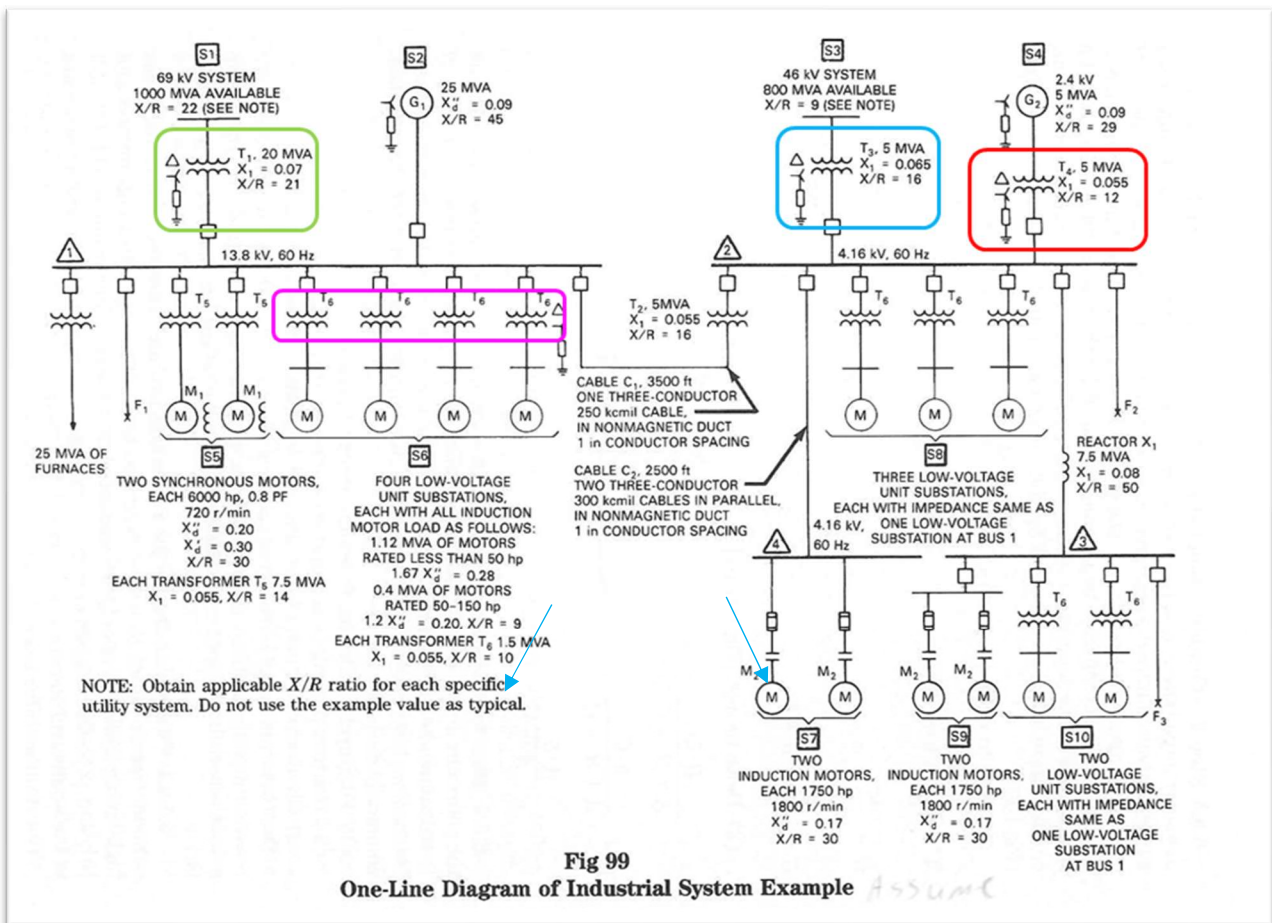
are joined by an “or” which means that if the prior art discloses either limitation, then the entire claim is obvious.

1. 9[a]: “9. The system of claim 1, further comprising: the at least one switch gear configured in the load sharing arrangement by being in part on an incoming side of the at least one transformer such that the sizing is based at least in part on current available for the voltage output of a secondary side of the at least one transformer that is coupled to the at least one first generator and the second generator; or”

198. In this limitation, the switchgear in the load share arrangement is arranged on the incoming (primary) side of the transformer, and sizing of the switchgear (including buses), interconnect. Busbar is based on the current available at the secondary side of the transformer.

199. As discussed above concerning Claim 1, *Reckels*’ e-room 22 includes switchgear and transformers for providing power from generators 20 to second trailers 14, but *Reckels* does not provide a particular configuration for how to arrange the switchgear and transformer. It would have been obvious to a POSITA that the switchgear could be located either on the incoming side of the transformer or on the outgoing side of the transformer, or both, as both arrangements were well known in the art. For example, the Figure 99 embodiment of *IEEE Red Book* discussed above (which depicts a main-tie-main configuration for coupling two generators with multiple loads (*e.g.*, motors)), shows that switchgear (denoted by the blue arrows)

can be located on the incoming side of transformers (e.g., transformers T6 annotated in magenta) and/or on the outgoing side of transformers (e.g., transformers T1 (annotated in green) T3 (annotated in blue) and T4 (annotated in red)).



Ex. 1005 (*IEEE Red Book*), Fig. 99 (annotated).

200. When the switchgear of the combined *Reckels-IEEE Red Book* system is arranged on the incoming (primary) side of the transformer, a POSITA would have understood that the sizing of the switchgear (and its associated buses), common bus bar, and electrical connections (i.e., “the sizing”) is based on the current available at

the secondary side of the transformer. As discussed above regarding Limitation 1[e], sizing equipment for the available current and voltage is disclosed by *IEEE Red Book*.¹⁵⁵ Although sizing components on the on the *incoming/primary* side of the transformer (e.g., the switchgear) based on current available at the *secondary* side of the transformer is considered “indirect” sizing, a POSITA would have understood that the current available at the primary of the transformer is related to the current available at the secondary side of the transformer based on the turns ratio of the transformer, such that the current on the primary side of the transformer (for which a switchgear, and any other components, on the primary side of the transformer would need to be sized) is based on current on the secondary side of the transformer.¹⁵⁶

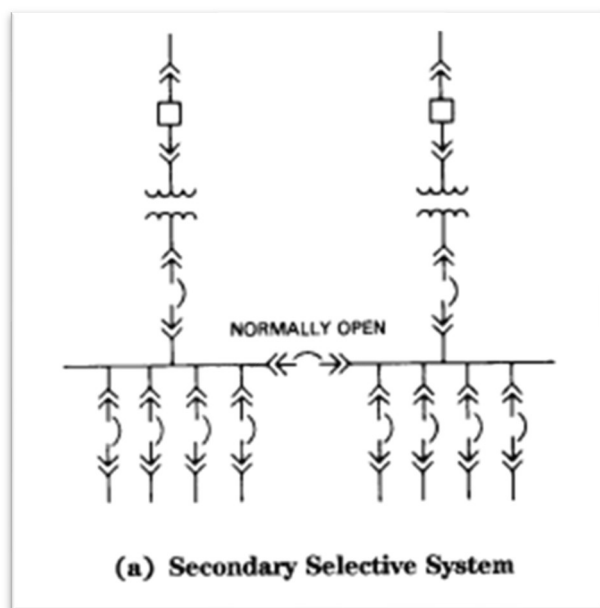
201. Further, a POSITA would have understood that the transformer (i.e., the transformer of e-room 22) is “coupled to the at least one first generator” because the transformer is located on the power generation trailer 10 as the trailer 10’s generator, and that the transformer is “coupled to...the second generator” via the common bus bar and switchgear busses connecting the first power generation trailer 10 with the second power generation trailer 10.

¹⁵⁵ See Section XII.B.6 above.

¹⁵⁶ See Section X.F above.

2. 9[b]: “the at least one switch gear configured in the load sharing arrangement by being in part on an outgoing side of the at least one of the at least one transformer such that the sizing is based at least in part on the current available at the secondary side of the at least one transformer that is coupled to the at least one first generator and the second generator.”

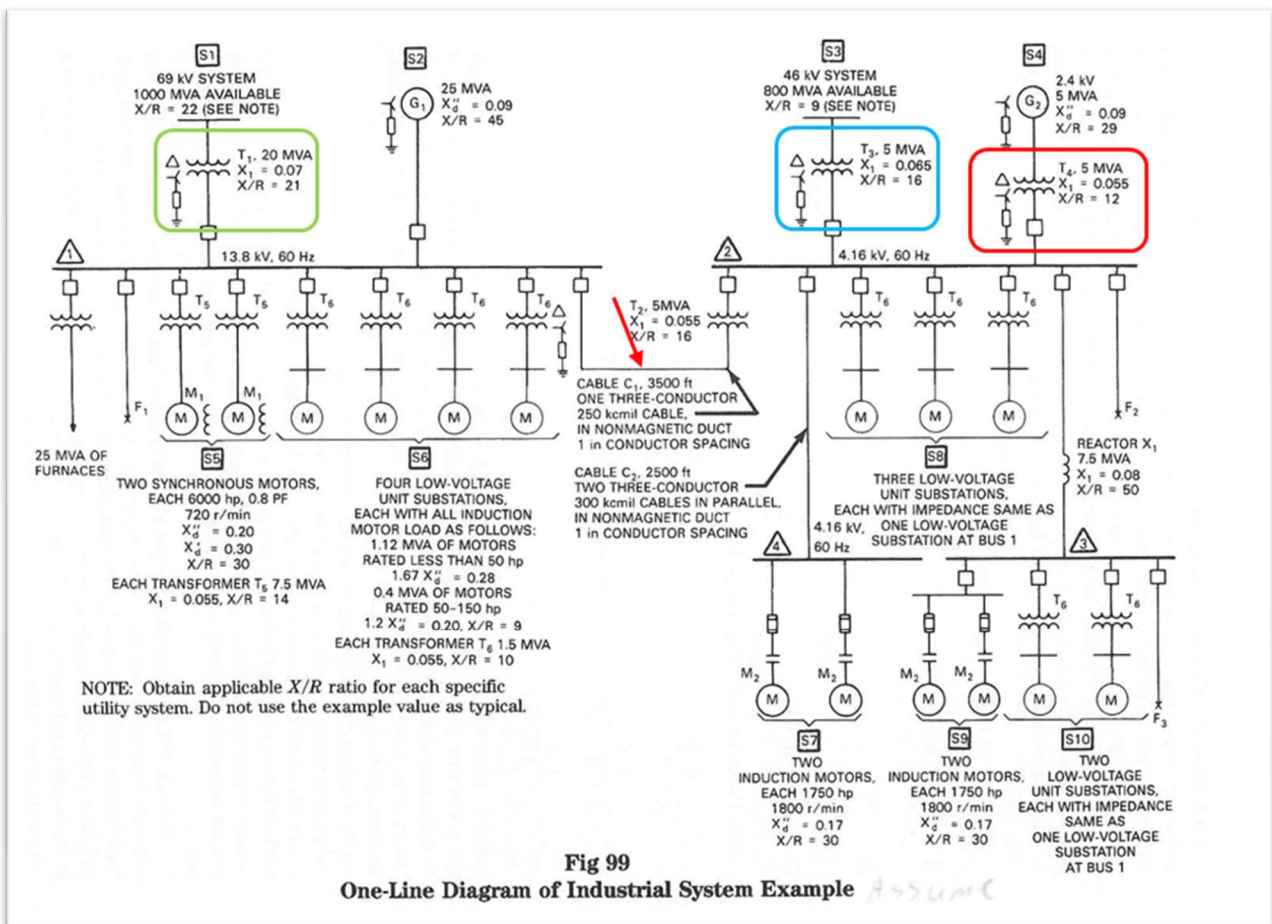
202. *IEEE Red Book* further discloses the interconnection occurring on the outgoing (secondary) side of the at least one transformer in both Fig. 5(a) and Fig. 99. In Fig. 5(a), the “pairs of unit substations [i.e., switchgear] are connected through a normally open secondary tie circuit breaker.”¹⁵⁷



Ex. 1006 (*IEEE Red Book*) Fig. 5(a)

¹⁵⁷ Ex. 1006 (*IEEE Red Book*) pg. 48.

203. Further, *IEEE Red Book* discloses that “A distributed secondary selective system has pairs of unit substations [i.e., switchgear] in different locations connected by a tie cable and a normally open circuit breaker in each substation [switchgear].”¹⁵⁸ This system is also shown in *IEEE Red Book’s* Fig. 99.



Ex. 1006 (*IEEE Red Book*) Fig. 99

¹⁵⁸ Ex. 1006 (*IEEE Red Book*) pg. 48.

In both cases, the interconnection (tie) is shown at the secondary of the transformers. The interconnection is at the secondary of both transformers of Fig. 5(a), and at the secondary of several transformers of Fig. 99 (red arrow), including, for example, Transformer T4 (red box).

204. As discussed above concerning Limitation 9[a], it would have been obvious to a POSITA that a switchgear located in the e-room 22 of the *Reckels-IEEE Red Book* system could be located on the outgoing side of a transformer of the same e-room 22, as was well known in the art. Further, as discussed above regarding limitation 1[e], sizing equipment for the available current and voltage is not only required by the National Electric Code, but the IEEE Red Book also discloses it. For the same reasons as those discussed in Limitation 1[e] and Limitation 9[a], *IEEE Red Book* discloses sizing the switchgear and other components of the distribution system based directly on the available current and voltage at the secondary of the transformer(s) in a secondary selective system and a distributed secondary selective system.

205. Accordingly, the combined teachings of *Reckels* and *IEEE Red Book* render claim 9 obvious.

I. DEPENDENT CLAIM 10

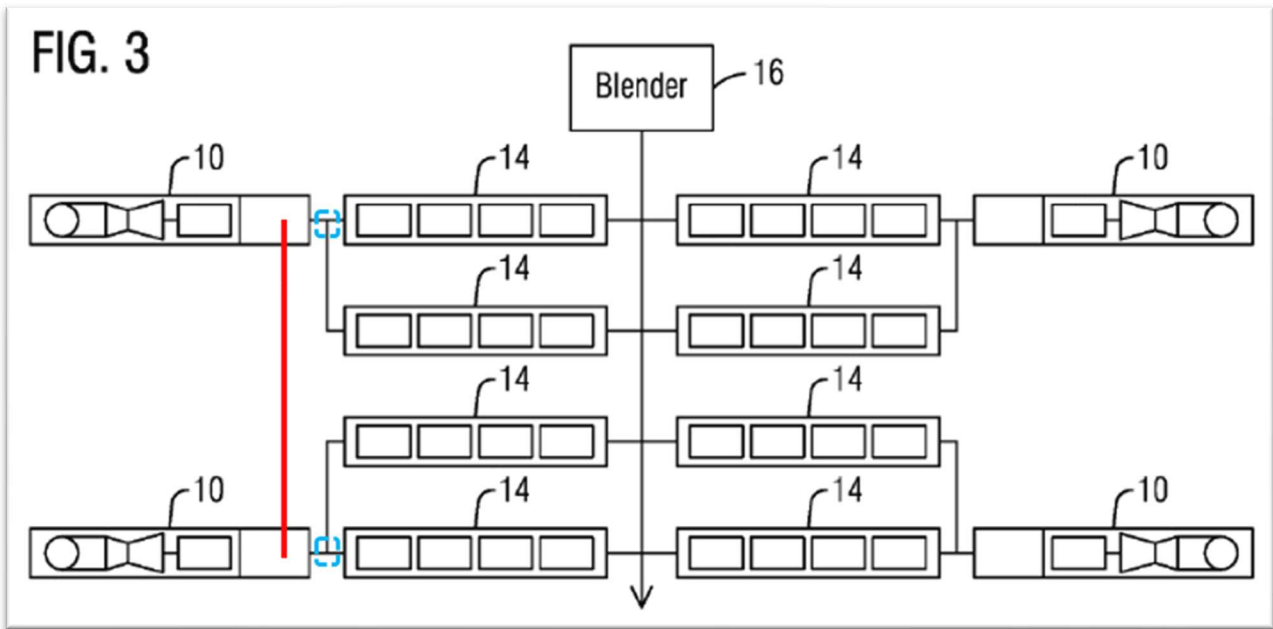
206. Claim 10 depends from Claim 1. The combination of Reckels and IEEE Red Book render Claim 1 obvious as discussed above in Section XIII.B, and incorporated herein by reference. Further, the combination of Reckels and IEEE Red Book discloses the additional limitations of Claim 10.

1. 10[a]: “10. The system of claim 1, further comprising: at least one load sharing FP mobile unit coupled, as at least one of the loads, with a second FP mobile unit of the one or more external mobile units; and”

207. As discussed above with reference to Claim 1, the modified Figure 3 embodiment of *Reckels*' power distribution system depicts power generation trailers 10 providing power to several second trailers 14, where power generation trailers 10 and second trailers 14 are coupled to each other via a common bus bar, such that the generators 20 of the power generation trailers 10 operate in a load sharing arrangement to provide combined power to drive the loads of the second trailers 14 (*i.e.*, the cooling units, motors, and pumps included in the trailers).¹⁵⁹ Because the loads of the second trailers (*i.e.*, “*FP mobile unit*,” see Section XII.E above) are driven by this load-sharing arrangement, a POSITA would have understood the

¹⁵⁹ See Sections XII.B.5-6 above.

second trailers 14 to be “load-sharing *FP mobile units*.” An annotated copy of the modified Figure 3 embodiment is provided below:



Ex. 1004 (*Reckels*), Fig. 3 (annotated).

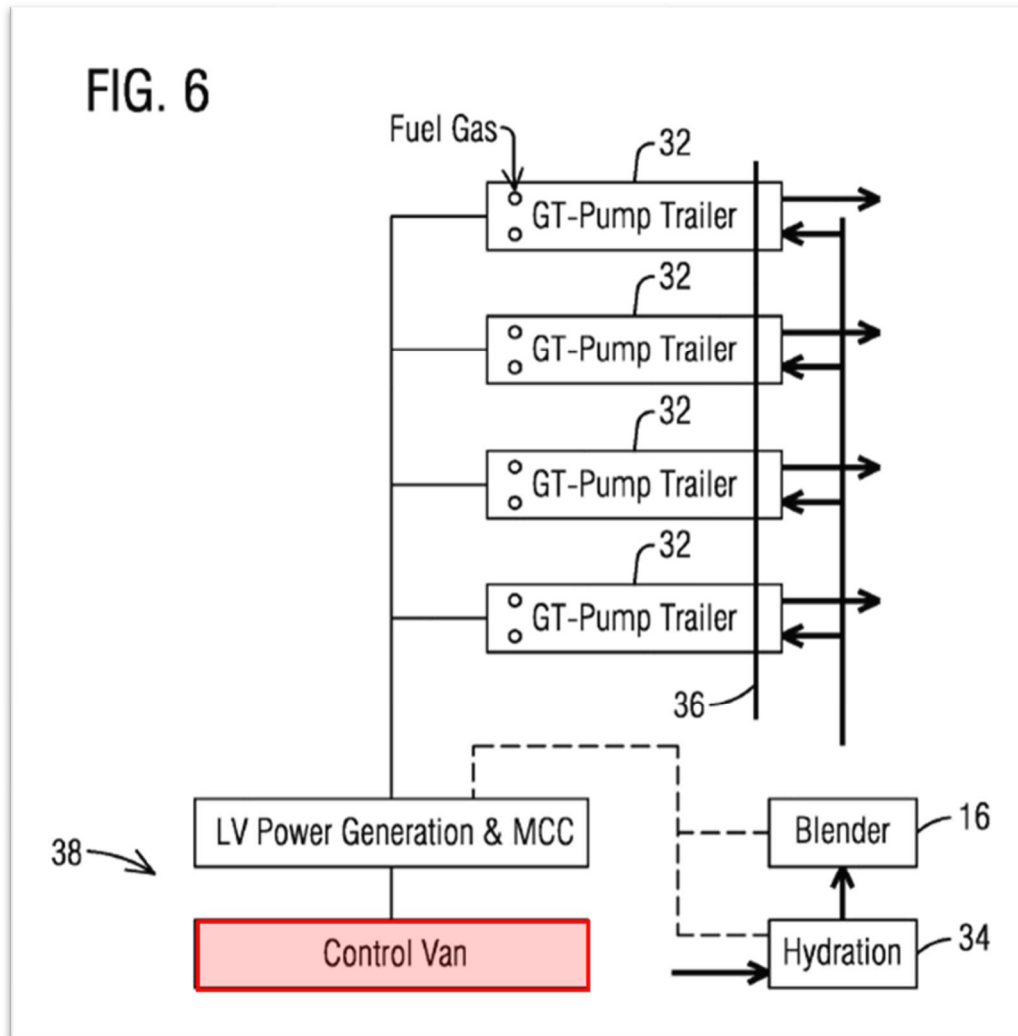
208. As shown, the second trailers 14 are paired such that two second trailers are coupled at a common electrical connection. This coupling is highlighted in blue in the above annotated copy of Figure 3. Accordingly, the combined *Reckels-IEEE Red Book* system discloses “at least one load sharing *FP mobile unit* coupled, as at least one of the loads, with a second *FP mobile unit* of the one or more external *mobile units*.”

209. Accordingly, *Reckels* discloses, and renders obvious in view of *IEEE Red Book*, Limitation 10[a].

2. **10[b]: “a datavan in the one or more external mobile units for control of the at least one load sharing FP mobile unit, the datavan offering the control of the at least one load sharing FP mobile unit instead of a second control available from within the first mobile unit.”**

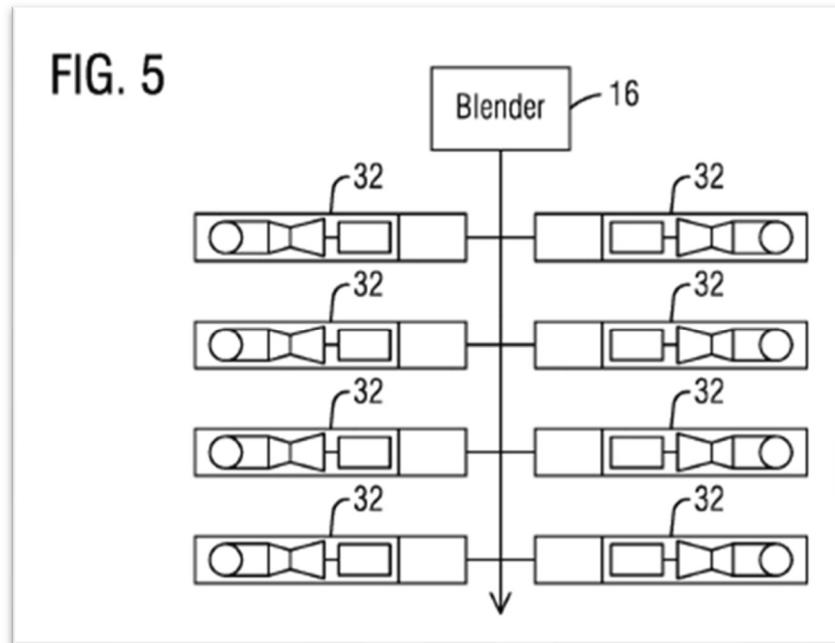
210. *Reckels* discloses several configurations of hydraulic fracturing pump systems, with and without datavans. For example, *Reckels* discloses “each of the hydraulic fracturing pump trailers 32 may be in electrical communication with a control system 38 that is configured to control the operation of each of the hydraulic fracturing pump trailers, along with the various other components of a hydraulic fracturing operation. The control system 38 is generally contained in a separate control van or trailer [highlighted in red] on the wellsite.”¹⁶⁰

¹⁶⁰ Ex. 1004 (*Reckels*) [0024].

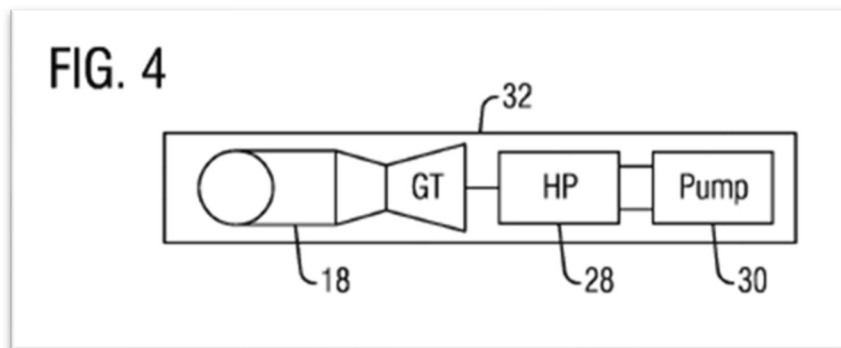


211. Reckels discloses that this is “similar to the configuration illustrated in figure 5, however, additional components used in the system and or the particular quadrant are shown.”¹⁶¹ Fig. 5 does not show a control van (datavan), nor do any of the configurations shown in Fig. 4, Fig. 3, Fig. 2 or Fig. 1.

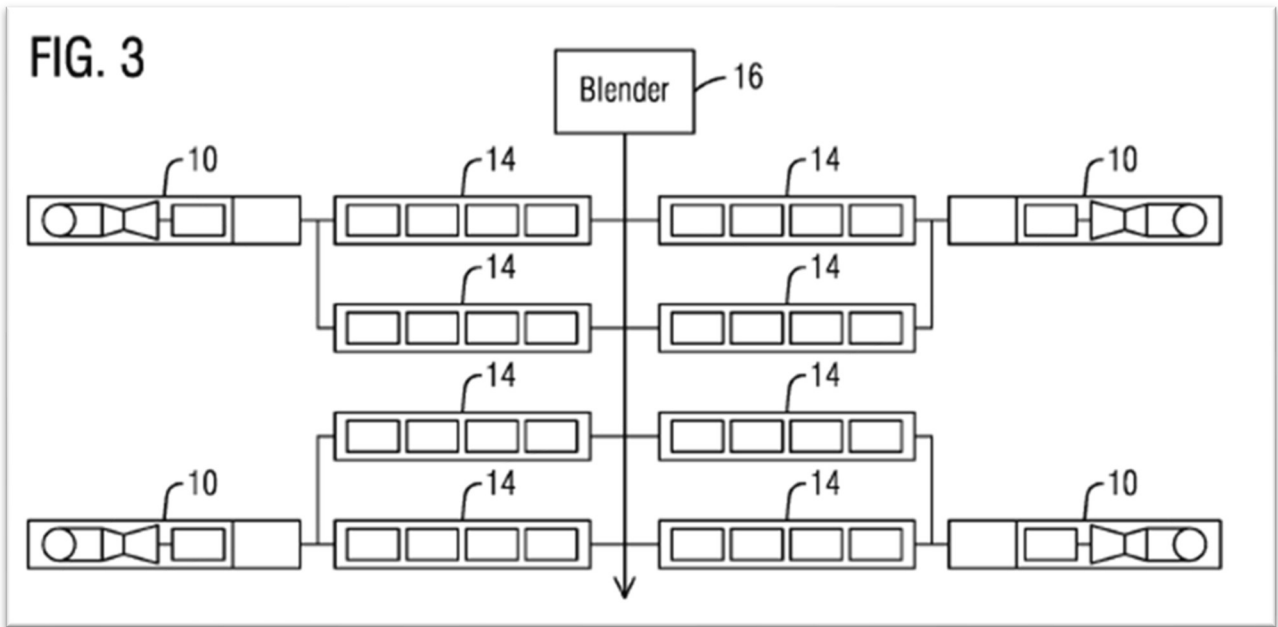
¹⁶¹ Ex. 1004 (*Reckels*) [0024].



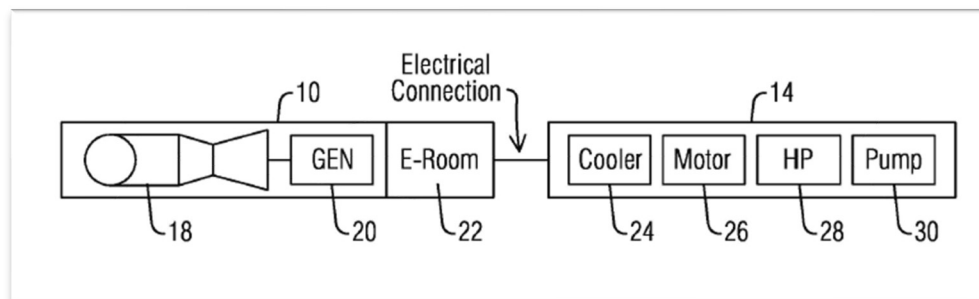
Ex. 1004 (Reckels) Fig. 5.



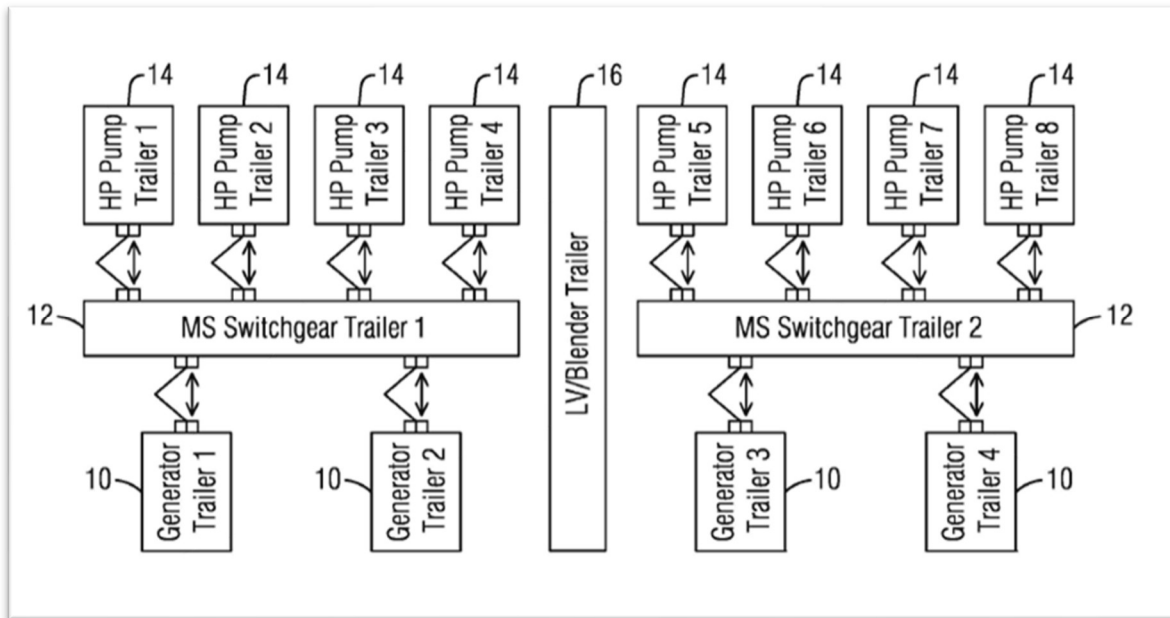
Ex. 1004 (Reckels) Fig. 4.



Ex. 1004 (Reckels) Fig. 3.



Ex. 1004 (Reckels) Fig. 2.



Ex. 1004 (Reckels) Fig. 1.

212. Based on the disclosure that Fig. 6 is “different” by adding a datavan, a POSITA would have understood that the other embodiments that do not show the datavan do not have one. Further, the fracturing pump is controlled somewhere, as it would be necessary to have some control for the system to perform the hydraulic fracturing operations that *Reckels* teaches.¹⁶² *Reckels* discloses “The hydraulic pump 28 generates hydraulic fluid pressure that is used to rotate and control the flowrate of the high pressure fracturing fluid pump 30.”¹⁶³ In an embodiment without a datavan, it would have at least been obvious to a POSITA to place the control “within the first

¹⁶² Ex. 1004 (Reckels) [0001], [0005].

¹⁶³ Ex. 1004 (Reckels) [0018].

mobile unit” which is already electrically connected to the pump trailers. This is particularly true as the VFD, disclosed as part of E-Room 22, was known to control the speed of the pump.¹⁶⁴ It would have at least been obvious to control the VFD, and subsequently the motor and pump, from the VFD, which is within the first mobile unit.

213. Accordingly, in implementations of *Reckels*’ system incorporating *Reckels*’ teaching of a control van (data van), the datavan would have been used for control “instead of” the local control (i.e., second control) which would have been available from within the first mobile unit.

214. Accordingly, the combination of *Reckels* and *IEEE Red Book* renders Claim 10 obvious.

J. INDEPENDENT CLAIM 12

215. It is my opinion that the combination of *Reckels* and *IEEE Red Book* would have rendered Claim 12 obvious. The combined teachings of *Reckels* and *IEEE Red Book* disclose, or at least suggest, each and every limitation of Claim 12, as discussed in the sections below.

¹⁶⁴ See, e.g., Section X.K.

1. **2[p]: “12. A method comprising:”**

216. To the extent the preamble is limiting, *Reckels* discloses a method of hydraulic fracturing, or at least renders a method obvious. *Reckels* discloses a system for hydraulic fracturing, as discussed above regarding 1[p]. It would have been obvious to a POSITA to use the system disclosed by *Reckels* in an actual hydraulic fracturing location. Accordingly, a method to use the hydraulic fracturing system would have been obvious to a POSITA.

2. **12[a]: “providing a first mobile unit with at least one first generator and at least one switchgear located together in the first mobile unit, the at least one first generator coupled to the at least one switch gear on the first mobile unit, the at least one switch gear to be associated with at least one transformer and with an interconnect and a bus bar;”**

217. Except for being written as a method claim “providing” a first mobile trailer, the description of the trailer being provided is contained in limitations 1[a] and 1[b]. For the same reasons as described above in Sections XII.B.2-XII.B.3 regarding limitations 1[a] and 1[b], the combination of *Reckels* and *IEEE Red Book* renders limitation 12[a] obvious.

3. **12[b]: “generating power from the at least one generator;”**

218. It would have been obvious to a POSITA to actually generate power with the generator described by *Reckels*. *Reckels* discloses that “The generator 20 is

then connected to an electric room 22, which may include transformers, switchgear, variable frequency drives, and other electrical components needed to drive high power electric motors. The second trailer 14, which is shown on the right side of Fig. 2, includes a cooling unit 24, a fixed speed electric motor 26, a hydraulic pump 28 connected to the electric motor, and a high pressure pump connected to the hydraulic pump 30. As such, the second trailer 14 receives electrical power from the power generation trailer 10.”¹⁶⁵ In order for second trailer 14 to receive electrical power from the power generation trailer, it would at least have been obvious to generate power from the generator.

219. Accordingly, the combination of *Reckels* and *IEEE Red Book* renders limitation 12[b] obvious.

¹⁶⁵ Ex. 1004 (*Reckels*) [0018].

4. 12[c]: “providing the power using electrical buses of the at least one switchgear and using the at least one transformer the interconnect, and the bus bar, the power for loads in one or more external mobile units, the at least one switchgear, the interconnect, the bus bar, and the electrical buses sized to support voltage and current requirements of the loads and to support voltage and current outputs of the at least one transformer with the at least one first generator in a load sharing arrangement with a second generator of a second mobile unit.”

220. Except for being rewritten as a method claim, the description of the equipment and process in limitation 12[c] is contained in the description of 1[d] and 1[e]. For the same reasons as described above in Sections XII.B.5-XII.B.6 regarding limitations 1[d] and 1[b], the combination of *Reckels* and *IEEE Red Book* renders limitation 12[c] obvious.

K. DEPENDENT CLAIM 13

1. 13[a]: “13. The method of claim 12, further comprising: providing at least one fracturing pump (FP) mobile unit of the one or more external mobile units that is physically external relative to the first mobile unit; and”

221. Except for being rewritten as a method claim, and depending from Claim 12, Limitation 13[a] is substantially similar to that of Claim 3. For the same reasons as described above in Sections XII.D regarding Claim 3, the combination of *Reckels* and *IEEE Red Book* renders Limitation 13[a] obvious

2. 13[b]: “conditioning the power supplied to the at least one FP mobile unit using the at least one transformer.”

222. Except for being rewritten as a method claim, and depending from Claim 12, Limitation 13[b] is substantially similar to that of Claim 3. For the same reasons as described above in Sections XII.D regarding Claim 3, the combination of *Reckels* and *IEEE Red Book* renders Limitation 13[b] obvious.

L. DEPENDENT CLAIM 14: “14. THE METHOD OF CLAIM 12, FURTHER COMPRISING: DETERMINING A NUMBER OF FP MOBILE UNITS FOR THE ONE OR MORE EXTERNAL MOBILE UNITS BASED AT LEAST IN PART ON A MAXIMUM OF THE POWER AVAILABLE FROM THE AT LEAST ONE FIRST GENERATOR AND HANDLED BY THE AT LEAST ONE SWITCH GEAR.

223. Except for being rewritten as a method claim, and depending from Claim 12, Claim 14 is substantially similar to that of Claim 4. For the same reasons as described above in Sections XII.E regarding Claim 4, the combination of *Reckels* and *IEEE Red Book* renders Claim 14 obvious.

M. DEPENDENT CLAIM 16: “16. THE METHOD OF CLAIM 12, FURTHER COMPRISING: PHYSICALLY ARRANGING THE AT LEAST ONE SWITCH GEAR TO REPLACE AN ELECTRONIC EQUIPMENT ROOM (EER) OF AT LEAST ONE OF THE ONE OR MORE EXTERNAL MOBILE UNITS THAT IS DESIGNED TO COMPRISE THE EER.”

224. Except for being rewritten as a method claim, and depending from Claim 12, Claim 16 is substantially similar to that of Claim 6. For the same reasons

as described above in Sections XIII.F regarding Claim 6, the combination of *Reckels* and *IEEE Red Book* renders Claim 16 obvious.

N. DEPENDENT CLAIM 18: “18.THE METHOD OF CLAIM 12, FURTHER COMPRISING: COUPLING THE FIRST MOBILE UNIT WITH THE SECOND MOBILE UNIT USING THE INTERCONNECT, THE SECOND MOBILE UNIT HAVING AT LEAST ONE SECOND SWITCH GEAR IN ADDITION TO THE SECOND GENERATOR, THE INTERCONNECT TO TRANSMIT POWER IN SUPPORT OF REDUNDANCY IN ADDITION TO THE LOAD SHARING BETWEEN THE FIRST MOBILE UNIT AND THE SECOND MOBILE UNIT.

225. Except for being rewritten as a method claim, and depending from Claim 12, Claim 18 is substantially similar to that of Claim 8. For the same reasons as described above in Sections XII.G regarding Claim 8, the combination of *Reckels* and *IEEE Red Book* renders Claim 18 obvious.

O. DEPENDENT CLAIM 19

1. 19[a]: “19. The method of claim 12, further comprising: coupling at least one load sharing FP mobile unit to share the at least one load of a second FP mobile unit of the one or more external mobile units and”

226. Except for being rewritten as a method claim, and depending from Claim 12, Limitation 19[a] is substantially similar to that of Limitation 10[a]. For the same reasons as described above in Section XII.I.1 regarding Limitation 10[a], the combination of *Reckels* and *IEEE Red Book* renders Limitation 19[a] obvious.

1. 19[b]: “controlling, via a datavan in the one or more external mobile units, the at least one load sharing FP mobile unit, the datavan offering the control of the at least one load sharing FP mobile unit instead of a second control available from within the first mobile unit.”

227. Except for being rewritten as a method claim, and depending from Claim 12, Limitation 19[b] is substantially similar to that of Limitation 10[b]. For the same reasons as described above in Section XII.I.2 regarding Limitation 10[b], the combination of *Reckels* and *IEEE Red Book* renders Limitation 19[b] obvious.

XIII. GROUND 2: OBVIOUS OVER RECKELS IN VIEW OF IEEE RED BOOK FURTHER IN VIEW OF COLI AND SOLAR TURBINES

A. MOTIVATION TO COMBINE

228. A POSITA would have been motivated to combine *Reckels* and *IEEE Red Book*.¹⁶⁶ A POSITA would have been motivated to combine *Coli* and *Solar Turbines* with the *Reckels/IEEE Red Book* combination.

229. As discussed above with reference to Claim 1, the *Reckels-IEEE Red Book* combination teaches a hydraulic fracturing system that uses turbine generators located on power generation trailers 10 to power electric motors that drive hydraulic fracturing pumps, the motors and pumps located on second trailers 14.¹⁶⁷

¹⁶⁶ See section XII.A above.

¹⁶⁷ See section XII.B above.

230. *Coli* similarly discloses the use of turbine generators to power electric motors that drive hydraulic fracturing pumps, and provides examples of such generators and pumps. In particular, *Coli* identifies “SWGS-2500 Well Service Pump sold by Gardner Denver, Inc.” as an example of a fracturing pump, and explains that such a pump can operate at “a true 2500 hp” provided directly from an electric motor.¹⁶⁸ *Coli* further identifies the “TM2500+ turbine generator sold by General Electric” as an example of a turbine generator that “can generate sufficient power (for example 31 MW at 13,800 volts AC power) to supply several electric motors 21 and pumps 22.”¹⁶⁹

231. *Solar Turbines* lists specifications of particular products within the Solar® Turbines industrial gas turbine product line, including those of the Taurus™ 60, which is rated for 5.7 MW of output power.¹⁷⁰ Solar Turbines was a well-known turbine generator manufacturer used in the oil and gas industry, and POSITA would have known that Solar Turbines could source generator sets for use in the *Reckels-IEEE Red Book* system.¹⁷¹

¹⁶⁸ Ex. 1009 (*Coli*), [0046], [0049]-[0050].

¹⁶⁹ Ex. 1009 (*Coli*) [0044].

¹⁷⁰ Ex. 1008 (*Solar Turbines*), 2.

¹⁷¹ See generally Ex. 1021.

232. A POSITA would have been motivated to look to *Coli* and *Solar Turbines* for the implementation details of incorporating particular generators and pumps when designing the *Reckels-IEEE Red Book* system. That is, *Reckels* does not specify what pumps and generators would be implemented in its system, or the specifications of such devices, so a POSITA would have been motivated to look to other references for such details. As discussed above, *Coli* discloses particular generators and hydraulic pumps used in electric-powered hydraulic fracturing systems, and *Solar Turbines* discloses particular turbine generator sets used in the oil and gas industry.

233. A POSITA would have had a reasonable expectation of success in combining the teachings of *Coli* and *Solar Turbines* with the *Reckels-IEEE Red Book* system, as it is merely the use of applying a known technique (particular generators and fracturing pumps as taught by *Coli* and *Solar Turbines*) to a known device (electric-powered hydraulic fracturing system of the *Reckels-IEEE Red Book* combination) ready for improvement (the practical design of the system) to yield predictable results (a system constructed with applicable pumps and generators).

234. Thus, a POSITA would have been motivated to combine *Coli* and *Solar Turbines* with the combined *Reckels-IEEE Red Book* system and would have reasonably expected success in doing so.

B. DEPENDENT CLAIM 5: “5. THE SYSTEM OF CLAIM 1, FURTHER COMPRISING: A PREDETERMINED NUMBER OF FIRST GENERATORS COMPRISING THE AT LEAST ONE FIRST GENERATOR, THE PREDETERMINED NUMBER OF FIRST GENERATORS HAVING INDIVIDUAL POWER OUTPUT VALUES THAT IS LESSER THAN A POWER OUTPUT OF AN ISOLATED SINGLE GENERATOR OCCUPYING ALL AVAILABLE SPACE IN AN INDEPENDENT MOBILE UNIT PHYSICALLY EXTERNAL TO THE FIRST MOBILE UNIT.”

235. Claim 5 depends from Claim 1. The combination of *Reckels* and *IEEE Red Book* render Claim 1 obvious as discussed above in Section XII.B, and incorporated herein by reference. Further, the combination of *Reckels*, *IEEE Red Book*, *Coli*, and *Solar Turbines* disclose the additional limitations of Claim 5.

236. As discussed above in Section XII.A, *Solar Turbines* discloses that its turbines, power generation and remote power systems, including those mounted on a trailer, were marketed and appropriate for use in oil and gas operations. Solar provides several gas turbine driven power generation packages with outputs ranging from 1.2 MW (electric) to 21.7 MW (electric).¹⁷² A POSITA would have taken the information from *Solar Turbines* about available turbine generators and designed the mobile turbine generator trailer most appropriate for the installation, as a normal function of designing and optimizing the system. For example, in the combined *Reckels/IEEE Red Book* system using Fig. 2 of *Reckels* as an example embodiment, each generator trailer would power one hydraulic fracturing pump. As shown in *Coli*,

¹⁷² Ex. 1008 (*Solar Turbines*) pg. 2.

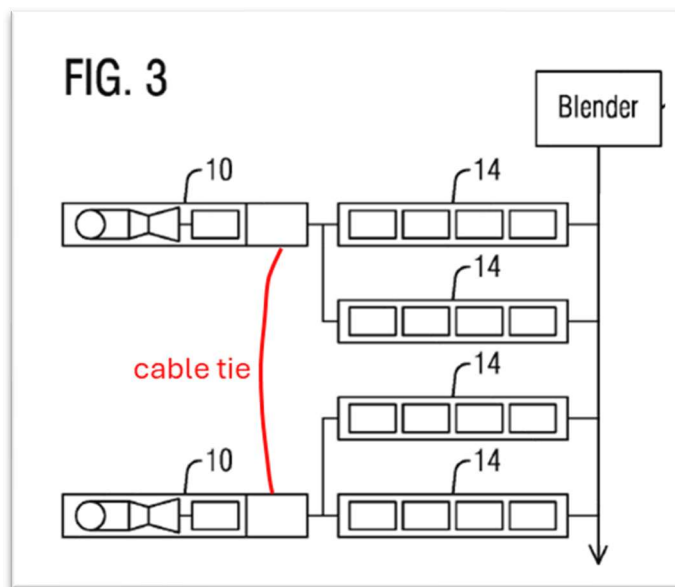
The diagram illustrates a power distribution system with two identical units connected to a central bus bar. Each unit consists of a generator (GEN, 20) and an engine (18) connected to an electrical room (E-Room, 22). The electrical room is connected to a power distribution unit (14) containing a Cooler (24), Motor (26), HP (28), and Pump (30). A central bus bar (red box) is connected to the E-Rooms of both units via electrical connections (indicated by red lines and arrows). The bus bar is labeled 'Bus bar' in a red box.

See, e.g., Ex. 1009 (*Coli*) [0049], [0050] (listing a “SWGS-2500 Well Service Pump sold by Gardner Denver, Inc.” as an example of a fracturing pump, and explaining that such a pump can operate at “a true 2500 hp” provided directly from an electric motor).

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Ex. 1004 (*Reckels*) Fig. 2 (annotated)

237. As another example, in the combined *Reckels/IEEE Red Book* system using Fig. 3 of *Reckels* as an example embodiment, each generator trailer would power at least two hydraulic fracturing pump, resulting in a pump load of 5,000 hp. A POSITA would have recognized that a single turbine generator with the rating of a Taurus 60 turbine generator, 5,700 kW (roughly 7,640 hp), would have sufficient capacity to power two 2,500 Hp pumps.¹⁷⁵ And two Taurus 60 Turbine generators would be needed for each load sharing set, with a total output of 11,400 kW (electric).

Ex. 1004 (*Reckels*) Fig. 2 (annotated)

¹⁷⁵ Ex. 1008 (Solar Turbines) pg. 2.

238. In both of these examples, the total combined power output of the generators is less than a single turbine generator with the output of a TM2500+ turbine generator sold by General Electric (i.e., 31 MW), which is provided by *Coli* as an example of “single natural gas powered turbine generator 30” that “can generate sufficient power (for example 31 MW at 13,800 volts AC power) to supply several electric motors 21 and pumps 22” in a hydraulic fracturing system.¹⁷⁶ It was well-known in the art that the TM2500 turbine generator is a “mobile power plant,” such that a POSITA would have understood it to be a “*mobile unit*.”¹⁷⁷ And a POSITA would have understood that the TM2500 generator “*occupies all available space*” in its supporting unit. For example, Figure 2 of *Coli* depicts several generators 30 in an area labeled “Area C of Figure 2, which a POSITA would have recognized to be a collection of four trailer units, each housing a TM2500 turbine engine to power components of the fracturing system disclosed by *Coli*. It was also well-known in the art that TM2500 “is packaged on a two-trailer system” and occupies the entirety of this system.¹⁷⁸

¹⁷⁶ See Ex. 1009 (*Coli*), [0044].

¹⁷⁷ Ex. 1011, 1 (also noting that the TM2500 “Can be transported via land, sea or air to remote locations and redeployed to other sites.”); *see also* Ex. 1012 (Ching Declaration), 4-14.

¹⁷⁸ Ex. 1011, 3 (depicting the “two-trailer system” that houses the TM2500); *see also* Ex. 1012 (Ching Declaration), 4-14.

239. Finally, a POSITA would have understood that a trailer housing the TM2500 would have been “*physically external to the first mobile unit*,” both in light of the TM2500 generator’s size and the fact that “*the first mobile unit*” contains just a single generator (which as discussed above, would have been understood by a POSITA to be a smaller generator with a lower power output). Thus, the *Reckels-IEEE Red Book-Coli-Solar Turbines* combination renders obvious Claim 5.

C. DEPENDENT CLAIM 15: “15. THE METHOD OF CLAIM 12, FURTHER COMPRISING: DETERMINING A NUMBER OF GENERATORS FOR THE AT LEAST ONE FIRST GENERATOR BASED AT LEAST IN PART ON THE NUMBER OF FIRST GENERATORS HAVING INDIVIDUAL POWER OUTPUT VALUES THAT IS LESSER THAN A POWER OUTPUT OF AN ISOLATED SINGLE GENERATOR OCCUPYING ALL AVAILABLE SPACE IN AN INDEPENDENT MOBILE UNIT PHYSICALLY EXTERNAL TO THE FIRST MOBILE UNIT.”

240. Other than being rewritten as a method claim, dependent claim 15 contains the same elements as dependent claim 5, and would have been obvious to a POSITA based on the combined teachings of *Reckels*, *IEEE Red Book*, and *Solar Turbines* for the same reasons as those discussed above in Section XIII.B regarding Claim 5.

XIV. GROUND 3: OBVIOUS OVER RECKELS IN VIEW OF IEEE RED BOOK FURTHER IN VIEW OF OEHRING178**A. MOTIVATION TO COMBINE**

241. A POSITA would have been motivated to combine *Reckels* and *IEEE Red Book*.¹⁷⁹ A POSITA would have been motivated to combine *Oehring178* with the *Reckels/IEEE Red Book* combination.

242. As discussed above concerning Claim 1, the *Reckels-IEEE Red Book* combination discloses a power generation and distribution system for powering loads on one or more second trailers 14, where the loads include a fixed speed electric motor 26, a hydraulic pump 28, and high pressure pump 30.¹⁸⁰ Further, *Reckels* teaches that “[t]he electrical power is provided to the fixed speed electric motor 26, which rotates the hydraulic pump 28. The hydraulic pump 28 generates hydraulic fluid pressure that is used to rotate and control the flowrate of the high pressure fracturing fluid pump 30. The high pressure fracturing fluid pump 30 receives the fracturing liquids and pressurizes them for subsequent injection into the wellbore and formation.”¹⁸¹

¹⁷⁹ See Section XII.A above.

¹⁸⁰ See Section XII.B.5; Ex. 1004 (*Reckels*), [0018].

¹⁸¹ Ex. 1004 (*Reckels*), [0018].

243. *IEEE Red Book* discloses the use of “motor control centers” (“MCCs”), which “are tailor-made assemblies of conveniently grouped control equipment primarily used for power distribution and associated control of motors.”¹⁸²

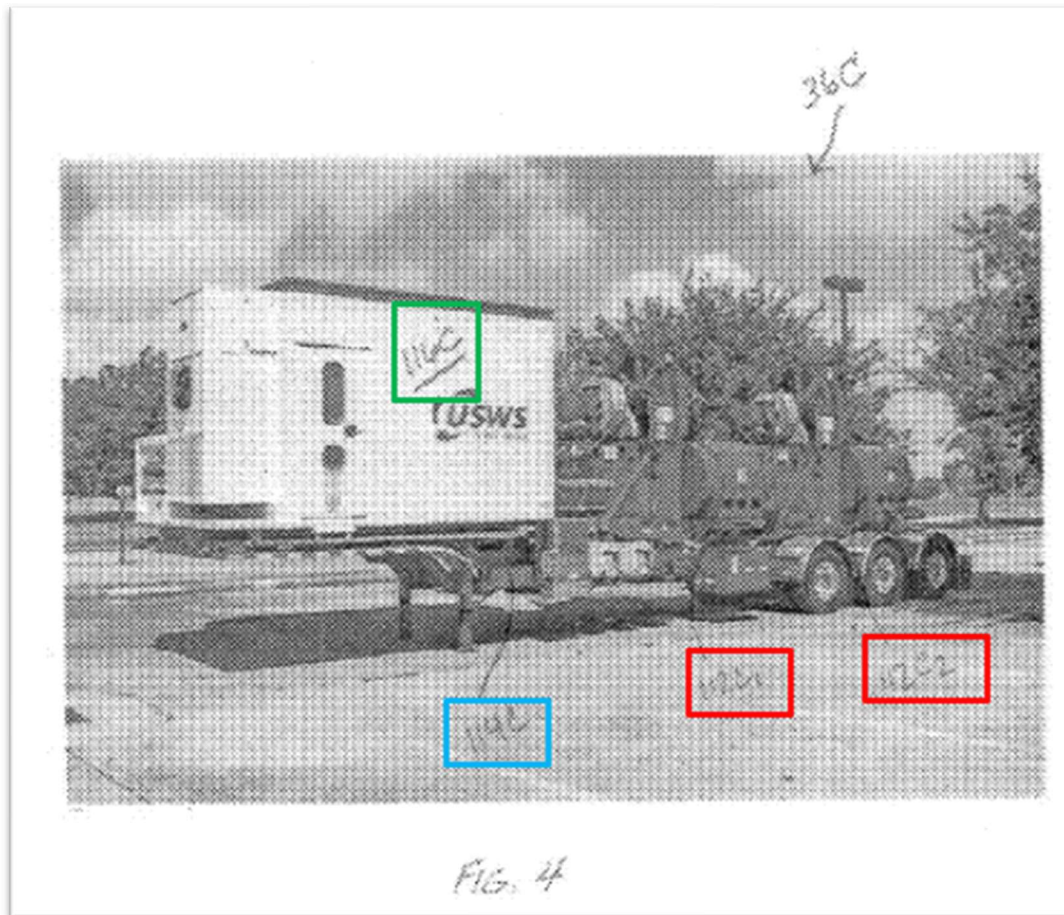
244. *Oehring178* discloses an electric hydraulic fracturing system with turbine generators, switchgear, transformers, electric motor-driven pumps, and variable frequency drives (VFDs), where the turbine generator provides power that feeds through the switchgear and transformers to provide power to an electric motor.¹⁸³ The electric motor then drives a hydraulic fracturing pump in a fracturing operation, like the system of *Reckels*.¹⁸⁴ Further, *Oehring178* discloses in Figure 4, annotated below, “one example of a pump system 36C, which can be used either for pump down operations or for fracturing operations. In the illustrated example, pumps 112C_{1,2} are shown mounted on a trailer 114C so that the pumps 112C_{1,2} can be readily transported to different locations for onsite operation. Additionally, a VFD housing 116C is also mounted on trailer 114C and in which equipment such as VFDs for pumps, isolation breakers, *and a motor control center* can be situated during operation of pumps 112C_{1,2}. The motor control cabinet can be a breaker

¹⁸² Ex. 1005 (*IEEE Red book*), 451.

¹⁸³ See Ex. 1007 (*Oehring178*), [0029].

¹⁸⁴ Ex. 1007 (*Oehring178*), [0026]-[0027].

cabinet that contains breakers for smaller motors such as blower motors, lube motors, and fan motors.”¹⁸⁵



Ex. 1007 (*Oehring178*), Fig. 4. (annotated, showing pumps 112C in red, VFD housing 116C in green, and trailer 114C in blue).

245. A POSITA would have been motivated to incorporate VFDs and MCCs into the second trailer 14 (i.e., the trailer in which the motors and pumps are included) of the combined *Reckels-IEEE Red Book* system. As taught by *IEEE Red*

¹⁸⁵ Ex. 1007 (*Oehring178*), [0038] (emphasis added).

Book and *Oehring178*, MCCs were well-known components used for controlling motors, such that it would have been obvious to a POSITA to incorporate MCCs into the *Reckels-IEEE Red Book* system to help drive the motors 26 located on *Reckels'* second trailers 14 along with the electrically powered auxiliary equipment.

246. It would have been further obvious, based on the teachings of *Oehring178*, to use an MCC and to place the VFD and MCC on the individual fracturing pump trailers. As discussed above regarding Claim 1, the “external mobile units” in the *Reckels / IEEE Red Book* combination are the fracturing pump trailers 14.¹⁸⁶ *Oehring178* teaches that VFDs and MCCs would be located on fracturing pump trailers.

247. Further, incorporating *Oehring178's* teachings of incorporating VFDs and MCCs on the same trailers as a fracturing pump and associated motors is applying a known technique (a trailer comprising a fracturing pump and associated motors as well as a VFD and MCC for controlling such components, as taught by *Oehring*) to improve similar devices (*Reckel's* second trailers 14 comprising fracturing pumps and associated motors) in the same way. The results of the combination would be predictable: a fracturing pump trailer, as taught by *Reckels*, which includes the VFD and MCC components needed to drive the trailer's motors.

¹⁸⁶ See Section, XIII.B.5.

Indeed, implementing a VFD and MCC on the same trailer as a fracturing pump and associated motor, as taught by *Oehring178*, into Reckels' second trailers 14 would involve a simple substitution of one known element (a VFD located on a power generation trailer 10, as taught by Reckels) for another (a VFD and MCC on the same trailer as a fracturing pump and associated motor, as taught by *Oehring178*) to obtain the predictable result of a second trailer 14 including both a VFD and MCC for controlling the motors located on the second trailer 14. Thus, a POSITA would have been motivated to modify the second trailers 14 (i.e., fracturing pump trailers 14) of the *Reckels-IEEE Red Book* combination to include a VFD and MCC, as taught by *Oehring178* and would have reasonably expected success in doing so.

B. DEPENDENT CLAIM 7

248. Claim 7 depends from Claim 1. The combination of *Reckels* and *IEEE Red Book* render Claim 1 obvious as discussed above in Section XIII.B, and incorporated herein by reference. Further, the combination of *Reckels*, *IEEE Red Book* and *Oehring178* discloses the additional limitations of Claim 7.

1. 7[a]: “7. The system of claim 1, further comprising: at least one Variable Frequency Drive (VFD); and”

249. As discussed above in Section XIII.B regarding Claim 1, *Reckels* discloses a variable frequency drive (VFD).¹⁸⁷ *Reckels* teaches that: “[t]he generator 20 is then connected to an electric room 22, which may include transformers, switchgear, variable frequency drives, and other electrical components needed to drive high power electric motors.”¹⁸⁸ As discussed above in section XI.K, VFDs (or ASDs) were well-known components of a power distribution and motor control system years before the ’801 Patent. And as discussed above, the combined *Reckels-IEEE Red Book-Oehring*¹⁷⁸ system renders it obvious to place the VFDs on second trailers 14.¹⁸⁹

250. Accordingly, the *Reckels-IEEE Red Book-Oehring*¹⁷⁸ combination discloses a variable frequency drive (VFD).

¹⁸⁷ Another, more proper term for VFDs is Adjustable Speed Drive (ASD).

¹⁸⁸ Ex. 1004 (*Reckels*) [0018].

¹⁸⁹ See Section XV.A.

2. 7[b]: “at least one Motor Control Center (MCC), the VFD and the MCC being on individual ones of the one or more external mobile units that is physically external relative to the first mobile unit.”

251. Motor control centers were well-known assemblies used for power distribution and associated control of motors. For example, the *IEEE Red Book* discloses “**Motor-control Center**. Most centers are tailor-made assemblies of conveniently grouped control equipment primarily used for power distribution and associated control of motors. They contain all necessary buses, incoming line facilities, and safety features to provide the utmost in convenience for space and labor saving and adaptability to everchanging conditions with a minimum of effort and a maximum of safety.”¹⁹⁰ Accordingly, the use of a motor control center, such as to distribute power to motor 26, coolers 24, lube motors, etc., on trailer 14 would have been obvious to a POSITA.

252. It would have been further obvious, based on the teachings of *Oehring178*, to use an MCC and to place the VFD and MCC on the individual fracturing pump trailers. As discussed above regarding Claim 1, the “external mobile units” in the *Reckels / IEEE Red Book* combination are the fracturing pump trailers 14.¹⁹¹ *Oehring178* teaches the VFD and MCC on the fracturing pump trailer

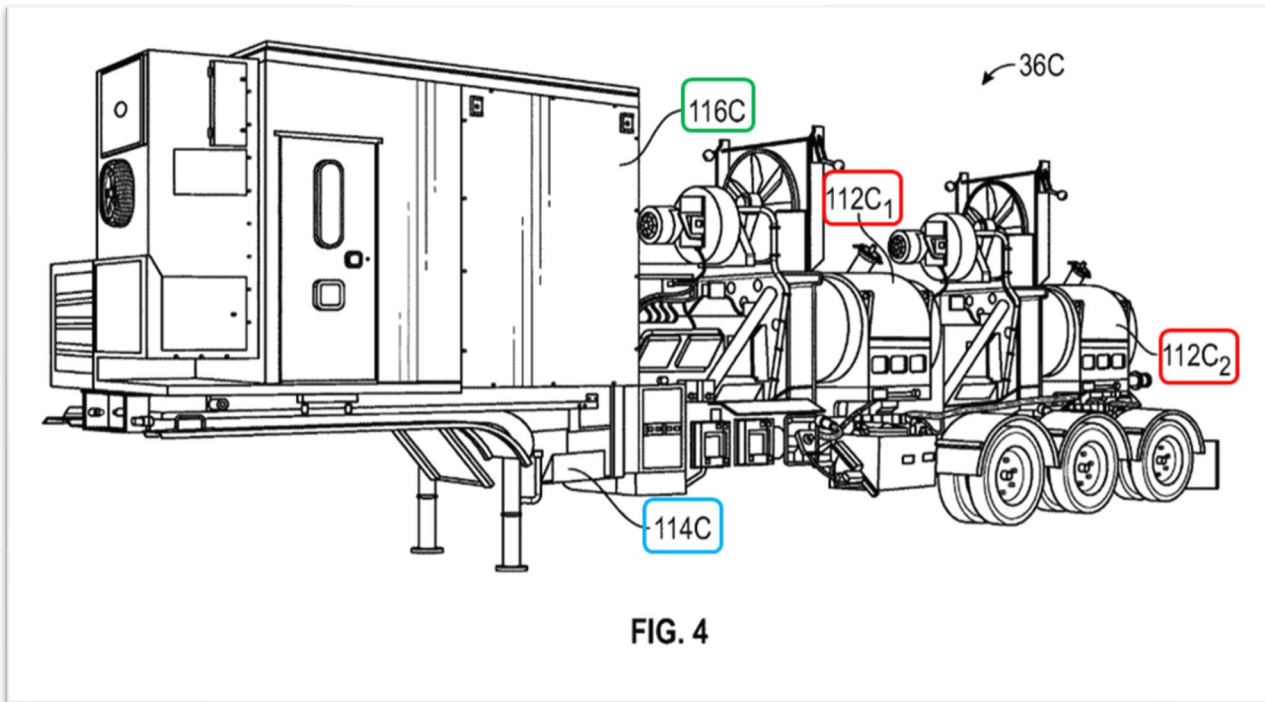
¹⁹⁰ Ex. 1005 (*IEEE Red Book*) pg. 451.

¹⁹¹ See Section **XI.B.5** above.

(external mobile units). *Oehring178* discloses an electric hydraulic fracturing system with turbine generators, switchgear transformers, electric motor-driven pumps and VFDs, where the turbine generator provides power that feeds through the switchgear and transformers to provide power to an electric motor. The electric motor then drives a hydraulic fracturing pump in a fracturing operation, like the system of *Reckels*.¹⁹² Further, *Oehring178* discloses “in FIG. 4 is one example of a pump system 36C, which can be used either for pump down operations or for fracturing operations. In the illustrated example, pumps 112C_{1,2} [annotated in red] are shown mounted on a trailer 114C [annotated in blue] so that the pumps 112C_{1,2} can be readily transported to different locations for onsite operation. *Additionally, a VFD housing 116C [annotated in green] is also mounted on trailer 114C, and in which equipment such as VFDs for pumps, isolation breakers, and a motor control center can be situated during operation of pumps 112C_{1,2}.* The motor control cabinet can be a breaker cabinet that contains breakers for smaller motors such as blower motors, lube motors, and fan motors.”¹⁹³

¹⁹² See, e.g., Ex. 1007 (*Oehring178*), Fig. 2, [0026-[0029]; [0042].

¹⁹³ Ex. 1007 (*Oehring178*) [0038], emphasis added.



Ex. 1007 (Oehring178) Fig. 4 (annotated)

253. Accordingly, *Oehring178* discloses the use of a VFD and an MCC, both mounted on the fracturing pump trailer 114C (analogous to trailer 14 of *Reckels*). The combination of *Reckels*, *IEEE Red Book* and *Oehring178* renders Claim 7 obvious.

C. DEPENDENT CLAIM 17

254. Other than being rewritten as a method claim, dependent claim 17 contains the same elements as dependent claim 7, and would have been obvious to a POSITA based on the combined teachings of *Reckels*, *IEEE Red Book*, and

Oehring178 for the same reasons as those discussed above in Section XV.B regarding Claim 7.

1. 17[a]: “17. The method of claim 12, further comprising: providing at least one Variable Frequency Drive (VFD); and”

255. Limitation 17[a] would have been obvious to a POSITA based on the combined teachings of *Reckels*, *IEEE Red Book*, and *Oehring178* for the same reasons as those discussed above in Section XV.B.1 regarding Limitation 7[a].

2. 17[b]: “providing at least one Motor Control Center (MCC), the VFD and the MCC being on individual ones of the one or more external mobile units that is physically external relative to the first mobile unit.”

256. Limitation 17[b] would have been obvious to a POSITA based on the combined teachings of *Reckels*, *IEEE Red Book*, and *Oehring178* for the same reasons as those discussed above in Section XV.B.2 regarding Limitation 7[b].

XV. GROUND 4: OBVIOUS OVER RECKELS IN VIEW OF IEEE RED BOOK, OEHRING178, AND FURTHER IN VIEW OF KUMAR**A. MOTIVATION TO COMBINE**

257. A POSITA would have been motivated to combine *Reckels*, *IEEE Red Book*, and *Oehring178*.¹⁹⁴ A POSITA would have been motivated to combine *Kumar* with the *Reckels/IEEE Red Book/Oehring178* combination.

258. As discussed above concerning Claim 7, the *Reckles-IEEE Red Book-Oehring178* combination discloses a power distribution system for providing power to one or more fracturing pumps located on mobile trailers, where variable frequency drives (VFDs) and motor control centers (MCCs) are included on the same trailers as the fracturing pumps.¹⁹⁵

259. *IEEE Red Book* teaches the concept of harmonics as applied to power distribution systems. In particular, *IEEE Red Book* discloses that “[h]armonics are caused by devices that change the shape of the normal sine wave of voltage or current in synchronism with the 60 Hz supply,” and may cause “objectionable interference” in “communication, signaling, and control circuits” of a system as well as “reduce the capacity of the current-carrying equipment and increase losses without providing

¹⁹⁴ See Section XV.A.

¹⁹⁵ See Section XV.B.

any useful work.”¹⁹⁶ *IEEE Red Book* identifies “[p]hase-controlled rectifiers used to provide variable-speed drives for dc motors, or used and frequency changes to provide variable-speed drives for ac motors” as “major sources of harmonics.”¹⁹⁷

260. Like *IEEE Red Book*, *Kumar* teaches the concept of “harmonics” as applied to similar power distribution systems.¹⁹⁸ *Kumar* explains that harmonics are created by “power electronic devices such as electrical submersible pumps (ESPs), variable speed drives, DC drives for drilling, programmable logic controllers (PLCs), trans-receivers, amplifiers, fluorescent tubes, air conditioners, discharge lamps, uninterrupted power supply (UPS) systems, battery chargers etc.”¹⁹⁹ These harmonics can damage on a power system including “damage to equipment and disruption to production process, can cause overheating, produce electromagnetic interference to other control/communication equipment.”²⁰⁰ *Kumar* discloses several methods to mitigate harmonics, including the use of isolation transformers. *Kumar* teaches that “[i]solation transformers are used to provide electrical isolation between distribution system and harmonic producing load. Isolation transformers are used for neutral isolation, phase shifting and dual supply for 12-Pulse converter. Isolation

¹⁹⁶ Ex. 1005 (*IEEE Red Book*), 94-95.

¹⁹⁷ Ex. 1005 (*IEEE Red Book*), 95.

¹⁹⁸ See generally, Ex. 1009 (*Kumar*).

¹⁹⁹ Ex. 1009 (*Kumar*), 2.

²⁰⁰ Ex. 1009 (*Kumar*), 4.

transformer often has single or multiple electrostatic shields to reduce common mode noise. They have the ability to change the voltage levels between load and supply, thereby mitigate the harmonic current.”²⁰¹ Further, *Kumar* explains that “harmonic control at the source (Harmonic producing Load) is the best option to control harmonics. All possible techniques such as line reactors, passive filter, *isolation transformer*, neutral isolation etc are applied in the device to control harmonics.”²⁰²

261. A POSITA implementing the power distribution system taught by the *Reckels-IEEE Red Book-Oehring178* combination would have been motivated to incorporate isolation transformers in the second trailers 14 of the system to limit the damaging effect of harmonics created by the VFDs located on second trailers 14. As *Kumar* teaches, it is best to control harmonics (e.g., by using isolation transformers) “at the source (Harmonic producing Load).”²⁰³ A POSITA would have recognized that the VFDs located on the second trailer 14 in the combined *Reckels-IEEE Red Book-Oehring178* combination are one such “Harmonic producing Load,” as *IEEE Red Book* and *Kumar* specifically identify these devices as an example of one such

²⁰¹ Ex. 1009 (*Kumar*), 6.

²⁰² Ex. 1009 (*Kumar*), 5.

²⁰³ Ex. 1009 (*Kumar*), 5.

harmonic producing load.²⁰⁴ Accordingly, a POSITA would have known to place an isolation transformer on the second trailer, 14, to limit the effects of harmonics caused by the VFDs on these trailers.

262. A POSITA would have been motivated to incorporate isolation transformers in the combined *Reckels-IEEE Red Book-Oehring*¹⁷⁸ system for various reasons. First, as discussed above, *IEEE Red Book* and *Kumar* explain the dangers of harmonics on power distribution systems, including interference in other components of the system, reduced current capacity, and power loss²⁰⁵ and “damage to equipment and disruption to production process, can cause overheating, produce electromagnetic interference to other control/communication equipment.”²⁰⁶ A POSITA would have been motivated to limit the risk of such damages by incorporating isolation transformers as taught by *Kumar*.

²⁰⁴ Ex. 1005 (IEEE Red Book), 95 (explaining that “[p]hase-controlled rectifiers used to provide variable-speed drives for dc motors, or used and frequency changes to provide variable-speed drives for ac motors are major sources of harmonics.”); Ex. 1009 (Kumar), 2 (explaining that harmonics are created by “power electronic devices such as electrical submersible pumps (ESPs), *variable speed drives*, DC drives for drilling, programmable logic controllers (PLCs), trans-receivers, amplifiers, fluorescent tubes, air conditioners, discharge lamps, uninterrupted power supply (UPS) systems, battery chargers etc.” (emphasis added)).

²⁰⁵ Ex. 1005 (IEEE Red Book), 95.

²⁰⁶ Ex. 1009 (*Kumar*), 4.

263. Further, incorporating *Kumar*'s teachings of incorporating an isolation transformer at a harmonics-creating component such as a VFD, is applying a known technique (an isolation transformer, as taught by *Kumar*) to improve similar devices (*Reckel*'s power distribution system) in the same way. The results of the combination would be predictable: a power distribution system as taught by *Reckels* that is protected from harmonics caused by a VFD.

264. Thus, a POSITA would have been motivated to combine *Kumar* with the *Reckels-IEEE Red Book-Oehring178* system and would have reasonably expected success in doing so.

B. DEPENDENT CLAIM 11: “11. THE SYSTEM OF CLAIM 1, FURTHER COMPRISING: THE AT LEAST ONE TRANSFORMER BEING AN ISOLATION TRANSFORMER THAT IS LOCATED IN THE ONE OR MORE EXTERNAL MOBILE UNITS, THE ISOLATION TRANSFORMER BEING PHYSICALLY EXTERNAL RELATIVE TO THE FIRST MOBILE UNIT AND BEING CONFIGURED FOR FILTERING HARMONICS BETWEEN THE AT LEAST ONE FIRST GENERATOR AND THE LOADS IN THE ONE OR MORE EXTERNAL MOBILE UNITS.”

265. Claim 11 depends from Claim 1. The combination of *Reckels* and *IEEE Red Book* renders Claim 1 obvious as discussed above in Section XIII.B, and incorporated herein by reference. Further, the combination of *Reckels*, *IEEE Red Book*, *Oehring178*, and *Kumar* discloses the additional limitations of Claim 11.

266. As *Kumar* discusses, harmonics are created by “power electronic devices such as electrical submersible pumps (ESPs), variable speed drives, DC

drives for drilling, programmable logic controllers (PLCs), trans-receivers, amplifiers, fluorescent tubes, air conditioners, discharge lamps, uninterrupted power supply (UPS) systems, battery chargers etc.”.²⁰⁷ These harmonics can damage on a power system including “damage to equipment and disruption to production process, can cause overheating, produce electromagnetic interference to other control/communication equipment.”²⁰⁸ *Kumar* discloses several methods to mitigate harmonics, including isolation transformers. *Kumar* teaches, “Isolation transformers are used to provide electrical isolation between distribution system and harmonic producing load. Isolation transformers are used for neutral isolation; phase shifting and dual supply for 12-Pulse converter. Isolation transformer often has single or multiple electrostatic shields to reduce common mode noise. They have the ability to change the voltage levels between load and supply, thereby mitigate the harmonic current.”²⁰⁹

267. As discussed above, the combined *Reckels-IEEE Red Book-Oehring178-Kumar* system teaches the use of isolation transformers in the second trailers 14 (*i.e.*, “*the one or more external mobile units,*” See Section XII.B.5) to limit the effects of harmonics caused by the fracturing pumps 30 in the second

²⁰⁷ Ex. 1009 (*Kumar*) pg 2.

²⁰⁸ Ex. 1009 (*Kumar*) pg 4.

²⁰⁹ Ex. 1009 (*Kumar*) pg 6.

trailers.²¹⁰ Because such isolation transformers are located on second trailers 14, downstream of the harmonic producing load (i.e. VFD) (which are external to power generation trailers 10 (i.e., “*the first mobile unit*”)), the isolation transformers are “*physically external relative to the first mobile unit.*” Further, *Kumar* explains that isolation transformers “are used to provide electrical isolation between distribution system and harmonic producing load” and “have the ability to change the voltage levels between load and supply, thereby mitigate the harmonic current.”²¹¹ Accordingly, a POSITA would have understood that the isolation transformers of the *Reckels-IEEE Red Book-Oehring178-Kumar* system would have filtered harmonics between the load (i.e., VFDs) and power distribution system (including the generators 20 (i.e., “*the at least one first generator*”)) of the system, thereby “*being configured for filtering harmonics between the at least one first generator and the loads in the one or more external mobile units.*”

268. Thus, the combination of *Reckels*, *IEEE Red Book*, *Oehring178*, and *Kumar* renders Claim 11 obvious.

²¹⁰ See Section XV.A.

²¹¹ Ex. 1009 (*Kumar*), 6.

C. DEPENDENT CLAIM 20: “20. THE METHOD OF CLAIM 12, FURTHER COMPRISING: FILTERING HARMONICS BETWEEN THE AT LEAST ONE FIRST GENERATOR AND THE LOADS IN THE ONE OR MORE EXTERNAL MOBILE UNITS USING AN ISOLATION TRANSFORMER AS THE AT LEAST ONE TRANSFORMER THAT IS IN THE ONE OR MORE EXTERNAL MOBILE UNITS, THE ISOLATION TRANSFORMER BEING PHYSICALLY EXTERNAL RELATIVE TO THE FIRST MOBILE UNIT.”

269. Other than being rewritten as a method claim, dependent claim 20 contains the same elements as dependent claim 11, and would have been obvious to a POSITA based on the combined teachings of *Reckels*, *IEEE Red Book*, *Oehring178*, and *Kumar* for the same reasons as those discussed above in Section XV.B regarding Claim 11.

XVI. CONCLUSION

270. All statements made herein of my own knowledge are true, and all statements made on information and belief are believed to be true. I further understand that willful false statements and the like are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code. I declare under penalty of perjury that the foregoing is true and correct.

Executed on August 20, 2025.



Dr. Robert A. Durham

Appendix A

Dr. ROBERT A DURHAM, PhD, FIEEE

Resume
Specialization
Honors & Awards
Publications

Dr ROBERT A DURHAM, PhD, FIEEE

Robert A Durham is the Principal of D² Tech Solutions, a technology related firm concentrating on Mechanical and Electrical systems and energy conversions. He also serves as a Principal Scientist of THEWAY LABs, Tulsa, OK, an engineering and energy consulting firm that provides design and failure analysis of facilities and system installations.

Dr. Durham's work experience is broad and encompasses all areas of the energy industry. Dr. Durham spent 11 years with AEP/CSW, at the time the country's largest utility, in electrical engineering positions in the power generation and transmission planning departments. He then accepted a position as Manager of Electric Infrastructure for New Dominion, LLC., a major independent energy producer in Oklahoma. Dr. Durham then moved on to hold the position of Vice President of Engineering and Project Management for EDG Power Group, an Engineering Procurement and Construction company specializing in design and construction of small to medium size power generating facilities. Dr. Durham left EDG Power Group to accept his current positions. Dr. Durham has been accepted as an expert and offered testimony in several jurisdictions.

Dr. Durham's extensive client list includes the development of a broad spectrum of forensic, electrical and facilities projects for many companies. He has also taught University offered courses in electrical engineering review for board licensure. He has published five books, six magazine articles and over 40 other technical papers and articles. Dr. Durham's extensive work on standards and electrical systems has resulted in his elevation to Fellow of the IEEE, the highest grade of recognition in the electrical technology industry.

Dr. Durham received the B.S. in electrical engineering from the University of Tulsa in 1992 and the M.E. in Technology Management from The University of Tulsa in 1997. Tulsa, OK. In 2004, Dr. Durham received a PhD in Engineering Management from Kennedy Western University.

Degrees Earned

BSEE, with Honors, The University of Tulsa
Master of Engineering, The University of Tulsa
PhD , Kennedy Western University

Area of Specialization

lightning & grounding
failure analysis & forensic engineering
electrical power systems & safety
economics & management
petroleum & chemical industry
 drilling
 completion
 production
 transportation
 refining
electrical / mechanical energy conversion

Registration

Professional Engineer - Oklahoma
Professional Engineer – Texas
Professional Engineer – California
Professional Engineer – New Hampshire (Inactive)
Professional Engineer – Kansas
Professional Engineer – North Carolina (Inactive)
Professional Engineer – Missouri
Professional Engineer – Arkansas
Professional Engineer – Virginia (Inactive)
Professional Engineer – Illinois (Inactive)
Electrical Contractor - Oklahoma

Work History

D ² Tech Solutions, Inc. Principal	2002 - 2025
THEWAY Corp. Principal Scientist	2004 - 2025

EDG Power Group, Inc. 2002 - 2004
Vice President Engineering & Project Management

New Dominion, LLC 2000 - 2002
Mgr Electric Infrastructure

Central & Southwest, Inc 1989 - 2000
Electrical Engineer

Professional Memberships

Fellow	Institute of Electrical and Electronic Engineers
Diplomate	American College of Forensic Examiners, International
Member	National Association of Fire Investigators
Voting Member	National Fire Protection Institute, Electrical Section
Executive Member	Petroleum and Chemical Industry Committee, IEEE
Diplomate,	
Past Board Member	American Board of Forensic Engineering and Technology
Member	IEEE Standards Association
Past Chair	Production Subcommittee, IEEE IAS/PCIC
CFC	American College of Forensic Examiners
Member	International Association of Arson Investigators
CFEI, CVFEI	National Association of Fire Investigators
Past Chair	Tulsa Section IEEE
Chair	IEEE RP1017.1 Working Group
Chair	IEEE RP1017.2 Working Group
Chair	IEEE RP1017.3 Working Group
Chair	IEEE RP1017.4 Working Group
Past Chair	IEEE PCIC Standards Subcommittee
Secretary	IEEE Petroleum and Chemical Industry Committee

Honors and Awards

Fellow of the IEEE

For contributions to submersible electrical equipment analysis and multi-point ground method in hazardous petroleum and chemical environments.

Honor Societies

Tau Beta Pi, national engineering honors

Eta Kappa Nu, national electrical engineering honors

Dr. Durham's publications have often successfully competed for outstanding paper awards from journals of the Institute of Electrical and Electronic Engineers (PCIC and IAS). This is an international competitive peer review and evaluation of papers that provide a significant contribution to the advancement and understanding of electrical applications.

IEEE Industry Applications Society, New Orleans, LA: Prize Article for "Data Quality and Grounding: Considerations in a Mixed Use Facility"

PCIC, Cincinnati, OH: Prize Paper for "Grounding and Bonding Conductors: Solid, Stranded, Bare or Insulated"

PCIC, New Orleans, LA: Prize paper for "Industrial Design Application for Power Distribution over Extra-Long Distances"

PCIC, Philadelphia, PA: Prize paper for "Paradigm Shifts and Impact on Engineers and Industry"

Transactions on Industry Applications, Orlando, FL: Prize Paper for "Lightning, Grounding, and Protection for Control Systems".

PCIC, Denver, CO: Prize Paper for "Grounding System Design for Isolated Locations and Plant Systems"

PCIC, St. Louis, MO: First place for "Lightning, Grounding, and Protection for Distributed Control and Communications Systems: A Retrofit".

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Electrical Failure Analysis for Fire and Incident Investigations, Marcus O. Durham, Robert A. Durham, Rosemary Durham, Jason Coffin, ISBN 978-1463773472, 2011

Leadership and Success in Relationships and Communication, Marcus O. Durham and Robert A Durham, ISBN 978-1463758769, 2011

Leadership and Success in Organizations, Culture & Ethics: Group or Horizontal Interactions, Marcus O. Durham and Robert A Durham, ISBN 978-1466250338, 2011

Leadership and Success in Economics, Law & Technology: Society or External Influence, Marcus O. Durham and Robert A Durham, OK, ISBN 978-1466250461, 2011

How Should Generating Asset Acquisitions by Regulated, Vertically Integrated Utilities be Overseen in Today's Quasi-Regulated Electric Utility Environment? A Dissertation Presented to the Faculty of the School of Engineering Kennedy-Western University, KWU Press, Thousand Oaks, CA, 2004

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R. A. Durham, M. O. Durham and T. W. Gillaspie, "Lightning Protection at Petrochemical Facilities - Part 2 Standards Requirements," *2021 IEEE Petroleum and Chemical Industry Committee Conference (PCIC)*, San Antonio, TX, 2021.

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