

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HARBOR FREIGHT TOOLS USA INC.,
GENERAC POWER SYSTEMS, INC., and
MWE INVESTMENTS, LLC,
Petitioner,

v.

CHAMPION POWER EQUIPMENT, INC.,

Patent Owner.

Case No. IPR2025-00805
U.S. Patent No. 10,393,034

Declaration of Dr. William Singhose

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EX2001	Docket for Champion Power Equipment, Inc. v. Firman Power Equipment Inc., Case No. 2:23-cv-02371 (D. Az.) (“Firman Case”)
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EX2004	Firman Case, Firman Answer to First Amended Complaint and Counterclaims, ECF No. 61
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EX2006	Firman Case, Declaration and Exhibit, ECF No. 116
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EX2008	Firman Case, ECF No. 149
EX2009	Firman’s Nov. 2024 Subpoena to third-party Generac (Firman Case)
EX2010	Docket for Generac Case (E.D. Wis.)
EX2011	Generac Case, Generac’s First Amended Answer and Counterclaims, ECF No. 30
EX2012	Generac Case, Champion's First Amended Answer to Generac's Amended Counterclaims, ECF No. 31
EX2013	Defendant Generac’s Feb. 14, 2025 Subpoena to third-party Firman
EX2014	May 22, 2025 Defendant Generac’s Letter to third-party Firman
EX2015	July 23, 2025 Stipulation from Generac
EX2016	Docket for Harbor Freight Case (C.D. Cal.)
EX2017	Harbor Freight Case, Complaint for Declaratory Judgment, ECF No. 1

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EX2021	Harbor Freight's July 14, 2025 Preliminary Claim Constructions
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EX2023	Harbor Freight's Mar. 10, 2025 Subpoena on third-party Firman
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EX2039	June 28, 2024 Letter from Champion to Harbor Freight
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EX2041	US11143120 ("the '120 Patent")
EX2042	US10598101 ("the '101 Patent")
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EX2044	Kubota DF-972 Information Sheet
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Glossary

Abbreviation	Term
'034 Patent	U.S. Patent No. 10,393,034
'060 Application	U.S. Patent Application No. 14/738060
'398 Patent	U.S. Patent No. 10,697,398
'441 Application	U.S. Patent Application No. 14/925441
'780 Patent	U.S. Patent No. 10,221,780
Board	Patent Trial and Appeal Board
Challenged Claims	Claims 1-24 of the '034 Patent
Generac	Generac Power Systems, Inc.
Harbor Freight	Harbor Freight Tools USA, Inc.
MWE	MWE Investments, LLC
Patent Owner	Champion Power Equipment, Inc.
Petition	Petition for Inter Partes Review of U.S. Patent No. 10,393,034 (Paper 4)
Petitioner	Harbor Freight, Generac, and MWE, collectively
POSITA	Person of Ordinary Skill in the Art
USPTO	United States Patent & Trademark Office

I, Dr. William Singhose, do hereby declare under penalty of perjury that the following statements are made based on my personal knowledge and are true and correct:

I. EDUCATION AND WORK EXPERIENCE

1. 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 provided as EX2079. Here, I provide a brief summary of my qualifications.

2. I am a mechanical engineer and professor of mechanical engineering at the Georgia Institute of Technology (“Georgia Tech”). I have substantial experience in the fields of, among others, product design, mechatronics, and controls.

3. I hold B.S. and Ph.D. degrees in mechanical engineering from the Massachusetts Institute of Technology (“MIT”), and a M.S. degree in mechanical engineering from Stanford University. From 1998 to 2004, I was an Assistant Professor of mechanical engineering at Georgia Tech. From 2004 to 2014, I was an Associate Professor at Georgia Tech. From 2014 to the present, I have held my current position as Professor of Mechanical Engineering at Georgia Tech. During my tenure at Georgia Tech, I have had visiting appointments at MIT, Stanford, the Polytechnic University of Madrid, and the Tokyo Institute of Technology.

4. In my current position at Georgia Tech, I teach courses in mechanical design, system dynamics, and controls. I also lead teams of professors, post-docs, graduate students, and undergraduate students that conduct research in product design, mechanical design, dynamics, controls, automation, robotics, and human-machine interfaces. I am currently the director of the Center for Crane Safety Research.

5. Based on my work experience, described in my curriculum vitae and in more detail below, I am knowledgeable about the subject matter of the '034 Patent. Specifically, my qualifications as an expert in the fields of product design and mechanical engineering stem from my prior work experience, as well as my experience as a Professor at Georgia Tech performing research, teaching, and consulting.

6. Before starting my teaching career at Georgia Tech, I worked as a full-time mechanical engineer for several companies, including Walt Disney World, Apple Computers, Inc., and Convolve, Inc.

7. In my role at Walt Disney World, I designed and developed a number of structures and components for the parks' rides, including, but not limited to, operational control procedures for the Body Wars simulators. These simulators are rooms that hold about 40 people at a time. The entire rooms, and the guests seated within, are automatically manipulated through a series of preprogrammed motions

using six large linear hydraulic cylinders. The machines were equipped with numerous valves and sensors that enabled accurate feedback control of the power drives.

8. For Convolve, Inc., I analyzed the dynamics of automated robots, satellites, and NASA high-altitude balloons. I also developed automated control systems for manufacturing machines, large-scale coordinate measuring machines, and laser interferometer sensors. One of my Convolve projects required the development and installation of a system to control a crane at the Savannah River Nuclear facility. The crane was a large overhead bridge structure that moved barrels of nuclear waste. The system we developed reduced the unwanted pendulum swing of the barrels.

9. The '034 Patent includes claim elements directed to components that enable multi-fuel use in generators such as, carburetor, fuel lines, solenoid valves, switches, and pressure regulators. I have experience working with all of these elements and combinations of these elements.

10. For example, I have worked on the control of valves since 1988. My first work in this area focused on the on-off control of thrusters used to reposition spacecrafts. The primary goals of my work in this area were to control the oscillation [1–4] of the satellite structures and to control the amount of fuel used [1, 5–7]. In addition to working on thruster valve control, I also worked on projects controlling

hydraulic valves when I worked at Disney World and during my career at Georgia Tech [8–10]. Furthermore, I have worked extensively with pneumatic valves [11–14]. As detailed on my CV, I have received numerous grants to conduct research and development on fluid power.¹

11. In addition to my research and work experience with valves, I have taught the use of pneumatic equipment, including on-off valve control and quick-disconnect hoses, to my students at Georgia Tech for more than 20 years.

12. In terms of my experience with generators, I have used portable generators in the course of my work for decades. For example, I used portable generators in the timeframe from 1987-1990 when I worked in the construction industry as a machine operator. I have also designed machines that relied upon portable generators. For example, in the 2006-2007 timeframe, I designed and built a small scale mobile robotic boom crane. The boom crane had a sophisticated control system that utilized a Programmable Logic Control (PLC) and numerous sensors. These electrical components ran off of electrical power that was provided by 110VAC. When used indoors, the crane was powered from wall sockets. However, when used outdoors, the crane was powered by an electrical generator that rode on a wagon towed by the crane. That wagon and generator are shown below.

¹ The references cited in this paragraph are listed at the end of this declaration.



Generator for Robotic Mobile Boom Crane.

13. I have also worked on previous litigation matters wherein control of fluid into an engine was a central issue. For example, I worked on a patent case that involved control of air supply into an internal combustion engine. I have also worked on intellectual property litigation involving engine-powered machinery such as cranes, slip-form concrete pavers, road milling machines, as well as water pump flow control.

14. Although the '034 patent does not claim, or even describe, the use of vaporizers, the prior art put forth by Petitioner requires the use of vaporizers to prepare liquid fuel for use in engines. I have also worked on several previous litigation matters wherein vaporizers were central and indispensable components. Therefore, I have considerable experience working with devices that heat up liquid to generate vapor.

15. In addition to my engineering experience as a professor and an engineer, I have commercialized technology developed in my research group at Georgia Tech by founding two companies: CAMotion Cranes and InVekTek. CAMotion Cranes designs and installs crane control systems that decrease payload swing, automatically avoid obstacles, and improve crane safety. These improvements are achieved through sensor systems and control methods that my research group developed, patented, and deployed. CAMotion Cranes was acquired by PAR Systems in 2013. InVekTek develops and commercializes control systems for robotic and industrial material-handling systems. The control systems are embedded in motor drives to reduce unwanted machine motion.

16. My CV provides further details about my degrees, employment history, teaching experience, publication list, scholarly accomplishments, professional contributions, grants, honors, and awards. [EX2079.]

17. Over the last five years, I have testified as an expert at trial or at a deposition in the following cases:

- a. K-fee System v. Nespresso, Case No. 2:21-cv-3402-GW-AGR_x (C.D. CA);
- b. Exotec v. Opex, IPR 2024-00850 (United States Patent and Trademark Office);
- c. Champion v. Firman, Civil Action CV-23-2371-PHX-DWL (D. Ariz.);

- d. Gomaco v. Guntert and Zimmerman, IPR2024-00835, PGR2024-00026 (United States Patent and Trademark Office);
- e. US Conec v. Senko, ITC Inv. No. 33-TA-1399 (International Trade Commission);
- f. Juul v. NJOY: IPR2024-00160, IPR2024-00161 (United States Patent and Trademark Office);
- g. Lenovo v. Asus: ITC Investigation No. 337-TA-1382 (International Trade Commission);
- h. Juul v. NJOY: ITC Investigation No. 337-TA-1368 (International Trade Commission);
- i. LightGuide v. Amazon: IPR2023-01423 (United States Patent and Trademark Office);
- j. Bissell v. Tineco: ITC Investigation No. 337-TA-1304 (International Trade Commission);
- k. Opex v. HC Robotics: ITC Investigation No. 337-TA-1293 (International Trade Commission);
- l. Caterpillar Paving Products v. Wirtgen America: IPR2022-01264, IPR2022-01277, IPR2022-01278, IPR2022-01310 (International Trade Commission);
- m. DJI v. Textron: IPR2022-00162, IPR2022-00163, and IPR2022-00453 (United States Patent and Trademark Office);
- n. Boyd v. Elliott Equipment: Case No: 1684CV00822 (Superior Court of Massachusetts);
- o. iRobot v. SharkNinja: ITC Investigation No. 337-TA-1252 (International Trade Commission);
- p. Courkamp v. Fisher Price: Case No. CV-19-02689-PHX-GMS (D. Ariz.);

- q. Coleman Co. vs. Team Worldwide Corp: Case No. 2:20cv351-RGD-RJK (E.D. Va.);
- r. Gomaco v. Guntert and Zimmerman: IPR2020-01698, IPR2021-00050, IPR2021-00136, IPR2021-00234 (United States Patent and Trademark Office);
- s. Unicorn Global v. GoLabs: Case No. 3:20-cv-02023 (N.D. Tex.);
- t. Gamevice v. Nintendo, ITC Investigation No. 337-TA-1197 (International Trade Commission);
- u. Guntert and Zimmerman v. Gomaco, Case No. 5:20-cv-4007 (N.D. Iowa); and
- v. Wong et al. v. Morrow Equipment et al: Case No. 19-2-33286-7 SEA (Superior Court of Washington, King County).

II. SCOPE OF ENGAGEMENT

18. I have been retained by Ziolkowski Patent Solutions on behalf of Patent Owner Champion Power Equipment, Inc. to provide analysis and opinion in connection with Champion's Patent Owner Preliminary Response to IPR2025-00805. I have also been retained as an expert on behalf of Patent Owner in co-pending district court litigation. *See e.g., Champion v. Firman*, Civil Action CV-23-2371-PHX-DWL; *Harbor Freight Tools USA Inc., v. Champion Power Equip., Inc.*, No. 2:24-cv-08722-SVW (C.D. Cal. Oct. 9, 2024).

19. I understand that the Petition involves U.S. Patent No. 10,393,034 (the "'034 Patent"). [EX1001.] I have been asked to provide my opinions as to the validity of Claims 1-24 (the "Challenged Claims") of the '034 Patent.

20. This Declaration sets forth the opinions that I have formed related to the Challenged Claims based on my personal knowledge, education, research, personal and professional experience, and the information I have reviewed as of the date of this Declaration. In connection with my analysis, I have reviewed the full record of IPR2025-00805, including the Petition and all exhibits thereto, Patent Owner's Brief in Support of its Request for Discretionary Denial of Institution (Paper 8), the exhibits listed in the above table of exhibits, and all documents referenced herein.

21. I am being compensated at the hourly rate of \$875 for my work in this proceeding, including studying this matter, preparing this declaration, and providing deposition and trial testimony. Travel time will be billed at a 50% rate. This is my standard hourly rate for engagements of this nature. My compensation is not contingent upon the outcome of this proceeding or the particular testimony or opinions that I express. I am also being reimbursed for expenses incurred as a result of activities performed as an expert in this matter.

22. Between now and such time that I may be asked to testify, I expect to continue my review, evaluation, and analysis of evidence presented during this proceeding. I expressly reserve the right to amend or supplement this Declaration, as appropriate. I have personal knowledge of the facts stated in the declaration, and I am willing to competently testify to them if and when called to do so. In the event

that additional relevant information becomes available to me, I also reserve the right to review and consider that information in further developing or refining my opinions.

III. PERSON OF ORDINARY SKILL IN THE ART

23. I understand that, in the context of an invalidity analysis, a person having ordinary skill in the art (“POSITA”) is a hypothetical person who looks to prior art at the time of the invention and compares the claimed invention to the prior teachings. An invalidity analysis is to be conducted from the point of view of a POSITA at the time of the invention.

24. I understand a POSITA is determined by looking at, among other factors, (1) the educational level of the inventor, (2) the type of problems encountered in the art, (3) prior art solutions to those problems, (4) the rapidity with which innovations are made, (5) the sophistication of the technology, and (6) the educational level of active workers in the field. I understand these factors are not exhaustive, but are merely a guide to determining the level of ordinary skill in the art. For example, the claimed subject matter can be compared to subject matter that is typically taught in the relevant engineering curricula to provide guidance as to what would constitute appropriate educational requirements for a person of ordinary skill in the art.

25. In light of these considerations, a POSITA pertinent to the '034 Patent would have a four-year degree in mechanical engineering or a closely related field and at least one year of experience designing, developing, servicing, or operating fuel-powered machinery. Additional education could substitute for professional experience, and significant work experience—such as working with, servicing, or operating such machinery in the field—could substitute for formal education.

26. The '034 Patent describes technology at a level that someone with the above education and work experience would understand. A POSITA, as described above, would understand the different mechanical components and functionality of fuel-powered machinery that are required to practice the Challenged Claims. They would have gained this understanding from either developing the components and control systems for such machines, or from servicing and operating such machinery in the field, which frequently requires knowledge of the machines to perform maintenance and repairs consistent with the requirements of operator manuals. Indeed, service manuals for such machinery assume that the reader is familiar with the mechanical components and control systems and how they work, at least at the level described in the '034 Patent.

27. As mentioned above, I often find it useful to compare the claimed subject matter to the topics taught in engineering curricula. This helps guide the selection of the formal educational requirements. My requirement of a four-year

degree in mechanical engineering or a closely related field is based on my experience teaching mechanical engineering students for more than 25 years. The material taught to mechanical engineering students covers the subject matter of the claims of the '034 Patent. For example, in our sophomore-level design class at Georgia Tech we teach the students how to use a processor and sensors to control the actions of an automated machine that includes pneumatic actuators controlled by electro-mechanical valves. The ultimate power source for the pneumatics is a pressured air tank whose fluid output goes through a regulator. The students utilize quick-connect hose couplings to connect the various components of their pneumatic systems.

28. During their senior year, mechanical engineering students complete a capstone design project wherein they usually design, construct, and demonstrate a prototype product. Such prototypes often utilize switches, valves, and various mechanical assemblies. Therefore, mechanical engineering students would be able to understand and practice most of the claimed features, as well as how those features would be combined and operate.

29. The '034 Patent also includes components involving delivery of liquid and/or gas to the engines. The detailed components of such systems, like carburetors comprising float bowls, are not usually taught at the undergraduate level. Therefore, my proposed definition of a POSITA includes the requirement of one year of

experience designing, developing, servicing, or operating fuel-powered machinery, or in the alternative, substantial work experience in the field.

30. I understand that Petitioner asserts that a POSITA:

[W]ould have a college degree in mechanical engineering, physics, or related fields, and three years of work experience in combustion engines operating on various fuel sources. Additional higher graduate education could substitute for work experience, and additional work experience/training could substitute for formal education. For example, a person having significant experience servicing or operating dual-fuel combustion engines, or incorporating such engines into their finished products, would qualify as a [POSITA].

[Petition, 11-12 (citing EX. 1003, ¶¶31, 49-50).]

31. I note that Petitioner provides no analysis of the claims nor justified reasoning for its proposed definition. As such, it is my understanding that its suggestion for the POSITA standard should be given little weight. In particular, its suggestion that a physics degree is an appropriate educational standard is off base and not appropriate for the claimed technology.

32. I am very familiar with the technology described in the '034 Patent. As of the earliest priority date of the '034 Patent, and well before, I qualified as a POSITA under my proposed definition.

33. Additionally, I had, and presently have, the capabilities set forth in Petitioner's definitions of a POSITA at the time of the alleged invention as I (1) met

the undergraduate educational requirements, (2) had additional higher graduate education, and (3) have significant experience servicing or operating combustion engines, or incorporating such engines into their finished products. [*See above* Section I (“Education and Work Experience”).]

34. My opinions in this declaration are not impacted regardless of whether Petitioner’s proposed definition or Patent Owner’s proposed definition of a POSITA is applied. Likewise, a POSITA’s understanding of the pertinent claim terms is not impacted regardless of whether Petitioner’s proposed definition or Patent Owner’s proposed definition is applied.

IV. UNDERSTANDING OF APPLICABLE LEGAL PRINCIPLES

35. I use the legal principles below, which I understand from counsel, as a guide in formulating my opinions.

A. Scope of the Proceedings

36. I understand that a petition must identify in writing and with particularity (1) each claim challenged, (2) the grounds on which the challenge to each claim is based, and (3) the evidence that supports the grounds for the challenge to each claim.

37. I further understand that, with respect to IPR proceedings, the scope of the proceedings is limited to the grounds recited in the petition. Specifically, I understand that the petition is required to include a full statement of the reasons for

relief requested, including a detailed explanation of the significance of the evidence and all material facts.

38. I further understand that the expedited nature of IPRs bring with it an obligation for a petitioner to make its case in its petition to institute. Rather than relying on vague conclusory statements to support unpatentability based on obviousness under 35 U.S.C. §103, the petitioner must provide specific reasoning supported by evidence.

39. Specifically, in order to satisfy its burden of proving obviousness, a petitioner cannot employ mere conclusory statements. Instead, a petitioner has the burden to submit facts to the record that show whether the prior art discloses a claim limitation, whether a skilled artisan would have been motivated to modify or combine teachings in the prior art, and whether the artisan would have had a reasonable expectation of success in doing so.

40. If the petition does not clearly demonstrate how the cited prior art meets each claim element, a petitioner will fail to meet its burden. Failure to prove the matter as required means that the party with the burden of persuasion loses on that point—thus, if the fact trier of the issue is left uncertain, the party with the burden (the petitioner) loses. Consequently, if the petition fails to particularly point out how the cited prior art meets each of the claimed elements as construed by the petitioner, the petitioner loses, and institution of the IPR should be denied.

B. Claim Interpretation

41. My opinions concern what I believe the person having ordinary skill in the art would have understood the meaning of certain claim terms to be based on the patent documents.

42. I understand that assessing the validity of a patent claim requires a two-step analysis. The first step involves the proper interpretation, or construction, of the claim language in order to determine its scope and meaning. The second step requires comparing the claim, as properly construed, to the alleged prior art to determine whether the limitations of the claim are met by the prior art.

43. My methodology for determining the meaning of claim terms or phrases involved the following steps. My first step was to study the patent carefully. In particular, I studied the claims themselves, followed by the background, detailed specification, figures, and other patent content. Next, I reviewed the prosecution history and looked for any clarifications or limitations that might be attached to various claim terms. Finally, in some circumstances, I looked at other documents, such as dictionary definitions and references applied by the patent office.

44. I understand that in an inter partes review, claim terms are to be given their ordinary and customary meaning as understood by persons having ordinary skill in the art in the context of the entire disclosure at the time of the invention. I understand that one must be careful not to read a specific embodiment appearing in

the written description into the claim if the claim language is broader than the embodiment. I further understand that any special definition for a claim term must be set forth with reasonable clarity, deliberateness, and precision.

45. I further understand that a claim construction that gives meaning to all the terms of the claim is preferred over one that does not do so, and that a proposed construction is disfavored where it would render express claim limitations meaningless.

46. I have been informed that this standard is the same as that used in United States district courts, in which claim terms are given their ordinary and customary meaning as would be understood by persons having ordinary skill in the art at the time of the invention having taken into consideration the language of the claims, the specification, and the prosecution history of record under the *Phillips* claim construction standard. *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005).

C. Prior Art

47. I understand that information that satisfies one of the categories of prior art set forth in 35 U.S.C. § 102 may be used in an invalidity analysis under §§ 102 or 103. If information is not properly classified as prior art under one of the subsections of § 102 of the Patent Code, then it may not form the basis of an anticipation or obviousness determination. It is also my understanding that, for inter partes review, applicable prior art is limited to patents and printed publications.

D. Anticipation

48. I understand that a patent claim is invalid due to anticipation under 35 U.S.C. § 102 if each and every element of the patent claim is disclosed in a single asserted prior art reference and that such disclosure may be either explicit or inherent. I also understand that a disclosure of an asserted prior art reference can be “inherent” if the missing element is necessarily present or is the inevitable outcome of the process and/or thing that is explicitly described in the asserted prior art reference.

49. I also understand that in order to anticipate the claimed invention, a prior art reference must disclose all elements of the claim within the four corners of the document, and it must disclose those elements arranged as in the claim. However, a reference can anticipate a claim even if it does not expressly spell out all the limitations arranged or combined as in the claim, if a person of skill in the art, reading the reference, would at once envisage the claimed arrangement or combination.

E. Obviousness

50. I also understand that a patent claim is invalid under 35 U.S.C. § 103 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 of the invention to persons having ordinary skill in the art to which the subject matter pertains. Obviousness, as

I understand, is determined based on the scope and content of the prior art; the level of ordinary skill in the art at the time of the alleged invention; differences between the alleged invention and the prior art; and objective evidence of non-obviousness.

51. I further understand that a party seeking to invalidate a patent on obviousness grounds must demonstrate by a preponderance of the evidence that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.

52. I understand that the pertinence of the prior art reference as a source of solution to the inventor's problem must be recognizable with the foresight of a person of ordinary skill, not with the hindsight of the inventor's successful achievement, and that a factfinder should be aware, of course, of the distortion caused by hindsight bias and must be cautious of arguments reliant upon ex post reasoning.

V. PETITIONER'S INVALIDITY CHALLENGES

53. I understand that Petitioner challenges Claims 1-24 of the '034 Patent based on the following:

Ground	Claims	Basis	Primary Reference	Secondary Reference(s)
1	1-3, 5-9, 18	103	Nakafushi	Olmr
2	4, 10	103	Nakafushi	Olmr; Duffy

3	19-23	103	Nakafushi	Olmr; Bernhardsson and/or Duffy
4	11-13, 16-17	103	Nakafushi	Jungmann; Parlatore
5	14-15, 24	103	Nakafushi	Jungmann; Parlatore; Olmr and/or Bernhardsson
6	1-3, 5-9, 11-14, 17-20, 22-23	102	Kubota DF972 Workshop Manual	
7	4	103	Kubota Workshop Manual	Duffy
8	16, 24	103	Kubota Workshop Manual	Parlatore and/or the Tri-Fuel Video

54. As explained in additional detail below, the alleged prior art relied on by Petitioner does not disclose either “a gaseous fuel source” or “a gaseous fuel supplied from a pressurized fuel source.”

VI. BACKGROUND

55. Liquefied petroleum gas is commonly referred to as “LPG” or “propane.” [EX1001, 1:46-49.] Propane “is derived from the refining of oil and gas and is compressible to a liquid form for storage.” [*Id.*, *see also* EX2080 (U.S. Patent Pub. No. 2012/0104008), ¶[0003].]

56. Like virtually all forms of matter, LPG can exist in various different states that have very different properties. The terms “liquid propane” or “liquid LPG” are commonly used to describe LPG when present in a liquid state.

57. The terms “propane vapor” and “gaseous LPG” are commonly used to describe LPG in a gaseous state.

58. Prior to the priority date of the '034 Patent, the distinctions between gaseous and liquid LPG were well known in the art. For example, I have reviewed archives of the “Propane 101” website which pre-date the '034 Patent. True and correct copies of excerpts of the Propane 101 website as they existed in February, 2015 are filed with this declaration as Exhibit 2081, including the following web pages:

- **EX2081.A:** <http://www.propane101.com>, dated February 9, 2015;
- **EX2081.B:** <http://www.propane101.com/propaneliquidandvapor.htm>, dated February 4, 2015;
- **EX2081.C:**
<https://www.propane101.com/understandingpropanetanks.htm>, dated February 6, 2015;
- **EX2081.D:** <http://propane101.com/propanecylinders.htm>, dated February 6, 2015;
- **EX2081.E:** <http://www.propane101.com/industrialpropanecylinders.htm>, dated February 11, 2015; and
- **EX2081.F:** <http://www.propane101.com/propanecylinderusage.htm>, dated February 14, 2015.

59. I have reviewed the information presented on these webpages, and concluded that it is both accurate, and consistent with my understanding of liquid petroleum gas.

60. The “Propane Liquid and Propane Vapor” webpage states that:

Before propane is used, it exists in one of two forms, liquid or vapor. Both liquid propane and vapor are usable but cannot be used interchangeably. *In other words, a propane system designed to use vapor can't utilize propane in its liquid form and vice-versa.* Additionally, the characteristics of propane liquid and propane vapor are so different that the primary properties we are concerned with are as different as night and day.

[EX2081.B.] Specifically, I agree that a propane system designed to use vapor cannot utilize propane in its liquid form and vice-versa. This is also true for component parts of a system that utilizes liquid propane in some parts of the system and propane vapor in other parts.

61. LPG “exists in a gaseous state at normal temperature and pressure but can be conveniently stored under pressure in a liquid state.” [EX1001, 1:46-49.] The propane storage disclosed by the '034 Patent can be accomplished in large on-site tanks, or in portable cylinders. [EX2081.C; EX2081.D.]

62. Petitioner’s expert, Dr. Morse, states that “A POSA would understand that . . . LPG is a gaseous fuel (LPG is most typically stored in a tank under pressure as a liquid, but is decompressed/vaporized and sent into the engine as a gas).”

[EX1003, ¶90; *see also id.*, ¶66 (referring to “LPG” and “propane” as “a hydrocarbon fuel that is stored under pressure as a liquid, but ultimately fed to the generator engine as a gas comprising mostly propane”).] I disagree with the characterization that liquified petroleum gas is always a gaseous fuel because it is often used as a fuel in its liquid state.

63. While Dr. Morse correctly states that LPG is typically stored as a liquid and enters the engine as a gas, his categorical assertion that a POSITA would have understood any reference to liquified petroleum gas (LPG) refers to a gaseous fuel is incorrect, as indicated by the very same references that Petitioner cites in its grounds. [*See, e.g.*, Ex. 1012, 65 (separately identifying both a “Liquid Propane Line” and a “Gaseous Propane Line”).]

64. *First*, Dr. Morse’s assertion that LPG is “sent into the engine as a gas” or “fed to the generator engine as a gas” is irrelevant. The vast majority of fuel sources (including liquid gasoline, which both Petitioner and Patent Owner agree is a *liquid* fuel) are sent into the engine in a gaseous state. Thus, the phase of matter at the time the fuel enters the engine does not indicate “a gaseous fuel **source**” or “a gaseous fuel supplied from a pressurized fuel **source**.”

65. *Second*, many LPG applications are optimized to run on either liquid or gaseous LPG. As such, categorically referring to LPG as a gaseous fuel source

completely discounts numerous liquid LPG applications, and incorrectly characterizes the knowledge of a POSITA.

A. Gaseous LPG Systems

66. The fuel source containers of LPG are often called “cylinders.” LPG cylinders have a wide variety of possible configurations. For example, consumer-focused cylinders are designed to supply gaseous LPG and are used to fuel gas grills, fire pits, and generators. [EX2081.D.]

67. As another example, Petitioner’s Parlatore reference describes a system configured to operate using gaseous LPG. [EX1010, ¶[0014] (“In one exemplary embodiment and as shown in the exemplary diagram in FIG. 1, a gas, such [as] liquefied petroleum gas or propane, may be supplied to an engine as fuel. The gas may be stored in a bottle or tank, such as LPG tank 102. . . . An exemplary fuel system may use liquefied petroleum gas (LPG or propane) which may be stored in a vapor gaseous state in LPG tank 102. . . .”)]

68. Parlatore explicitly recognizes the benefits of propane vapor, stating that the LPG applications described therein “may be accomplished through the use of vapor fuel delivery rather than the delivery of liquid propane gas.” [EX1010, ¶[0025].] Moreover, using propane vapor supplied directly from the source, rather than converting liquid propane to propane vapor, allows the system to avoid “issues

pertaining to cooling and freezing, such as those known to affect the conversion of propane from liquid to gas.” [EX1010, ¶[0025].]

B. Liquid LPG Systems

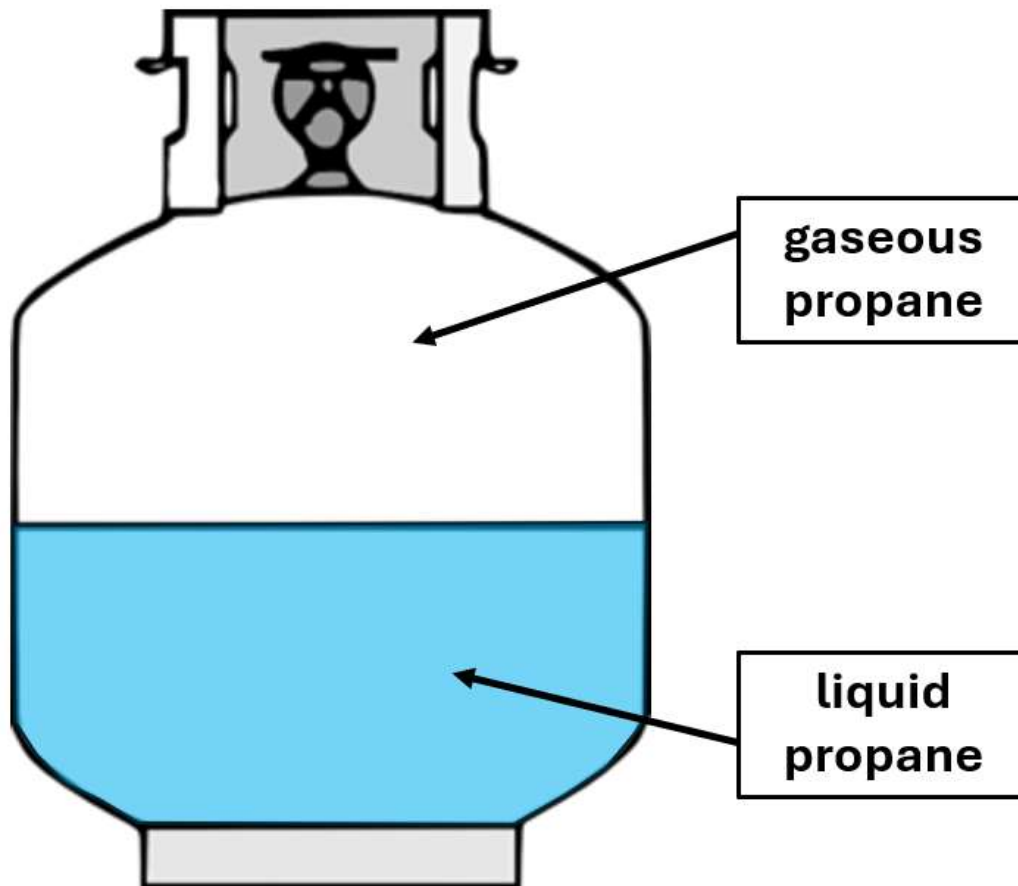
69. Conversely, commercial or industrial cylinders are optimized to supply liquid LPG to motorized commercial equipment such as forklifts. [EX2081.D-E.]

70. For example, “[p]ropane powered forklifts primarily use 33 pound [sic] cylinders as their fuel source and are equipped for liquid service. Because the cylinders are designed for liquid service, they have to be placed properly on the lift truck to operate correctly. Improper cylinder installation can result in loss of power and eventually complete loss of engine functionality.” [EX2081.E.]

71. Petitioner’s Bernhardsson reference provides another example of a system configured to operate using liquid LPG. [EX1008, 2:58-68 (“The system 4 for supplying a gaseous fuel, e.g. LPG (Liquefied Petroleum Gas) or natural gas, includes a container 40 in which the gas assumes liquid form under pressure. . . . The container 40 is connected to a vaporizer 43 via a solenoid valve 42 and a pipe 41 . . . and *gas supplied in liquid form to the vaporizer 43 is successively transformed into gas.*”) (emphasis added).] Notably, Bernhardsson *does not* teach that its system is operable on gaseous LPG, and using gaseous LPG in the system disclosed by Bernhardsson would render Bernhardsson’s vaporizer 43 superfluous.

C. LPG Storage and Distribution

72. Regardless of whether a LPG tank or cylinder is designed to supply liquid or gaseous LPG, the storage device contains LPG in both a liquid and gaseous state. Liquid propane is more dense than gaseous propane, and therefore sinks to the bottom of the tank, as depicted below:



Schematic Representation of an LPG Tank with Both Gaseous and Liquid Propane.

73. When the valve at the top of the LPG cylinder is opened, it causes the pressure within the cylinder to drop, which (1) causes the liquid LPG to boil and evaporate into a gas, and (2) releases the gaseous propane located near the valve.

74. The different LPG use cases and storage configurations would have been known to a POSITA. For example, such differences are discussed on the Propane 101 Website: “The proper use of a propane cylinder involves the appliance(s) being serviced. Propane appliances and equipment that utilize cylinders . . . are not to be used as a replacement for an empty bulk propane tank. . . . Also, bottles that are used in vapor service such as a barbeque grill or fish fryer cannot be replaced by a forklift propane cylinder, as LP Gas forklift cylinders use liquid propane for their specific engine fuel applications. . . LP Gas cylinders are not interchangeable with ASME bulk propane tanks or with other types of cylinders that are approved for specific LP Gas applications.” [EX2081.F.]

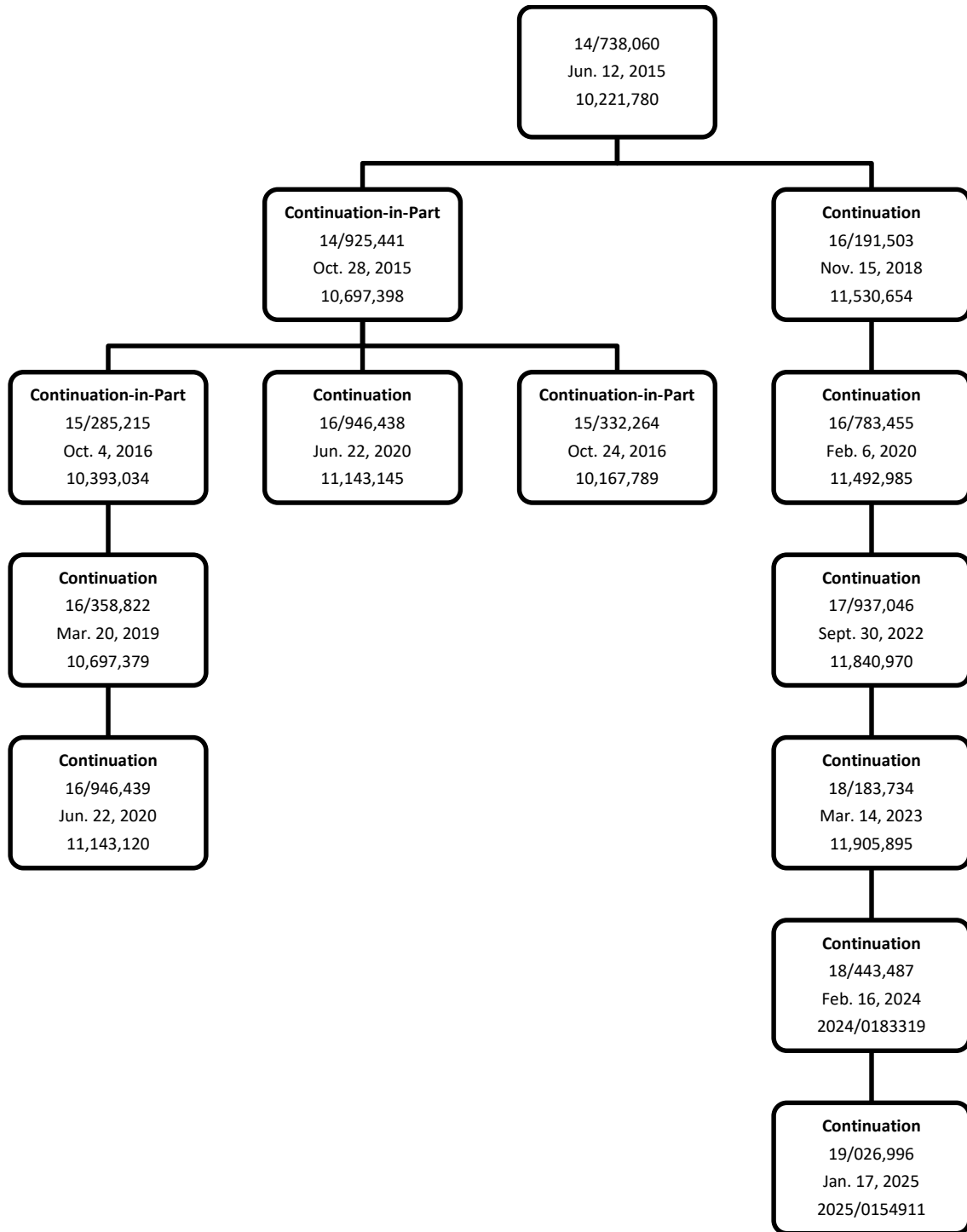
75. Of key importance to the understanding of the '034 Patent's claims, “[p]ropane vapor service and propane liquid service are completely different from one another.” [EX2081.B.] The vast majority of propane applications—such as water heaters, furnaces, gas grills, and the generators at issue in the co-pending disputes between Patent Owner and Petitioner—utilize propane vapor. [EX2081.B.] These applications are not configured to operate on liquid LPG. If liquid propane were injected into these systems it could result in fire or similar danger, which is

why consumer propane cylinders should always be positioned upright with their valves at the top of the storage vessels. [EX2081.B.]

VII. OVERVIEW OF THE '034 PATENT

76. The '034 Patent claims priority to and is a continuation-in-part of U.S. Patent Application No. 14/925,441, which issued as U.S. Patent No. 10,697,398. [EX1001, (63).] The '398 Patent in turn claims priority to and is a continuation-in-part of U.S. Patent Application No. 14/738,060, which issued as U.S. Patent No. 10,221,780. [EX1001, (63).] The '060 Application was originally filed on June 15, 2015. [*Id.*]

77. I understand that the '034 Patent is one of thirteen members of a patent family directed to multi-fuel engine technology, which are collectively referred to as the "2015 Family." The structure of the 2015 Family is depicted below in block diagram form:



Structure of the 2015 Family.

A. The Specification of the '034 Patent

78. The '034 Patent, titled “Fuel System for a Multi-Fuel Internal Combustion Engine,” is directed to a multi-fuel engine operable on both liquid fuel and gaseous fuel. [EX1001, Abstract.] The '034 Patent explains that problems with such multi fuel engines include overly rich air-fuel ratios, difficulties starting the engine, and unstable operating conditions when switching between liquid fuel and gaseous fuel:

[A] common problem with such configurations that couple two fuel sources to a single fuel inlet, such as a carburetor, of an engine is that during cross-over switching between the fuel sources the engine can experience overly rich air-fuel ratio. This is particularly problematic when switching from a liquid fuel to a gaseous fuel because carburetors have a fuel bowl containing fuel that is drawn into the engine even after the liquid fuel source is cut-off. Therefore, for a period of time, the engine is running on both liquid and gaseous fuels causing an overly rich fuel mixture. Further, such simultaneous delivery of fuel from the first fuel line and the second fuel line, even if for a brief time, may make the engine hard to start and lead to unstable operating conditions.

[EX1001, 1:60-2:6.]

79. To address these problems, the multi-fuel engine of the '034 Patent “includes a liquid cutoff solenoid coupled to open and close a liquid fuel path to the engine, and a gaseous cutoff solenoid coupled to open and close a gaseous fuel source to the engine.” [*Id.* at 2:16-20.] Further, “[a] switch couples a power source

to the liquid cutoff solenoid and the gaseous cutoff solenoid to switch between fuel sources on-the-fly during engine operation.” [*Id.* at 20-23.]

80. As the '034 Patent explains, gaseous fuels include, for example, gaseous “liquified petroleum gas, compressed natural gas, hydrogen, or the like.” [EX1001, 1:45-46.] “Liquified petroleum gas (LPG), often referred to as propane, exists in a gaseous state at normal temperature and pressure but can be conveniently stored under pressure in a liquid state.” [*Id.* at 1:46-49.] With respect to the systems disclosed by the '034 Patent, when the valve at the top of the LPG cylinder is opened, it causes the pressure within the cylinder to drop, which causes the LPG to evaporate into a gas. The LPG exits the valve in a gaseous state, *not* as a liquid. [See Section VI, above.]

81. Because the pressurized fuel source described by the '034 Patent supplies gaseous fuel to the system (as opposed to liquid fuel), it does not require a vaporizer, or a heat source necessary for operation of a vaporizer, to change the fuel from a liquid state to a gaseous state. Instead, the '034 Patent discloses two pressure regulators: (1) primary pressure regulator 64 to regulate the pressure of the gaseous fuel when it is drawn from the fuel source and (2) secondary pressure regulator 66 to regulate the pressure of the gaseous fuel received from primary pressure regulator 64. However, the fuel flowing through pressure regulator 64 and secondary pressure regulator 66 is in a gaseous state, as drawn from the gaseous fuel source.

B. The Independent Claims of the '034 Patent

Claims 1, 11, and 18 are reproduced below:

<p>1. A multi-fuel engine comprising: an engine operable on a liquid fuel and a gaseous fuel; a carburetor attached to an intake of the engine to mix air and fuel and connect a liquid fuel source to the intake, the carburetor comprising a float bowl; a liquid cutoff solenoid coupled to the carburetor to open and close a liquid fuel path to the engine downstream from the float bowl; <u>a gaseous cutoff coupled to open and close a gaseous fuel source to the engine</u>; and a switch selectively coupling a power source to the liquid cutoff solenoid to open and close the liquid fuel path.</p>	<p>11. A multi-fuel generator and fuel delivery system comprising: a multi-fuel internal combustion engine configured to operate on a liquid fuel supplied from a liquid fuel source through a liquid fuel line and <u>a gaseous fuel supplied from a pressurized fuel source</u> through a gaseous fuel line; an alternator driven by the multi-fuel internal combustion engine; a fuel regulator system comprising: a primary pressure regulator coupled to a service valve of the pressurized fuel source to regulate fuel supplied from the pressurized fuel source to a reduced pressure, and a secondary pressure regulator coupled to the primary pressure regulator to regulate fuel supplied from the primary pressure regulator to a desired pressure for delivery through the gaseous fuel line to operate the engine; and an electro-mechanical valve system coupled to the engine and operated by an electrical switch powered by one of the alternator, a battery, and a magneto that controls fuel flow to the engine from the liquid fuel source and the pressurized fuel source.</p>	<p>18. A multi-fuel internal combustion engine comprising: an engine operable on liquid fuel supplied through a liquid fuel line from a liquid fuel source and <u>gaseous fuel supplied through a gaseous fuel line from a pressurized fuel source</u>; a carburetor coupled to an intake of the engine to mix air and fuel and connect to the liquid fuel line and the gaseous fuel line; a carburetor cutoff solenoid coupled to control fuel flow within the carburetor from the liquid fuel line and selectively engage engine operation on liquid fuel; and a gaseous fuel valve coupled to control fuel flow through the gaseous fuel line and selectively engage engine operation on gaseous fuel.</p>
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C. The Prosecution History of the '034 Patent

1. The Parent '441 Application

82. U.S. Patent Application No. 14/925,441 (the parent to the '034 Patent), was filed on October 28, 2015. [EX1001, (63).] On October 11, 2018, the Examiner (“Long T Tran”) rejected then-pending claims 1-63 of the '441 Application. [EX2053, 1-2.] Of particular relevance, the Examiner rejected pending Claim 1 “under 35 U.S.C. 103 as being unpatentable over Poehlman (US 4,489,699) and in view of Tsuda et al. (US 5,809,979).” [EX2053, 4.] Regarding Claim 1, the Examiner explained that “Poehlman teaches . . . a carburetor (15) attached to an intake (105) of the engine to mix air and fuel and connect to a gaseous fuel source (27) and a liquid fuel source (21)” and “Tsuda et al. teaches to the liquid fuel cut-off (14) is incorporated into the carburetor.” [EX2053, 4-5.]

83. After several rounds of back and forth with the Examiner, Patent Owner amended the Claim 1 on May 28, 2019 to add additional limitations directed towards liquid and gaseous fuel valves:

1. (Currently Amended) A dual fuel engine comprising:
 - an engine operable on a gaseous fuel and a liquid fuel;
 - a switch to change operation of the engine between gaseous fuel and liquid fuel;
 - a carburetor attached to an intake of the engine to mix air and fuel and connect to a gaseous fuel source and a liquid fuel source;
 - a liquid fuel valve positioned along a liquid fuel line coupling the liquid fuel source to the carburetor;
 - a gaseous fuel valve positioned along a gaseous fuel line coupling the gaseous fuel source to the carburetor; and
 - a liquid fuel cut-off incorporated into the carburetor to interrupt liquid fuel upon actuation of the switch from liquid fuel to gaseous fuel.

[EX2082, 119.]

84. However, the Examiner issued a final rejection on July 22, 2019. [EX2082, 81.] Again, the Examiner found that “Poehlman teaches . . . a liquid fuel valve (43) positioned along a liquid fuel line (19) coupling the liquid fuel source to the carburetor; a gaseous fuel valve (45) positioned along a gaseous fuel line (25) coupling the gaseous fuel source to the carburetor.” [EX2082, 84.]

85. In response to the final rejection, Patent Owner filed an appeal brief on January 22, 2020, arguing that the claims were patentable over the *combination* of Poehlman and Tsuda. Specifically, Patent Owner argued that a POSITA “would recognize that it would not be a mere ‘rearrangement of parts’ to modify the system of Poehlman to incorporate [features from Tsuda], as alleged by the Examiner.” [EX2082, pp. 24, 37.] A Notice of Allowance issued on March 6, 2020, where the

Examiner conceded that “[i]t would not have been obvious to *further modify* the combination of Poehlman and Tsuda et al.” [EX2082, 13.]

2. The '215 Application

86. Concurrently, prosecution of the '034 Patent was ongoing. The '034 Patent was filed as U.S. Patent Application No. 15/285,215 on Oct. 4, 2016. The Examiner (again, “Long T Tran”) issued a non-final rejection on February 2, 2018 alleging that then-pending claims 1-7 and 20-25 were rejected as anticipated by Poehlman. Specifically, the Examiner stated:

Peohlman [sic] teaches a multi-fuel engine comprising: an engine (13) operable on a liquid fuel (21) and a gaseous fuel (27); a liquid cutoff solenoid (43) coupled to open and close a liquid fuel path to the engine; a gaseous cutoff solenoid (45) coupled to open and close a gaseous fuel source to the engine; and a switch (51) coupling a power source (59) to the liquid cutoff solenoid and the gaseous cutoff solenoid to switch between fuel sources on-the-fly during engine operation.

[EX1002, 266.] The remaining claims were rejected over various combinations of Poehlman, Kern (US2004/0139943), and Graf (US 5,450,832). [EX1002, 263-278.]

87. In response, Patent Owner argued, *inter alia*, that “Poehlman fails to disclose a liquid cutoff solenoid coupled to open and close a liquid fuel path to the engine and a gaseous cutoff solenoid coupled to open and close a gaseous fuel source to the engine” and “cannot be said to anticipate that which is called for in claim 1.”

[EX1002, 231.] The Examiner made the rejection final on June 8, 2018. EX1002, 142.

88. The Examiner issued another non-final rejection on January 25, 2019, stating that Claims 1-7 and 20-25 were “rejected under 35 U.S.C. 103 as being unpatentable over Poehlman (US4,489,699) and in view of Walker (US 3,718,000). [EX1002, 47-48.] Specifically, the Examiner explicitly found that “Poehlman is silent to the liquid and gaseous cutoff is a cutoff solenoid” but that “Walker teaches a similar multi-fuel engine in which the liquid and gaseous fuel lines comprise a control valve 85 being energized by a solenoid 84 to control the flow of gasoline; and a control valve 99 energized by a solenoid 98 to control the gaseous fuel flow.” [EX1002, 47-48.]

89. On April 25, 2019, Patent Owner amended the Claims to state: “a liquid cutoff solenoid coupled to the carburetor to open and close a liquid fuel path to the engine downstream from the float bowl.” [EX1002, 28.] Patent Owner also argued that “neither Poehlman nor Walker teaches or suggests a carburetor to mix air and fuel and connect to the liquid fuel line and the gaseous fuel line with a carburetor cutoff solenoid coupled to control fuel flow within the carburetor from the liquid fuel line, as called for in claim 20.” [EX1002, 38.] Finally, Patent Owner argued that “neither of Kem or Graf teaches or suggests a fuel regulator system including a primary pressure regulator and a secondary pressure regulator, with the secondary

pressure regulator regulating fuel supplied from the primary pressure regulator to a desired pressure for delivery through the gaseous fuel line to operate the engine.”

[EX1002, 39.] The Examiner issued a Notice of Allowance on June 18, 2019.

VIII. CLAIM CONSTRUCTION

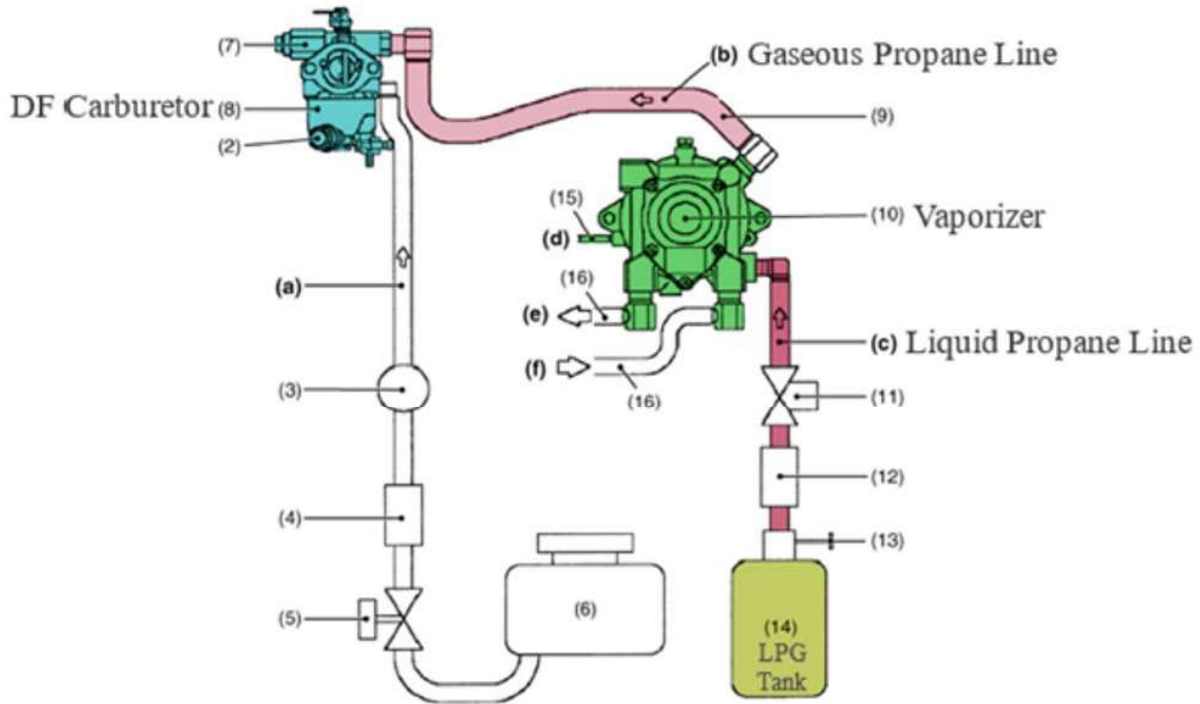
90. I understand that Petitioner alleges that they “have not identified any claim terms that need construction in order to address the issues raised by this Petition.” [Pet., 12.] I further understand that for purposes of the arguments set forth in its Preliminary Response, Patent Owner applies the plain and ordinary meaning of each claim limitation which is addressed.

91. As such, I have also applied the plain and ordinary meaning of the claim terms for my analysis.

IX. THE ALLEGED PRIOR ART

A. Kubota DF972-E2 Workshop Manual (“Workshop Manual”)

92. The Petition states “[t]he Workshop Manual describes the Kubota DF972-E2 engine—a dual-fuel engine with an alternator to function as a generator that runs alternatively off of gasoline or LPG.” [Pet., 20 (citing Ex. 1012, 65).] Without conceding their accuracy, Petitioner’s annotations to the Workshop Manual’s “Fuel System” diagram are reproduced in part below:



[Pet., 21 (citing EX1012, 65).]

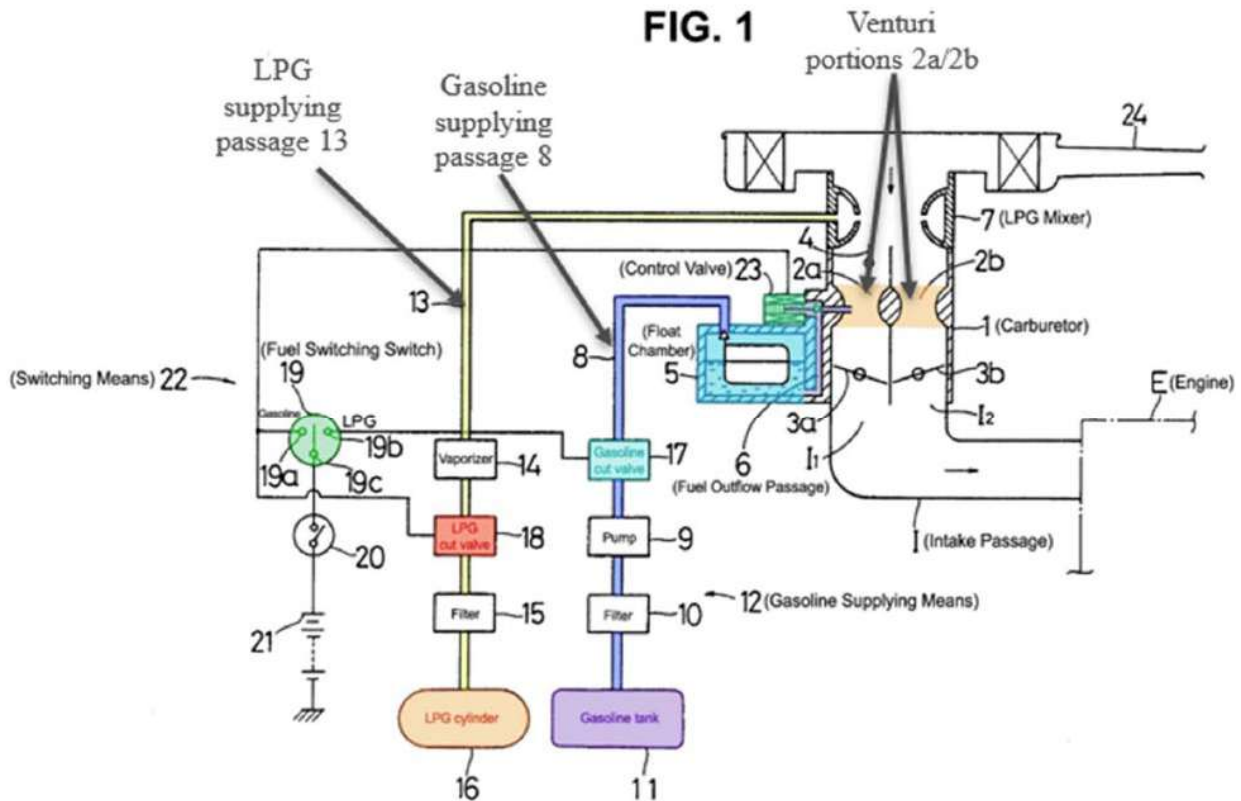
93. The Workshop Manual teaches that “[f]or LPG fuel, the liquid fuel stored in the LPG tank (14) is sent to vaporizer (10) by pressure in the gaseous phase in the tank” and “[t]he liquid fuel is evaporated in vaporizer.” [EX1012, 65.] Specifically, the Workshop Manual explains that a “[v]aporizer is a device which converts the liquid fuel into the gaseous fuel” [*id.*, 69] and that, “[w]hen evaporating by primary chamber of vaporizer[,] liquid LPG needs the evaporation heat.” [*Id.*, 64.] “The coolant of the engine is made to circulate as a heat source to evaporate the LPG.” [*Id.*, 69.] The above-referenced figure shows that liquid propane is transported to the vaporizer (10) via a liquid propane line (c), and also shows coolant flows to and from the vaporizer (10) via a “Hot Coolant In Line” (f) and a “Hot

Coolant Out Line” (e). [*Id.*, 65.] The Workshop Manual summarizes the purpose of the vaporizer on page 64: “This vaporizer installs the water jacket, throws the coolant of engine, heats primary chamber, promotes evaporation, and prevents valves being frozen.” A POSITA would have understood that the Workshop Manual discloses that LPG tank (14) supplies *liquid* LPG.

B. JPS61283734A (“Nakafushi”) (Ex. 1004/1005)

94. Nakafushi operates on the same principle as the Workshop Manual. The Petition states that “Nakafushi is directed to an engine configured to selectively use gasoline or liquid petroleum gas (“LPG”) as fuel.” [Petition, 12 (citing Ex. 1005, ¶[0001]).] Nakafushi discloses “LPG bomb 16” which a POSITA would have understood comprises an on-site LPG tank. [Ex. 1005, ¶[0012].]² Without conceding their accuracy, Petitioner’s annotations to Nakafushi’s Figure 1 are reproduced below:

² Nakafushi refers to numeral 16 as both an “LPG cylinder” and an “LPG bomb.” Ex. 1005, ¶[0012] (“LPG bomb 16 as an LPG supplying means by an LPG supplying passage 13 via a vaporizer 14 for vaporizing LPG”); ¶[0013] (“LPG supplying means (LPG bomb) 16 is operated to switch so as to supply LPG”); *see also* ¶¶[0016], [0021].



[Pet., 13 (citing Ex. 1005, Fig. 1).]

95. A POSITA would have understood that LPG bomb 16 supplies *liquid* LPG to vaporizer 14, which then converts the LPG into gaseous form. [Ex. 1005, ¶[0012] (“LPG bomb 16 as an LPG supplying means by an LPG supplying passage 13 via a vaporizer 14 for vaporizing LPG”).] The function of the vaporizer is to convert the liquid LPG into a gaseous state so it may be properly combusted by the engine. The vaporizer 14 is designed to receive the liquid LPG and raise its temperature (heat the liquid) to the boiling point at the delivery pressure.

X. THE CHALLENGED CLAIMS OF THE '034 PATENT ARE NOT INVALID

96. The Petition alleges the following grounds for invalidity of the independent claims:

- Ground 1 alleges that Independent Claims 1 and 18 are obvious, applying Nakafushi as a base reference;
- Ground 4 alleges that Independent Claim 11 is obvious, applying Nakafushi as a base reference; and
- Ground 6 alleges that Independent Claims 1, 11, and 18 are anticipated by the Kubota DF972 Workshop Manual.

97. Collectively, Grounds 1, 4, and 6 are the *only* Grounds which address the independent claims of the '034 Patent. As such, if Petitioner is unable to show that one or more of Grounds 1, 4, and 6 present a reasonable likelihood that Petitioner would prevail with respect to Claims 1, 11, or 18, then I understand that institution should be denied.

A. The Workshop Manual-based grounds (Grounds 6-8) do not demonstrate a reasonable likelihood that any claims are unpatentable.

98. Specifically, in Ground 6 Petitioner alleges the Workshop Manual allegedly discloses the following limitations:

- Claim 1: “a gaseous fuel source”
- Claim 11: “a gaseous fuel supplied from a pressurized fuel source”

- Claim 18: “gaseous fuel supplied through a gaseous fuel line from a pressurized fuel source”

99. For the reasons set forth below, the Petition does not present a reasonable likelihood that the petitioner would prevail with respect to *any* of these limitations. As such, the Petition should be denied.

1. The Workshop Manual’s LPG Tank (14) is not a “gaseous fuel source” as alleged by the Petition.

100. Claim 1 of the ’034 Patent recites: “a gaseous cutoff coupled to open and close *a gaseous fuel source to the engine.*”

101. The Petition identifies LPG Tank (14) as the alleged gaseous fuel source. [Pet., 78-79 (“the Workshop Manual discloses a gaseous cutoff (i.e. a ‘LPG Cut Off Solenoid’) that opens and closes a gaseous fuel source (i.e. the ‘LPG Tank (14)’”) (citing EX1012, 65, 68).]

102. LPG Tank (14) is a liquid fuel source that supplies liquid LPG, not gaseous LPG. [Ex. 1012, 64-65, 69 (“[f]or LPG fuel, *the liquid fuel stored in the LPG tank (14) is sent to vaporizer (10)* by pressure in the gaseous phase in the tank” and “[t]he liquid fuel is evaporated in vaporizer”) (emphasis added); *see also* Section VI, above.] As such, the Workshop Manual does not disclose a gaseous cutoff coupled to open and close *a gaseous fuel source* to the engine because—simply put—LPG Tank (14) is a *liquid fuel source*, not a *gaseous fuel source*.

2. The Workshop Manual does not disclose “a gaseous fuel supplied from” LPG Tank (14) as alleged by the Petition.

103. Claim 11 of the '034 Patent recites: “a gaseous fuel supplied from a pressurized fuel source through a gaseous fuel line.” Similarly, Claim 18 recites “gaseous fuel supplied through a gaseous fuel line from a pressurized fuel source.” Importantly, both claims require gaseous fuel supplied from a pressurized fuel source.

104. The Petition identifies the Workshop Manual’s LPG Tank (14) as the alleged “pressurized fuel source.” [Pet., 78, 94, 103.]

105. LPG Tank (14) supplies *liquid* LPG, not gaseous LPG. [Ex. 1012, 64-65, 69 (“[f]or LPG fuel, *the liquid fuel stored in the LPG tank (14) is sent to vaporizer (10)* by pressure in the gaseous phase in the tank” and “[t]he liquid fuel is evaporated in vaporizer”); *see also* Section VI, above.] As such, the Workshop Manual does not disclose a gaseous fuel *supplied from* a pressurized fuel source because LPG Tank (14) *does not supply gaseous fuel*.

B. The Nakafushi-based grounds (Grounds 1-5) do not demonstrate a reasonable likelihood that any claims are unpatentable.

106. Petitioner relies on Nakafushi in the same erroneous manner as the Workshop Manual. Specifically, for Grounds 1 and 4, Petitioner relies solely on Nakafushi as allegedly disclosing the following limitations:

- Claim 1: “a gaseous fuel source”

- Claim 11: “a gaseous fuel supplied from a pressurized fuel source”
- Claim 18: “gaseous fuel supplied through a gaseous fuel line from a pressurized fuel source”

107. For the reasons set forth below, the Petition does not present a reasonable likelihood that the petitioner would prevail with respect to any of these limitations. As such, the Petition should be denied.

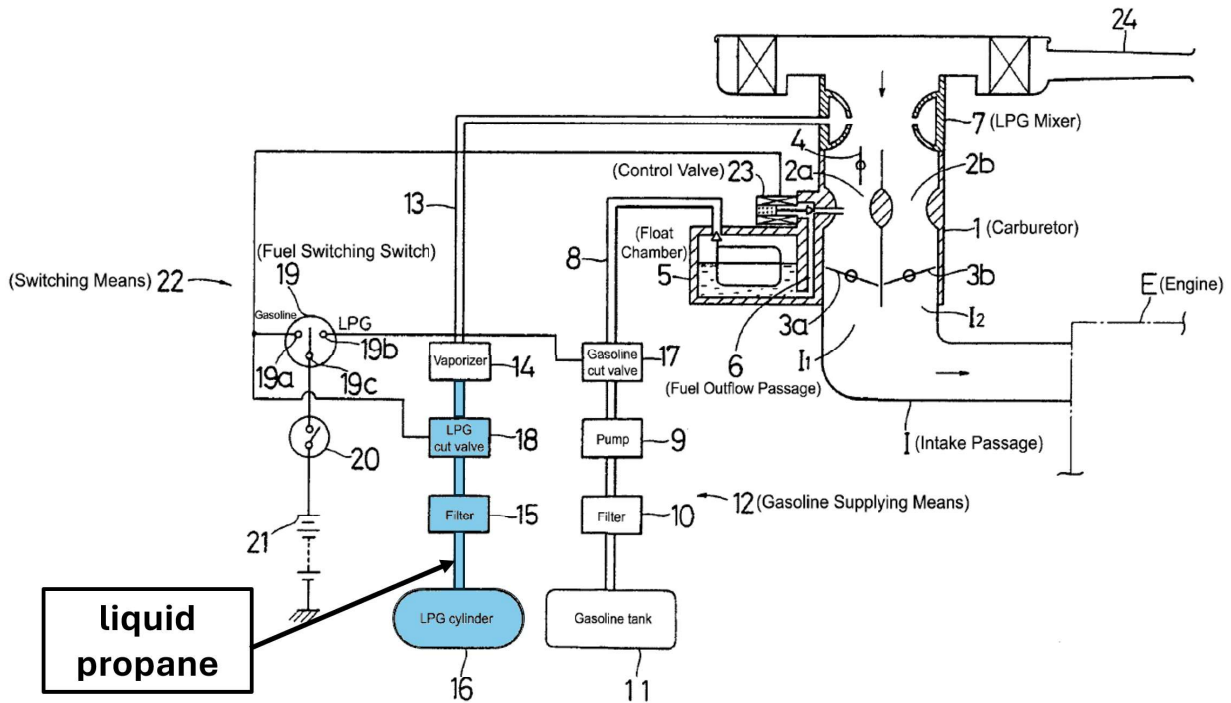
1. Nakafushi’s LPG bomb 16 is not a “gaseous fuel source” as alleged by the Petition.

108. Claim 1 of the ’034 Patent recites: “a gaseous cutoff coupled to open and close *a gaseous fuel source to the engine.*”

109. Petitioner identifies Nakafushi’s LPG bomb 16 (or LPG cylinder 16) as the claimed “gaseous fuel source.” [Pet., 34-35.]

110. The system disclosed by Nakafushi includes *liquid* LPG from LPG cylinder 16 to vaporizer 14. [Ex. 1005, ¶[0012] (“LPG bomb 16 as an LPG supplying means by an LPG supplying passage 13 via a vaporizer 14 for vaporizing LPG”); *see also* Section VI, above.] The function of the vaporizer is to convert the liquid LPG into a gaseous state so it may be properly combusted by the engine. As is depicted below, vaporizer 14 receives liquid LPG and boils it to create gaseous LPG.

FIG. 1



111. As such, Nakafushi does not disclose a gaseous cutoff coupled to open and close a gaseous fuel source to the engine because—simply put—LPG cylinder 16 is a liquid fuel source, not a gaseous fuel source.

2. Nakafushi does not disclose “a gaseous fuel supplied from” LPG bomb 16 as alleged by the Petition.

112. Claim 11 of the '034 Patent recites: “a gaseous fuel supplied from a pressurized fuel source through a gaseous fuel line.” Similarly, Claim 18 recites “gaseous fuel supplied through a gaseous fuel line from a pressurized fuel source.” Importantly, both claims require gaseous fuel *supplied from* a pressurized fuel source.

113. The Petition identifies Nakafushi's LPG bomb 16 (or LPG cylinder 16) as the claimed "pressurized fuel source." [Pet., 45 ("Nakafushi's 'pressurized fuel source' is LPG cylinder 16, which supplies gaseous fuel") (citing Ex. 1005, ¶[0012], Fig. 1; Ex. 1003, ¶178); *see also* Pet., 55.]

114. LPG bomb 16 supplies *liquid* LPG to vaporizer 14, which then converts the LPG into gaseous form. [Ex. 1005, ¶[0012] ("LPG bomb 16 as an LPG supplying means by an LPG supplying passage 13 via a vaporizer 14 for vaporizing LPG"); *see also* Section VI, above.] As such, the Nakafushi reference does not disclose a gaseous fuel *supplied from a pressurized fuel source* because LPG cylinder 16 *does not supply gaseous fuel*.

XI. CONCLUSION AND SUPPLEMENTATION

115. The alleged prior art relied on by Petitioner does not disclose either "a gaseous fuel source" or "a gaseous fuel supplied from a pressurized fuel source." As such, Petitioner has not met its burden to show that there is a reasonable likelihood that at least one of the Challenged Claims in the Petition is unpatentable. For this reason, and for the additional reasons set forth above, in my opinion institution should be denied.

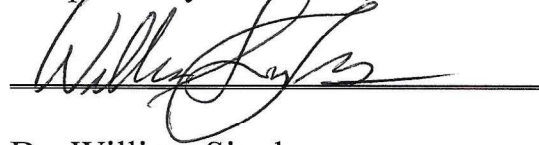
116. In this Declaration, I have presented my opinions regarding the validity of the Challenged Claims of the '034 Patent based on the information available to me. My opinions are subject to change in view of opinions provided by the Petitioner

or its expert, or any additional information that I may receive. I reserve the right to supplement my opinions accordingly. Specifically, if the Petition is instituted, I reserve the right to submit an additional declaration in support of Patent Owner's Response.

I hereby declare that all statements made herein of my own knowledge are true and that all opinions expressed herein are my own, and further that these statements were made with the knowledge 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.

Dated: August 29, 2025

Respectfully submitted,

A handwritten signature in black ink, appearing to read "William Singhose", is written over a solid horizontal line.

Dr. William Singhose

References

- [1] W. Singhose, K. Bohlke, and W. Seering, "Fuel-Efficient Pulse Command Profiles for Flexible Spacecraft," *AIAA J. of Guidance, Control, and Dynamics*, vol. 19, no. 4, pp. 954-960, 1996.
- [2] W. Singhose, S. Derezinski, and N. Singer, "Extra-Insensitive Input Shapers for Controlling Flexible Spacecraft," *AIAA J. of Guidance, Control, and Dynamics*, vol. 19, no. 2, pp. 385-91, 1996.
- [3] L. Y. Pao and W. E. Singhose, "Verifying Robust Time-Optimal Commands for Multi-Mode Flexible Spacecraft," *AIAA J. of Guidance, Control, and Dynamics*, vol. 20, no. 4, pp. 831-833, 1997.
- [4] W. Singhose, A. Banerjee, and W. Seering, "Slewing Flexible Spacecraft with Deflection-Limiting Input Shaping," *AIAA J. of Guidance, Control, and Dynamics*, vol. 20, no. 2, pp. 291-298, 1997.
- [5] B. W. Mills, W. E. Singhose, and W. P. Seering, "Closed-Form Generation of Specified-Fuel Commands for Flexible Systems," in *American Control Conference*, Philadelphia, PA, 1998, vol. 5: IEEE, Piscataway, NJ, pp. 2632-6.
- [6] W. Singhose, T. Singh, and W. Seering, "On-Off Control with Specified Fuel Usage," *ASME J. Dynamic Systems, Measurement, and Control*, vol. 121, no. 2, pp. 206- 212, 1999.
- [7] Y.-G. Sung and W. Singhose, "Closed-Form Specified-Fuel Commands for Two Flexible Modes," *AIAA J. of Guidance, Control, and Dynamics*, vol. 30, no. 6, pp. 1590-6, 2007.
- [8] W. Singhose and K. Grosser, "Limiting Excitation of Unmodeled High Modes with Negative Input Shapers," in *IEEE Conference on Controls Applications*, Kohala, Hawaii, 1999.
- [9] K. Grosser and W. Singhose, "Command Generation for Reducing Perceived Lag in Flexible Telerobotic Arms," *JSME International Journal*, vol. 43, no. 3, pp. 755-761, 2000.
- [10] S. Klooster, K. Kozak, J. Vaughan, P. Sanders, and W. Singhose, "Fluid Power Control of a Hyper-Active Seat for Low-Frequency Vibration Suppression," in *IFAC Symposium on Advances in Automotive Control*, Salerno, Italy, 2004.
- [11] W. Singhose, E. Biediger, H. Okada, and S. Matunaga, "Control of Flexible Satellites Using Analytic On-Off Thruster Commands," in *AIAA Guidance, Navigation, & Control Conf.*, Austin, TX, 2003: AIAA-2003-5333.

- [12] W. Singhose, E. Biediger, H. Okada, and S. Matunaga, "Experimental Verification of Real-Time Control for Flexible Systems with On-Off Actuators," *ASME J. of Dynamic Systems, Measurement, and Controls*, vol. 128, no. 2, pp. 287-96, 2006.
- [13] W. Singhose, E. Biediger, H. Okada, and S. Matunaga, "Closed-Form Specified-Fuel Commands for On-Off Thrusters," *AIAA J. of Guidance, Control, and Dynamics*, vol. 29, no. 3, pp. 606-11, 2006.
- [14] G. Peláez, W. Singhose, and A. Vizan, "Shaping Tool Head Pneumatic Actuator Commands to Reduce Cut Car Letters Machine Vibration," in *WSEAS Int. Conf. on Signal Processing, Robotics and Automation*, 2002, pp. 54-59.