

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GENERAC POWER SYSTEMS, INC.,
Petitioner,

v.

CHAMPION POWER EQUIPMENT, INC.,
Patent Owner.

Case No. IPR2025-01457
U.S. Patent No. 11,143,145

DECLARATION OF WILLIAM E. SINGHOSE, PH.D.
IN SUPPORT OF PATENT OWNER RESPONSE

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GLOSSARY

Abbreviation	Term
'145 Patent	U.S. Patent No. 11,143,145
'398 Patent	U.S. Patent No. 10,697,398
Board	Patent Trial and Appeal Board
Patent Owner or Champion	Champion Power Equipment, Inc.
Petition	Petition for Inter Partes Review of U.S. Patent No. 11,143,145 (Paper 4)
Petitioner or Generac	Generac Power Systems, Inc.
POSITA	Person of Ordinary Skill in the Art
USPTO	United States Patent & Trademark Office

I, Dr. William E. 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. INTRODUCTION

A. Scope of Engagement

1. I have been retained as an expert witness on behalf of Patent Owner Champion Power Equipment, Inc. to provide expert analysis and opinions in connection with Champion's Patent Owner Response to IPR2025-01457.

2. I understand that the Petition involves U.S. Patent No. 11,143,145 (the "'145 Patent"). [EX1001.] I have been asked to provide my opinions as to the validity of certain claims of the '145 Patent.

3. This Declaration sets forth the opinions that I have formed related to the '145 Patent 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 Petition in IPR2025-01457 and all exhibits cited therein, as well as all exhibits cited in this declaration.

4. 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.

5. I have considered certain issues from the perspective of a person of ordinary skill in the art, as described below, as of the effective filing date of the '145 Patent, which I have been asked to assume is June 12, 2015. [EX1001, (63).]

B. Professional Qualifications and Experience

6. 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.

7. 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, machinery, and controls.

8. 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.

9. 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.

10. Based on my work experience, described in my curriculum vitae and in more detail below, I am knowledgeable about the subject matter of the '398 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.

11. 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.

12. 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.

13. 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.

14. The '145 Patent includes claim elements directed to components that enable multi-fuel use in generators such as carburetors, fuel lines, solenoid valves, and switches. I have experience working with all of these elements and combinations of these elements.

15. 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 spacecraft. 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

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

17. 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

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

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 were driven by electrical power that was provided by 110VAC. When used indoors, the crane was powered from wall outlets. 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.



Portable Generator for Robotic Mobile Boom Crane.

18. 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.

19. Although the '145 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.

20. 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.

21. Finally, I am a named inventor on the following issued patents in the areas of mechanical engineering: U.S. Patent No. 5,638,267; 6,920,378; 7,970,521; 8,235,229; 8,975,853; 9,132,997; and 9,776,838.

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

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

- a. Airspace Systems v. Dedrone Holdings, IPR 2025-00629 (United States Patent and Trademark Office);
- b. Krieg v. Graco, Civil Action No. 6:24-cv-171L, (W.D. TX);
- c. Dale v. Segway, Civil Action CGC-23-609657 (Superior Court of CA);
- d. Harbor Freight v. Champion, Case No. 2:24-cv-08722-SVW-AS (C.D. CA);
- e. K-fee System v. Nespresso, Case No. 2:21-cv-3402-GW-AGRx (C.D. CA);
- f. Exotec v. Opex, IPR 2024-00850 (United States Patent and Trademark Office);
- g. Champion v. Firman, Civil Action CV-23-2371-PHX-DWL (D. Ariz.);
- h. Gomaco v. Guntert and Zimmerman, IPR2024-00835, PGR2024-00026 (United States Patent and Trademark Office);
- i. US Conec v. Senko, ITC Inv. No. 33-TA-1399 (International Trade Commission);
- j. Juul v. NJOY: IPR2024-00160, IPR2024-00161 (United States Patent and Trademark Office);
- k. Lenovo v. Asus: ITC Investigation No. 337-TA-1382 (International Trade Commission);

- l. Juul v. NJOY: ITC Investigation No. 337-TA-1368 (International Trade Commission);
- m. LightGuide v. Amazon: IPR2023-01423 (United States Patent and Trademark Office);
- n. Bissell v. Tineco: ITC Investigation No. 337-TA-1304 (International Trade Commission);
- o. Opex v. HC Robotics: ITC Investigation No. 337-TA-1293 (International Trade Commission);
- p. Caterpillar Paving Products v. Wirtgen America: IPR2022-01264, IPR2022-01277, IPR2022-01278, IPR2022-01310 (International Trade Commission);
- q. DJI v. Textron: IPR2022-00162, IPR2022-00163, and IPR2022-00453 (United States Patent and Trademark Office);
- r. Boyd v. Elliott Equipment: Case No: 1684CV00822 (Superior Court of Massachusetts);
- s. iRobot v. SharkNinja: ITC Investigation No. 337-TA-1252 (International Trade Commission);
- t. Courkamp v. Fisher Price: Case No. CV-19-02689-PHX-GMS (D. Ariz.);
- u. Coleman Co. vs. Team Worldwide Corp: Case No. 2:20cv351-RGD-RJK (E.D. Va.);
- v. Gomaco v. Guntert and Zimmerman: IPR2020-01698, IPR2021-00050, IPR2021-00136, IPR2021-00234 (United States Patent and Trademark Office);
- w. Unicorn Global v. GoLabs: Case No. 3:20-cv-02023 (N.D. Tex.);

- x. Gamevice v. Nintendo, ITC Investigation No. 337-TA-1197 (International Trade Commission);
- y. Guntert and Zimmerman v. Gomaco, Case No. 5:20-cv-4007 (N.D. Iowa); and
- z. Wong et al. v. Morrow Equipment et al: Case No. 19-2-33286-7 SEA (Superior Court of Washington, King County).

C. Materials Considered

24. In connection with my analysis, I have reviewed the Petition in IPR2025-01457 and all exhibits cited therein, as well as all exhibits cited in this declaration. A complete list of exhibits is included below.

Ex.	Description
1001	U.S. Patent No. 11,143,145
1002	File History for U.S. Patent No. 11,143,145
1003	Declaration of Dr. Mahdi Shahbakhti
1004	JPS61283734A (Original) (“Nakafushi”)
1005	Certified Translation of JPS61283734A (“Nakafushi”)
1006	Small Engine Technology, Second Edition, Schuster, William A, (1999) (“Schuster”)
1007	U.S. Patent No. 5,301,644 (“Olmr”)
1008	U.S. Patent No 1,931,698 (“Holzapfel”)
1009	Kubota DF972-E2 Workshop Manual (“Workshop Manual”)
1010	Declaration from Mr. James Strepek re Kubota Manuals

1011	Declaration from Mr. Scott Schlabach re Kubota Manuals
1012	U.S. Patent No. 5,161,496 (“Matsushima”)
1013	U.S. Patent No. 6,213,083 (“Winberg”)
1014	Champion’s Infringement Contentions with Respect to Petitioner Generac’s Model PM4500DF and GP7500E DF Generators
1015	U.S. Patent No. 3,718,000 (“Walker”)
1016	DuroMax XP4400EH Operator’s Manual (“DuroMax”)
1017	Declaration of David Raskin (dated May 7, 2025)
2079	Curriculum Vitae of Dr. William Singhose
2080	US2012/0104008 (“DeNardo”)
2081	Propane 101 Internet Archive
2100	U.S. Patent No. 4,372,276 (“Bernhardsson”)
2126	U.S. Patent Pub. No. 2011/0100335A1 (“Parlatore”)
2127	Timothy Morse Deposition Transcript
2128	U.S. Patent No. 3,465,740
2129	U.S. Patent No. 5,197,910
2130	U.S. Patent No. 4,707,017
2136	IPR2025-01457 Deposition Transcript of Mahdi Shahbakhti
2137	File History of U.S. Patent No. 10,697,398

D. Compensation

25. 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.

26. I have no financial interest in Patent Owner. I similarly have no financial interest in the '145 Patent.

II. UNDERSTANDING OF APPLICABLE LEGAL PRINCIPLES

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

A. Scope of the Proceedings

28. 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.

29. 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.

30. 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.

31. 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.

32. 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 of at least one claim as construed by the petitioner, the petitioner loses.

B. Claim Interpretation

33. 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.

34. 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.

35. 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.

36. 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.

37. 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.

38. 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

39. 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

40. 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.

41. 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

42. 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.

43. 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.

44. 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.

III. PETITIONER'S INVALIDITY CHALLENGES

45. I understand that Petitioner challenges various claims of the '145 Patent based on the following Grounds:

Ground	Claims	Basis	Primary Reference	Secondary Reference(s)
1	1-7, 10	103	Workshop Manual	-
2	8-9	103	Workshop Manual	Matsushima, Olmr
3	1-10	103	Nakafushi	Matsushima, Olmr

4	1-10	103	Holzapfel	Matsushima, Olmr
5	11-16	103	Workshop Manual	Matsushima, Winberg
6	11-16	103	Nakafushi	Matsushima, Winberg
7	11, 13, 14	103	Holzapfel	
8	12, 15, 16	103	Holzapfel	Matsushima, Winberg

IV. SUMMARY OF OPINIONS

46. It is my opinion that Claims 1-16 of the '145 Patent (the “Challenged Claims”) are not obvious over the combination of prior art suggested by Petitioners.

V. Background

47. Liquified petroleum gas is commonly referred to as “LPG” or “propane.” [EX1001, 1:47-50.] 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].]

48. 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.

49. In my experience, the terms “propane vapor” and “gaseous LPG” are commonly used to describe LPG in a gaseous state.

50. Prior to the priority date of the '145 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 '145 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.

51. 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 as of June 12, 2015.

52. 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.

53. LPG “exists in a gaseous state at normal temperature and pressure but can be conveniently stored under pressure in a liquid state.” [EX1001, 1:47-50.] A POSITA would have understood that the propane storage disclosed by the '145 Patent can be accomplished in large on-site tanks, or in portable cylinders. This is confirmed by reference to the “Propane 101” website referenced above. [EX2081.C; EX2081.D.]

54. In my experience, the vast majority of fuel sources (including liquid gasoline, which both Petitioner and Patent Owner agree is a *liquid* fuel) are vaporized prior to combustion.

55. In fact, many LPG applications are optimized to run on either liquid or gaseous LPG. As such, categorically referring to any LPG source as a gaseous fuel source completely discounts numerous liquid LPG applications, and incorrectly characterizes the knowledge of a POSITA.

A. Gaseous LPG Systems

56. 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.]

57. As another example, U.S. Patent Pub. No. 2011/0100335A1 (“Parlatore”), (cited by Petitioner in related proceedings) describes a system configured to operate using gaseous LPG. [EX2126, ¶[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. . . .”).]

58. 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.” [*Id.*, ¶[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.” [*Id.*, ¶[0025].]

B. Liquid LPG Systems

59. Conversely, it is my understanding that commercial or industrial cylinders are optimized to supply liquid LPG to motorized commercial equipment such as forklifts. Again, this is consistent with my experience and confirmed by reference to the “Propane 101” website referenced above. [EX2081.D-E.]

60. 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.]

61. Petitioner’s Bernhardsson reference, which was cited in a related proceeding, provides another example of a system configured to operate using liquid LPG. [EX2100, 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.

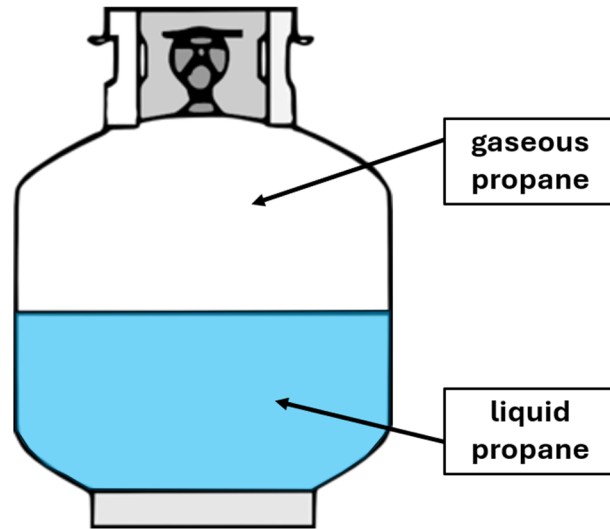
62. Other references provide examples of LPG vaporizers for use with liquid LPG. For example, the Kubota Workshop manual describes a vaporizer which includes both primary and secondary chambers. [EX1009, 69.] The primary and secondary chambers—acting together—vaporize liquid LPG into a gaseous state before the fuel enters the carburetor. [*Id.*, 70-71.]

63. Perhaps most critically, Petitioner’s Holzapfel reference discloses “an additional fuel supply system employing a normally gaseous fuel” but explicitly teaches that the system should be configured “so as to draw off the liquid and not gas.” [EX1008, 2:8-15.]

C. LPG Storage and Distribution

64. 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.² 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.

65. 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.

66. 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

² This is also true with respect to gasoline tanks, which contain liquid gasoline and gasoline vapor.

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.]

67. Of key importance to the understanding of the ’398 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.

D. Electric Generators

68. Devices to generate electricity have existed for hundreds of years, dating back to at least to the 1660’s when electrostatic generators were developed. Such devices created static electricity that had limited utility for powering useful

operations. One of the more famous electrical generators is the Van de Graaff generator that can generate large amount of static electricity and then discharge sparks, or small “lightning” strikes. Other types of generators include piezoelectric generators that can convert small physical motions, like vibrations, into voltage that can charge small batteries.

69. The electric generators at issue in this matter are very different than those mentioned above because they produce 110V and/or 220V AC electricity to power devices when an electrical grid is unavailable.

VI. OVERVIEW OF THE '145 PATENT

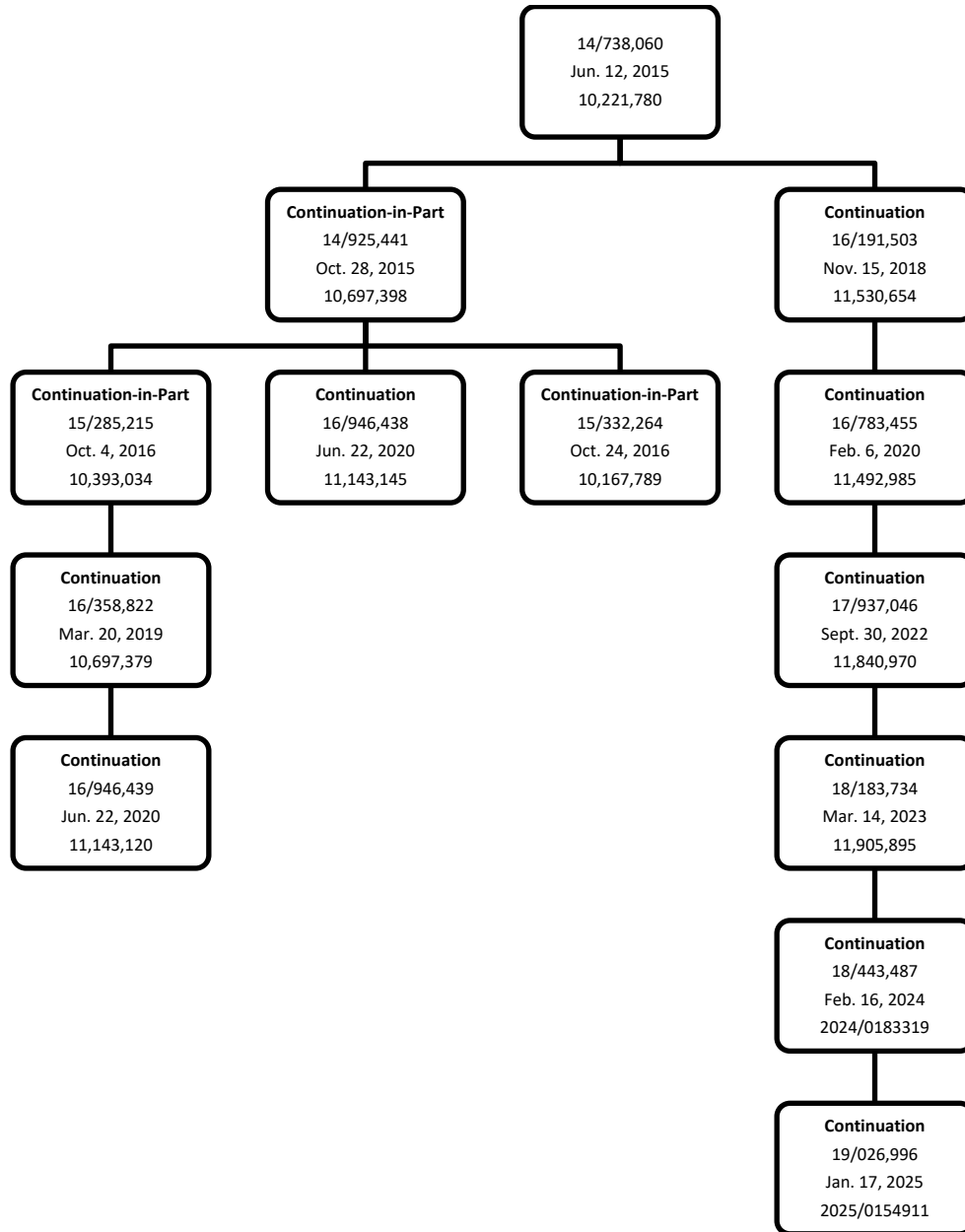
70. US Patent 11,143,145 (“the '145 Patent”) is titled, “Batteryless Dual Fuel Engine With Liquid Fuel Cut-off.” It was filed as U.S. Patent Application No. 16/946,438 on June 22, 2020. [EX1001, (21), (22).]

71. The '145 Patent discloses and claims an electric generator that can produce power when an electrical grid is unavailable. For example, the patent addresses the problem it solves by stating:

[G]enerators are frequently used when power outages in the utility grid result from severe weather. Unfortunately, gas stations may also be closed as a result of the power outage. Such a circumstance presents just one example where it would be advantageous to operate electrical generators on alternative fuels.

[’145 Patent, 1:33-38.] Therefore, the ’145 patent claims a generator that can produce 110V and/or 220V AC electricity to power lights, appliances, garage door openers, and other devices that run on the electric utility grid.

72. The ’145 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.” Specifically, the ’145 Patent is a continuation of U.S. Patent Application No. 14/925,441, now U.S. Patent No. 10,697,398. The 2015 Family is depicted below:



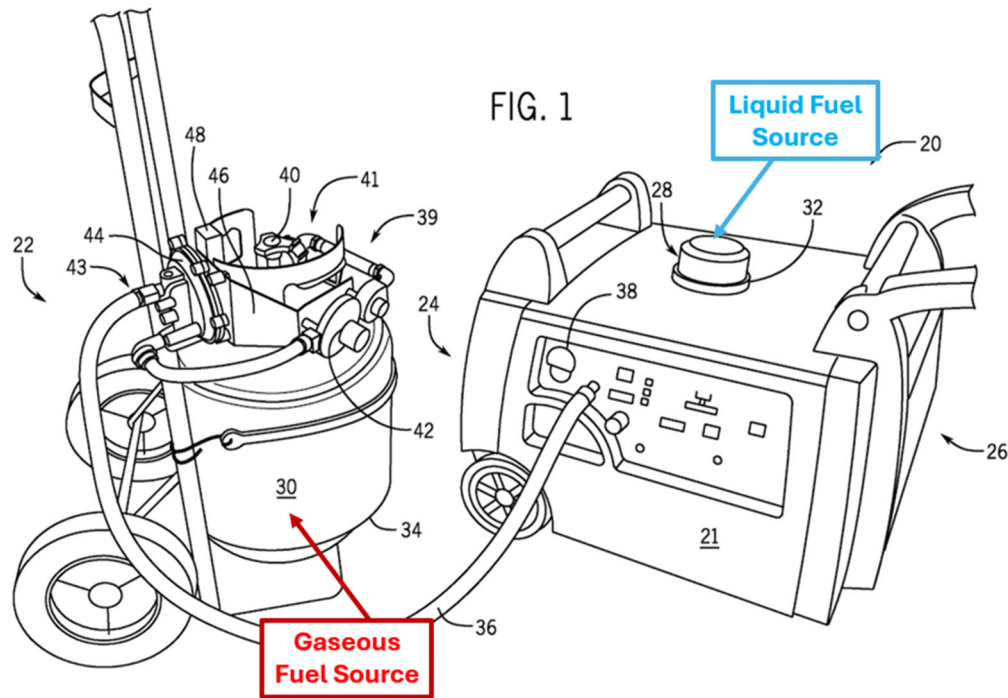
A. Summary

73. As mentioned above, the '145 Patent claims an electric generator for producing power when an electrical grid is unavailable. In fact, the preamble of both independent claims 1 and 11 recite: “A dual fuel generator comprising.”

Additionally, claim 1 has a specific limitation requiring “an electrical power generator driven by the engine and comprising a charging coil.”

74. The claims focus on a specific way of generating power to replace an electrical grid. As the specification of the '145 Patent explains, the patent describes “A dual fuel engine includes an engine operable on a gaseous fuel and a liquid fuel and a switch to change operation of the engine between gaseous fuel and liquid fuel.” [EX1001, Abstract.] The technology requires a carburetor that can mix air and fuel and connect to both a gaseous fuel source and a liquid fuel source. The invention is directed at using such dual-fuel engines in portable electric generators.

75. Figure 1 of the '145 Patent, reproduced below for convenience, shows an example embodiment of the technology. The patent teaches “mechanical fuel lockout switch 38 provides gasoline flow from gasoline tank 32 to the engine while preventing connection of an LPG supply line to fuel inlet 59 of the second fuel line.” [EX1001, 5:46-51.] The patent distinguishes the types of fuel used as either liquid or gaseous. For example, when describing “an exemplary embodiment of the invention, first fuel source 28 is a liquid fuel and second fuel source 30 is a gaseous fuel. The liquid fuel may be gasoline and the gaseous fuel may be liquid petroleum gas (LPG).” [EX1001, 4:11-14.]



[EX1001, Fig. 1.]

76. Note that the second fuel source 30 shown in Figure 1 is an LPG tank with the fuel outlet (service valve 40) located at the top of the tank. Such an embodiment would use a gaseous fuel flowing out from the second fuel source 30. The liquid in the LPG tank settles to the bottom of tank and cannot exit from the fuel source tank because the outlet is at the top of the tank. There are other types of applications that use LPG as a fuel source in liquid form. In those applications, the liquid LPG is drawn from the bottom of an LPG tank. This is not the configuration or use case taught by Figure 1 of the '145 Patent.

77. The '145 Patent explains that there are advantages to being able to use different types of fuel to generate electricity when, for example, “power outages in

the utility grid result from severe weather.” [EX1001, 1:33-38.] However, the patent warns that “a common problem with such configurations that couple two fuel sources to a single engine is that the engine can experience overly rich air-fuel ratio when both fuels are simultaneously engaged during cross-over switching between the fuel sources.” [EX1001, 1:60-65.] An associated problem is that “a float bowl in the carburetor that must first fill or empty prior to changeover causes delay in cross-over switching between the fuel sources.” [EX1001, 1:67-2:3.]

78. Given the benefits of a dual-fuel generator, as well as the associated drawbacks described in the Background of the Invention section, the ’145 Patent sets forth technology that retains the benefits, while minimizing the drawbacks. The technology achieves such a balance by using both gaseous and liquid fuels. The use of the two fuel types is achieved with various switches, valves, solenoids, microcontrollers, and carburetors that can accept both gaseous and liquid fuel sources.

79. An exemplary configuration of the invention is displayed in Figure 4B of the patent, which has been reproduced below for convenience. The invention routes both gasoline and propane from their storage tanks, through valves, into the carburetor, and on to the engine.

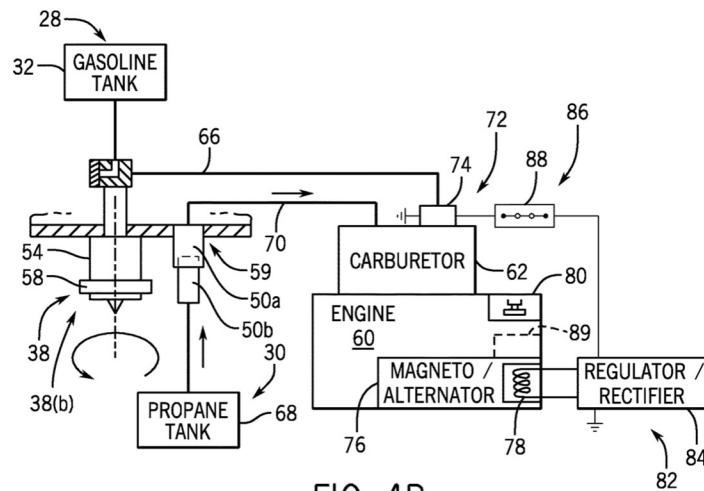
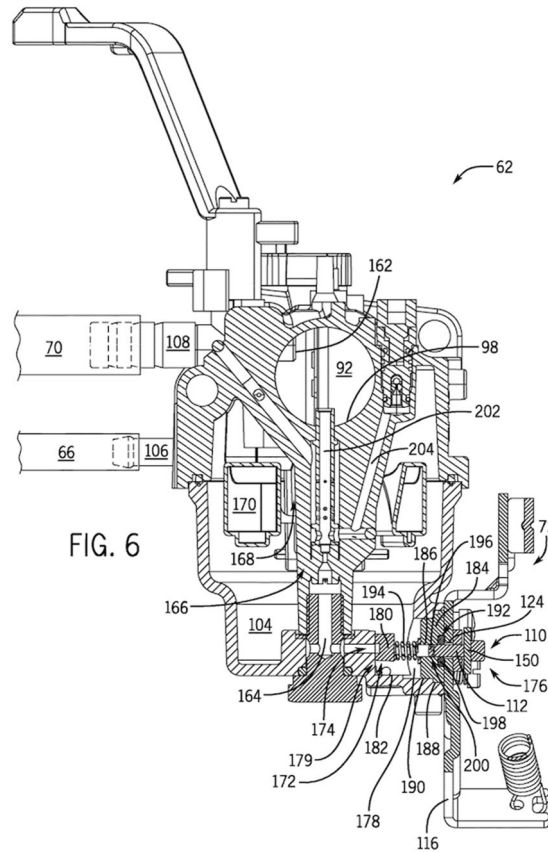


FIG. 4B

['145 Patent, Figure 4B.]

80. One embodiment of the dual-fuel carburetor 62 is shown in cross sectional form in Figure 6, which has been reproduced below for convenience. Gasoline flows into the carburetor through liquid fuel line 66, while propane flows into the carburetor through gaseous fuel line 70.



[’145 Patent, Fig. 6 Showing a Cross-Sectional View of a Carburetor Embodiment.]

B. Independent Claims of the ’145 Patent

81. Claim 1 of the ’145 Patent is an independent claim reciting:

’145 Patent, Claim 1	
Element	Claim language
[1.0]	A dual fuel generator comprising:
[1.1]	an engine operable on a gaseous fuel and a liquid fuel;
[1.2]	an electrical power generator driven by the engine and comprising a charging coil;
[1.3]	a switch to change operation of the engine between gaseous fuel and liquid fuel;
[1.4]	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;

'145 Patent, Claim 1	
Element	Claim language
[1.5]	a liquid fuel cut-off solenoid to interrupt liquid fuel flow to the engine upon actuation of the switch from liquid fuel to gaseous fuel; and
[1.6]	a voltage regulator coupled to the charging coil to receive power therefrom and that operates to provide a regulated voltage to the liquid fuel cut-off solenoid.

82. Claim 11 of the '145 Patent requires the following limitations:

'145 Patent, Claim 11	
Element	Claim language
[11.0]	A dual fuel generator comprising:
[11.1]	an engine operable on a gaseous fuel and a liquid fuel;
[11.2]	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; and
[11.3]	a manually actuated fuel shutoff coupled to the carburetor, the manually actuated fuel shutoff comprising: a first end in the carburetor that actuates to selectively allow or block a flow of fuel through the carburetor; and a second end external to the carburetor to actuate the first end.

C. Prosecution History of the Related '398 Patent

83. During prosecution of the parent '398 Patent, the examiner asserted that U.S. Patent Pub. No. 2007/0137591 ("Sugimoto") teaches "the engine operable on a gaseous fuel and a liquid fuel (paragraphs 0085 – 0086 describes a first fuel in liquid phase to gas, and a second gas fuel)." [EX2137, 399.]

84. In response, Patent Owner stated that:

Sugimoto actually discloses "[t]he external fuel bottle 71 supplies the second fuel gas in gas phase to the fuel gas pressure regulator 62" and

“[t]he fuel pressure regulator 62 functions as a vaporizer for vaporizing the first fuel gas supplied thereto in liquid phase.” Sugimoto, ¶ [0078]. Since the first fuel gas is vaporized by the fuel pressure regulator 62, the first fuel gas and the second fuel gas are provided in a gaseous form to the carburetor 18b. *See Id.* at ¶ [0071]. As such, the Examiner has not shown that Sugimoto discloses an engine operable on a gaseous fuel and a liquid fuel.

[EX2137, 373.]

VII. OVERVIEW OF THE PRIOR ART

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

85. The Workshop Manual describes the Kubota³ DF972-E2 engine, which is an “off road engine” that can run on two different types of fuel. [EX1009, 10.] More specifically, the DF972-E2 engine is a “Vertical, water cooled, 4-cycle Dual Fuel (Gasoline/LPG) engine.” [EX1009, 8.]

86. As an initial matter, the Workshop Manual does not describe a dual fuel generator as claimed in the ’145 patent. It describes an engine. The engine does use an alternator to charge its battery and allow its components to use 12V DC power. As the Petition points out, the “alternator outputs 150W at 12V.” However, as

³ Kubota is a Japanese company that is most well known for making heavy machinery used in construction and agriculture.

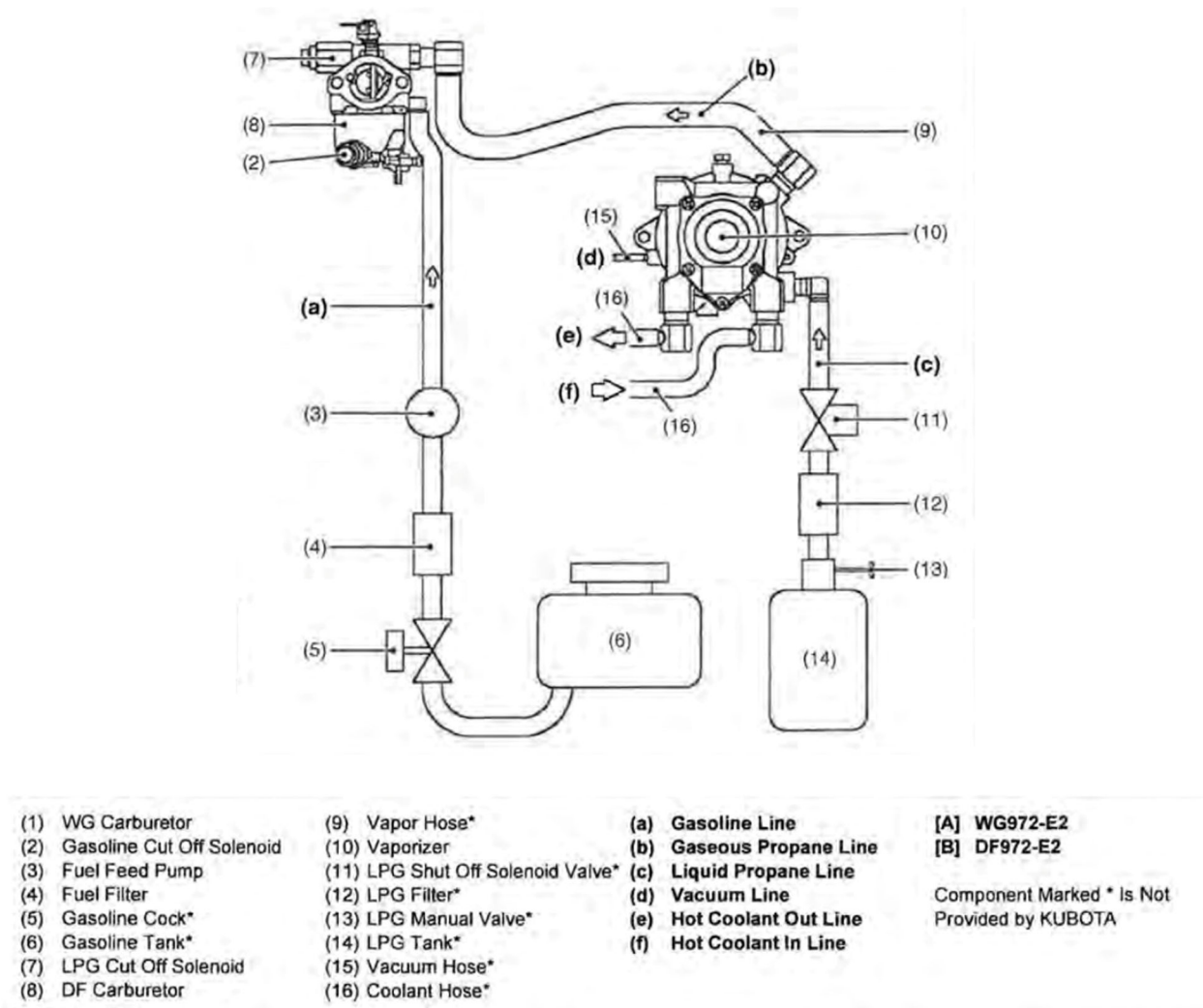
discussed in additional detail below, Petitioner does not argue that the Workshop Manual discloses the claimed dual fuel generator. Petitioner has not argued that a POSITA would have considered a 150W alternator that generates 12V DC as the claimed “dual fuel generator.”

87. The Workshop Manual does explain that its engine is supplied by two different liquid fuel sources: gasoline and liquid LPG. The Workshop Manual teaches, “[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 [the] vaporizer.” [EX1009, 65.] 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.]

88. As described in detail below, liquid propane is transported to the vaporizer (10) via a liquid propane line (c). [*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.” From these teachings, a POSITA would have understood that the Workshop Manual discloses that LPG tank (14)

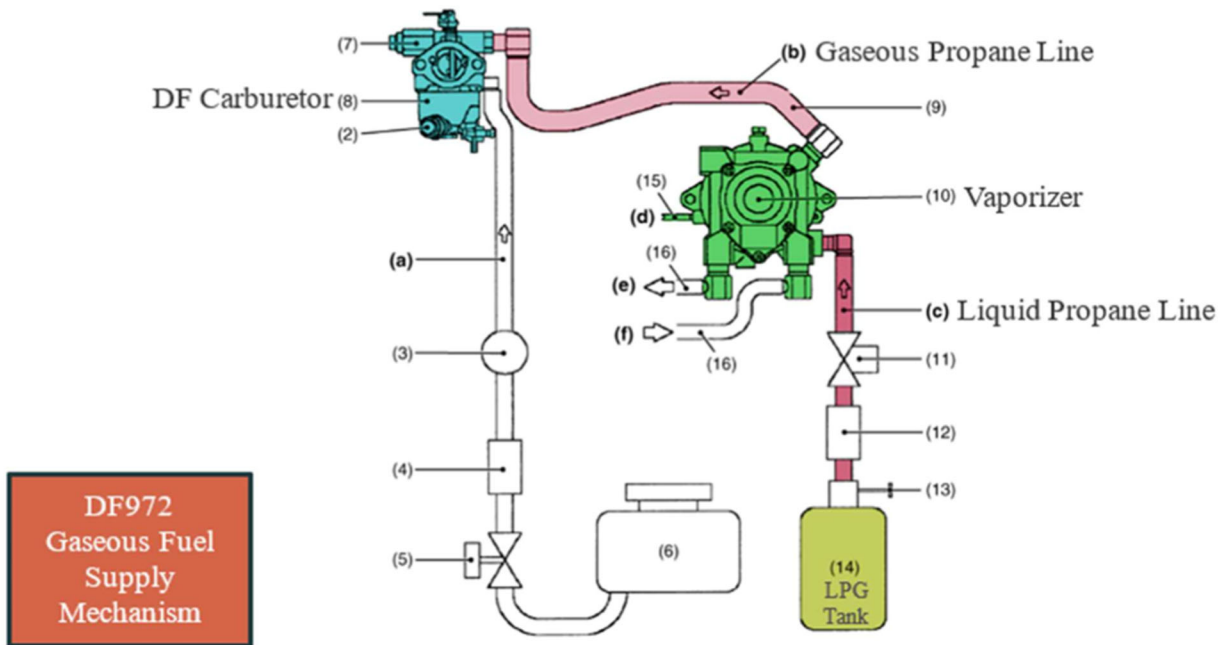
supplies *liquid* LPG, which is converted to a gaseous state only after passing through the vaporizer.

89. The Workshop Manual's fuel system is illustrated with the following diagram:



Fuel System Diagram and Index. [EX1009, 65.]

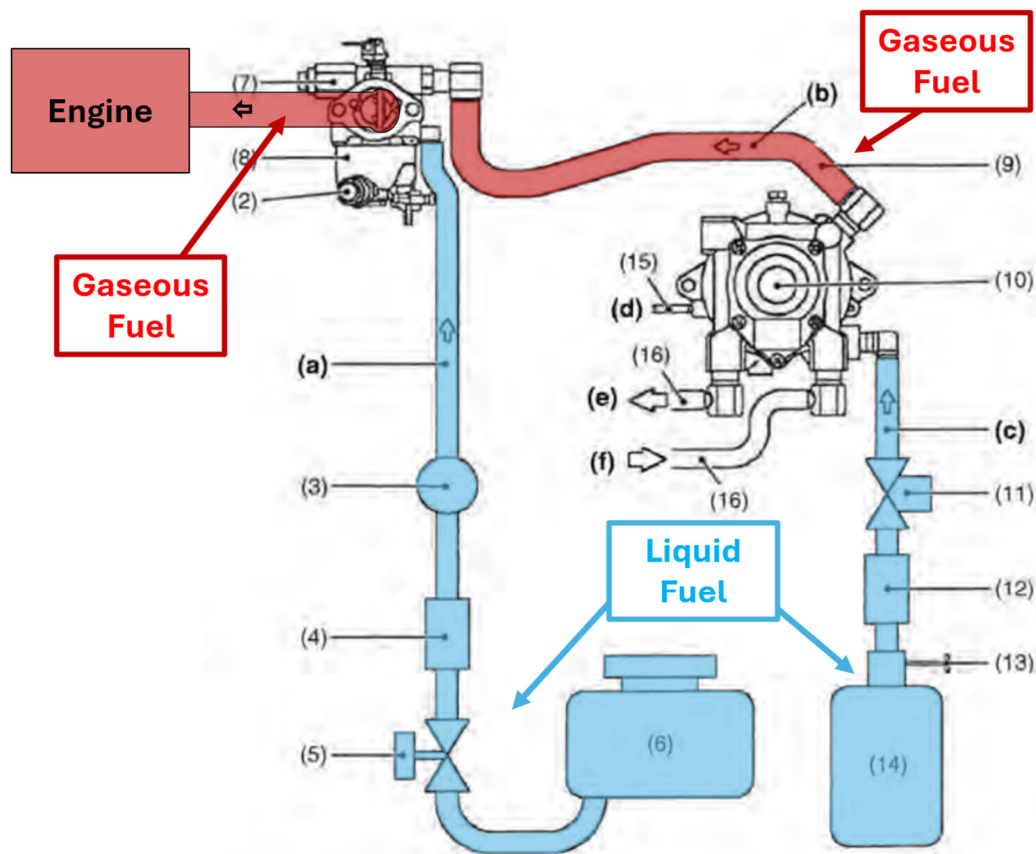
90. In an attempt to argue that the Workshop Manual teaches a gaseous fuel supply, the Petition annotates this diagram in the following manner:



Petition-Annotated Diagram of the Fuel System. [Pet., 19.]

91. What is important to note in the above diagram is that the fuel in the LPG tank flows out of the tank in liquid form, passes through LPG manual valve (13) in liquid form, continues to flow in liquid form through the LPG filter (12), as well as through the LPG shut off solenoid valve (11). Through this process, the liquid fuel flows through a fuel line identified as the “Liquid Propane Line” (c) before entering the Vaporizer (10).

92. To better understand how the Workshop Manual teaches the use of two liquid fuel sources, I have annotated the Fuel System diagram below with clear indications of when the fuels are in liquid form (blue) and when they are in a gaseous state (red).

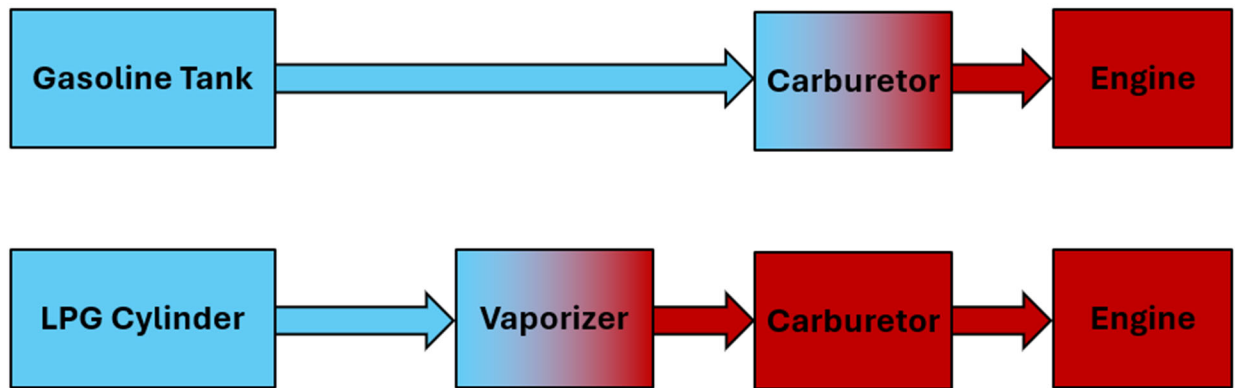


**Fuel System Diagram Annotated to Show Liquid and Gaseous Fuel States.
[Workshop Manual, pg. 65.]**

93. As shown above, the Workshop Manual discloses gasoline and LPG that are supplied from liquid fuel sources, travel through several components of the fuel system in liquid form, and are ultimately converted to a gaseous state for combustion.

94. The process of using two liquid fuels in the Workshop Manual can be represented by the process timeline below, depicting liquid fuel in blue and gaseous

fuel in red. A POSITA would have recognized that both the gasoline and LPG are liquid fuels that get converted to a gaseous state prior to combustion in the engine.



Workshop Manual Fuel System Process.

B. JPS61283734A (“Nakafushi”)

95. Nakafushi is a Japanese patent application by the Mazda Motor Corporation based in Hiroshima Japan. Just like the Workshop Manual, it does not describe an electric generator as claimed in the ’145 patent. It describes an engine. The engine does not even drive a claimed generator whose purpose is to power devices with 110V and/or 220V AC when the electrical grid fails.

96. The Petition states that “Nakafushi is directed to an engine configured to selectively use gasoline or LPG as fuel.” [Pet., 21 (citing EX1005, ¶[0001]).]

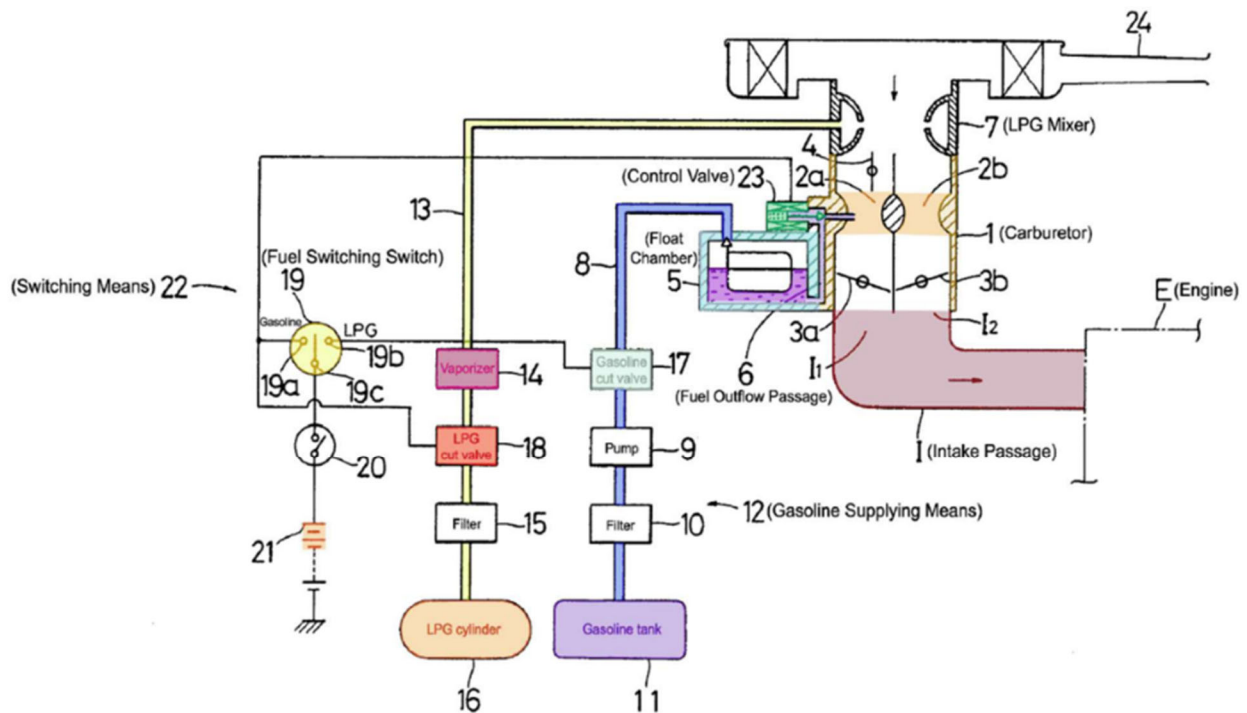
Nakafushi discloses “LPG bomb 16” which a POSITA would have understood comprises an on-site LPG tank. [EX1005, ¶[0012].]⁴

97. Much like the Workshop Manual, Nakafushi’s LPG cylinder 16 is a source of liquid fuel that is subsequently vaporized by a vaporizer. Thus, at various points in the Nakafushi system, the LPG is either liquid or gaseous, as is the gasoline fuel.

98. In order to argue that Nakafushi uses a gaseous fuel, the Petition annotates Nakafushi’s fuel system diagram in Figure 1, but does not distinguish between the liquid and gaseous LPG, as shown below.

⁴ Nakafushi refers to numeral 16 as both an “LPG cylinder” and an “LPG bomb.” EX1005, ¶[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].

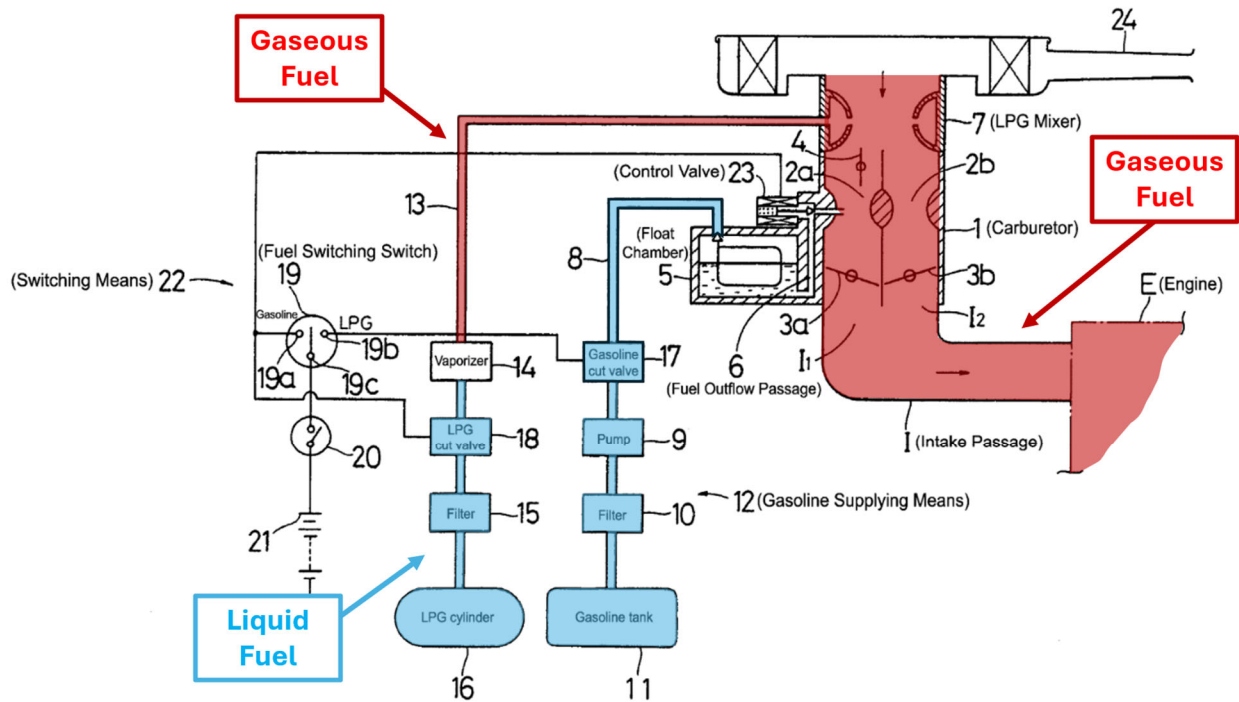
FIG. 1



[Pet., 22 (citing EX1005, Fig. 1).]

99. In the diagram above, the Petitioner has shown the liquid LPG fuel in the same color as the gaseous LPG. That is misleading and not consistent with how a POSITA would understand the diagram. In order to clearly show the system's use of liquid fuel, I have annotated the liquid fuel sections in a common blue color in the figure below. Additionally, when the LPG is converted to its gaseous state by the vaporizer, I have indicated that phase change by showing the outflow in red.

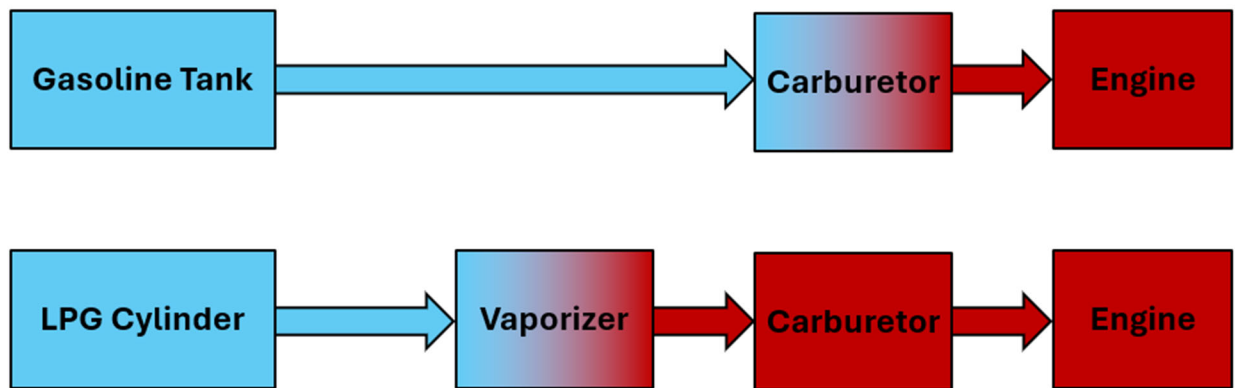
FIG. 1



[EX1005, Fig. 1. Annotated to Show Liquid and Gaseous Fuel States.]

100. A POSITA would have understood that LPG bomb 16 supplies *liquid* LPG to filter 15, through LPG cut valve 18, and into vaporizer 14, which then converts the LPG into gaseous form. [EX1005, ¶[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 heat the liquid to its boiling point.

101. The process of using two liquid fuels in Nakafushi can be represented by the process timeline below, depicting liquid fuel in blue and gaseous fuel in red. A POSITA would have recognized that both the gasoline and LPG are liquid fuels that get converted to a gaseous state prior to combustion in the engine.



Nakafushi Fuel System Process.

102. Nakafushi also discloses numerous additional components such as LPG mixer 7, gasoline cut valve 17, LPG cut valve 18, filters 10 and 15, pump 9, and fuel switching switch 19. These teachings demonstrate that Nakafushi discloses a Mazda combustion engine which is less compact, heavier, and more complex than a typical internal combustion engine used in portable electric generators. [EX1005, Fig. 1; ¶¶[0011]-[0013].]

C. U.S. Patent No 1,931,698 (“Holzapfel”)

103. Holzapfel was filed March 30, 1931, and discloses a fuel system for internal combustion engines that can operate on traditional gasoline, as well as a “low boiling point fuel.” [Holzapfel, 2:139-140.] Just like the Workshop Manual and

Nakafushi, Holzapfel does not describe an electric generator as claimed in the '145 patent. It describes an engine. The engine does not even drive a claimed generator whose purpose is to power devices with 110V and/or 220V AC when the electrical grid fails.

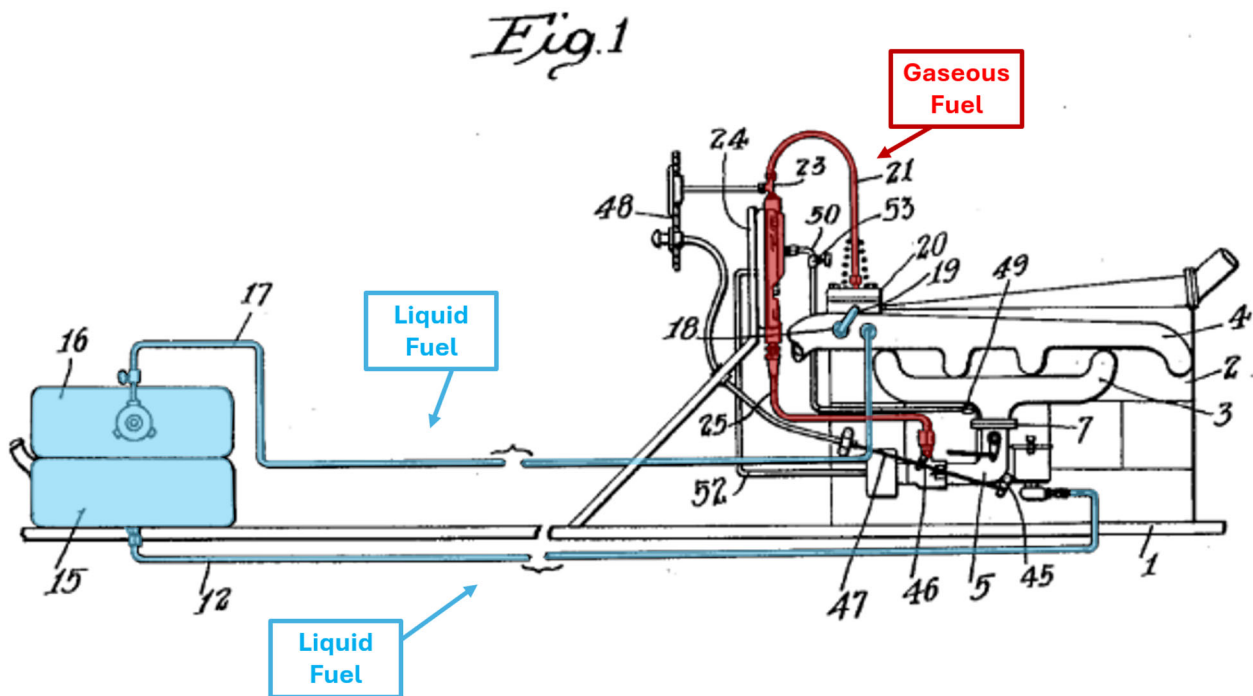
104. Rather than an electric generator, Holzapfel is directed at applications where an “engine is employed for the purpose of driving a motor vehicle.” [Holzapfel, 1:23-24.] Holzapfel claims its invention is advantageous because “on a cold morning, or with a cold motor, it would be preferable to use the low boiling point fuel in tank 16 to start the motor.” [Holzapfel, 1:130-133.]

105. More specifically, Holzapfel “relates to fuel systems for internal combustion engines, and has particular reference to a fuel system embodying the supplying of liquid fuel and gaseous fuel to an engine in alternation at will.” [EX1008, 1:1-5.] With respect to the gaseous fuel system, Holzapfel explains:

I propose to add an additional fuel supply system employing a normally gaseous fuel, this system comprising a fuel supply tank 16 in which normally gaseous fuel is compressed and thereby maintained in liquified condition. From tank 16 there extends a suitable gaseous fuel supply tube 17 extending to the bottom of the tank 16, *so as to draw off the liquid and not gas.*

[EX1008, 2:8-15 (emphasis added).]

106. Holzapfel's "low boiling point fuel" and gasoline fuel paths are depicted in the annotated figure, below, wherein the states of the two fuels are colored blue when they are in the liquid state and red when they have been converted to a gaseous state. Note that both the gasoline tank 15 and the tank for the "normally gaseous fuel" tank 16 supply *liquid* fuel into the system.



[EX1008, Fig. 1 (annotated).]

VIII. PERSON OF ORDINARY SKILL IN THE ART

107. The Petitioner proposed that a person of ordinary skill in the art ("POSITA") at the time of the alleged invention of the '145 Patent "would have at least a Bachelor of Science degree in mechanical engineering, physics, or related fields, and three years of work experience in combustion engines." [Pet., 16.]

Petitioner also states that “[a]dditional higher graduate education could substitute for work experience, and extensive experience/technical training could substitute for formal education.” [*Id.*]

108. I disagree with this proposed definition. As an initial matter, I note that Petitioner has provided virtually no justification for its proposal, which appears to rest on its expert’s summary conclusion provided in his declaration. As such, it is my understanding that it should be given little consideration. In contrast, I provide a detailed analysis and justification for my proposed definition below.

109. 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.

110. In light of these considerations, as explained further below, a POSITA pertinent to the ’145 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.

111. The '145 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 claims of the '145 Patent. 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 '145 Patent.

112. As mentioned above, I often find it useful to compare the claimed subject matter to the subjects taught in engineering curricula. This comparison 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 '145 Patent. For example, in the sophomore-level design class at Georgia Tech students learn 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.

113. 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 practice most of the claimed features, as well as understand how those features would be combined and operate.

114. The '145 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.

115. I am very familiar with the technology described in the '145 Patent. As of the earliest priority date of the '145 Patent, and well before, I qualified as a POSITA under either parties' proposed definition. My opinions in this declaration are not impacted by the use of Petitioner's proposed definition or Patent Owner's proposed definition of a POSITA.

IX. CLAIM CONSTRUCTION

116. I have reviewed the claims, specification, and file history of the '145 Patent.

117. I have been informed that in an IPR proceeding, only terms that are in controversy need to be construed and only to the extent necessary to resolve the controversy. In all cases, I have applied the ordinary and customary meaning of claim terms, as understood by a POSITA, in my analysis provided herein.

X. CLAIMS 1-16 OF THE '145 PATENT ARE NOT INVALID

118. The Petition alleges eight (8) separate grounds in its invalidity challenges. Specifically, Grounds 1-2 and 5 (the "Workshop Manual Grounds") allege the Challenged Claims are obvious over the Kubota Workshop Manual, alone or in combination with other references. Next, Grounds 3 and 6 (the "Nakafushi Grounds") allege the Challenged Claims are obvious over Nakafushi, in combination with other references. Finally, Grounds 4 and 7-8 (the "Holzapfel Grounds") allege the Challenged Claims are obvious over Holzapfel, alone or in combination with

other references. In the following sections I address the Workshop Manual Grounds, the Nakafushi Grounds, and then the Holzapfel Grounds.

A. The Workshop Manual Grounds: The '145 Patent is Not Obvious over the Workshop Manual, Alone or in Combination with Other References

119. Petitioner has not established that the Challenged Claims are obvious over the Workshop Manual, alone or in combination with other references. I address Petitioner's challenges on a limitation-by-limitation basis below.

1. Independent Claims 1, 11

i. Element [1.0] & Element [11.0]: "A dual fuel generator"

(a) The term "dual fuel generator" gives meaning to Claims 1 and 11 and properly defines the invention.

120. The very first substantive sentence of the '145 Patent emphasizes that "Embodiments of the invention relate generally to *dual fuel generators*, and more particularly, to an apparatus and method for delivering liquid fuel or gaseous fuel to a *dual fuel generator*." [EX1001, 1:17-20 (emphasis added).] In fact, the '145 Patent provides additional guidance regarding the structure of the claimed generator: "Dual fuel generator 30 includes a dual fuel internal combustion engine 34 within housing 36 at one end 38, operatively connected to an alternator 40 also enclosed in housing 36 at another end 42 by conventional means." [EX1001, 4:5-9.] Thus, a POSITA would have understood the inventors of the '145 Patent were working on the

particular problem of improved *generators*, not on general improvements in conventional engines. The term “dual fuel generator” in the preambles of Claims 1 and 11 connotes structural limitations above and beyond those specified in the body of the claims.

121. As further evidence, Petitioner’s expert (Dr. Shahbakhti) expressly looked to the preamble to give meaning to other claim limitations. For example, Dr. Shahbakhti confirmed that the preamble guided his understanding of Element [1.1] (“an engine operable on a gaseous fuel and a liquid fuel”). [EX2136, 120:1-121:24; EX1001, Cl. 1.] Dr. Shahbakhti’s testimony is reproduced in relevant part, below:

Q. With respect to Element 1.1, do you understand the claim to be referring to the state of the fuel at a particular point in the system?

A. I would say because this one is connected to Element 1, which is a dual-fuel generator. That means that generator being able to run with gaseous fuel, and the same generator being able to run with liquid fuel.

Q. So the fact that Element 1.0 says a dual-fuel generator guides your understanding of what Element 1.1 means?

A. The way I read it, because it says, "A dual-fuel generator comprising:" So that means that dual-fuel generator then is trying to describe that dual-fuel generator.

122. As such, a POSITA would have understood that the term “dual fuel generator” gives meaning to Claims 1 and 11 and properly defines the invention.

(b) The Workshop Manual does not disclose or otherwise render obvious “a dual fuel generator.”

123. The Workshop Manual does not disclose or otherwise render obvious a dual fuel generator. Rather, as discussed above, it discloses a Kubota engine, not a generator. Nowhere in the reference is any device that a POSITA would have considered to be the claimed generator. Therefore, the obviousness allegation fails at a foundational level.

124. Additionally, Petitioner’s entire “analysis” of this limitation is reproduced below:

Workshop Manual teaches a dual fuel engine. Ex.1009, 65. It would have been obvious to a POSA to have implemented Workshop Manual’s dual fuel engine in a generator, as dual fuel generators were well known as of the earliest priority date of the ‘145 Patent. Ex.1016; Ex.1003, [0088].⁵

[Pet., 30.]

⁵ Paragraph 88 of Dr. Shahbakhti’s declaration repeats this paragraph verbatim without any additional analysis. [EX1003, ¶[0088]; *see also* Pet., 98; EX1003, ¶[0279].]

125. Petitioner’s obviousness “analysis” is based on a single conclusory sentence alleging it would have been obvious to implement the Workshop Manual’s engines in a generator because “dual fuel generators were well known as of the earliest priority date of the ‘145 Patent.” Pet., 30 (citing EX1016; EX1003, [0088]).

126. Petitioner’s purported “analysis” is deficient for several reasons. First, the mere fact that dual fuel generators were allegedly well known says nothing about whether a POSITA would have been motivated to implement the specific prior art engine at issue here in a specific generator. Neither Petitioner nor its expert provide any analysis regarding how (or why) the Workshop Manual’s specific prior art engine would have been implemented in a generator. The Petition’s conclusory recitation that dual fuel generators were well known in the art is insufficient to show that a POSITA would have been motivated to make the proposed implementation. Not only did Petitioner fail to provide any meaningful motivation for the proposed modification, it is my opinion that there is no motivation to use the Kubota engine in the claimed generator. The engine is too big and complicated for the needs of a dual fuel generator. Furthermore, I see no advantage to the engine, in terms of being used in a portable generator.

127. Second, Petitioner’s sole support for the statement that “dual fuel generators were well known” is a single generic reference to Exhibit 1016 (the operator’s manual for a single, specific DuroMax generator). Petitioner does not cite

any portion of the operator's manual that allegedly supports its proposition that similar generators were "well known." And, it is unclear from the Petition whether Petitioner proposed implementing the Workshop Manual's dual fuel engine in a generic, hypothetical "dual fuel generator," or specifically combining it with the DuroMax XP4400EH generator described in EX1016.

128. If Petitioner intends the latter, then the Petition is devoid of any analysis or explanation indicating how or why a POSITA would have been motivated to replace the engine already present in the DuroMax XP4400EH generator with each of the identified prior art engines.

129. Third, there is no analysis indicating that a POSITA would have had a reasonable expectation of success in performing the proposal to use a Kubota engine in a portable dual fuel generator. Although I do not understand the details of the proposed combination (because none have been provided), it is my opinion that the general proposal of using the Kubota engine in a dual fuel generator would have an expectation of failure. A POSITA would know that the engine is too big, heavy, complicated, and expensive to successfully used in a dual fuel generator.

130. Petitioner's conclusory expert testimony is not sufficient to salvage its deficient obviousness analysis. The cited prior art simply does not disclose Elements 1.0 and 11.0 and Petitioner's obviousness analysis is deficient.

ii. Element [1.4] & Element [11.2]: “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”

131. The Workshop Manual does not disclose or otherwise render obvious “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.”

132. Specifically, the Workshop Manual does not disclose a “gaseous fuel source.”

(a) The Challenged Claims explicitly require a gaseous fuel source.

133. Independent Claims 1 and 11 of the '145 Patent each recite a “dual fuel generator” separately comprising (1) “an engine operable on a gaseous fuel and a liquid fuel,” and (2) “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.” [EX1001, Cls. 1, 11.]

134. Thus, a POSITA would have understood each of Claim 1 and Claim 11 to distinctly claim the state of the fuel (i.e., gaseous or liquid) at two separate locations: the *source* of the fuel and the *engine*.⁶

135. The '145 Patent separately recites a *gaseous* fuel source, a *gaseous* fuel line coupling the gaseous fuel source to the carburetor, and an engine operable on *gaseous* fuel. As shown below, Figure 4B of the '145 Patent depicts a gaseous fuel source (Propane Tank 68), a gaseous fuel line (Second Fuel Line 70) and an engine operable on gaseous fuel (Engine 60).

⁶ Dependent Claim 2 further recites: “2. The dual fuel generator of claim 1 further comprising: a liquid fuel valve along a liquid fuel line coupling the liquid fuel source to the carburetor; and a gaseous fuel valve along a gaseous fuel line coupling the gaseous fuel source to the carburetor.” [EX1001, Cl. 2.]. Thus, a POSITA would have understood Claim 2 to distinctly claim the state of the fuel (i.e., gaseous or liquid) at three separate locations: the *source* of the fuel, the fuel *line*, and the *engine*.

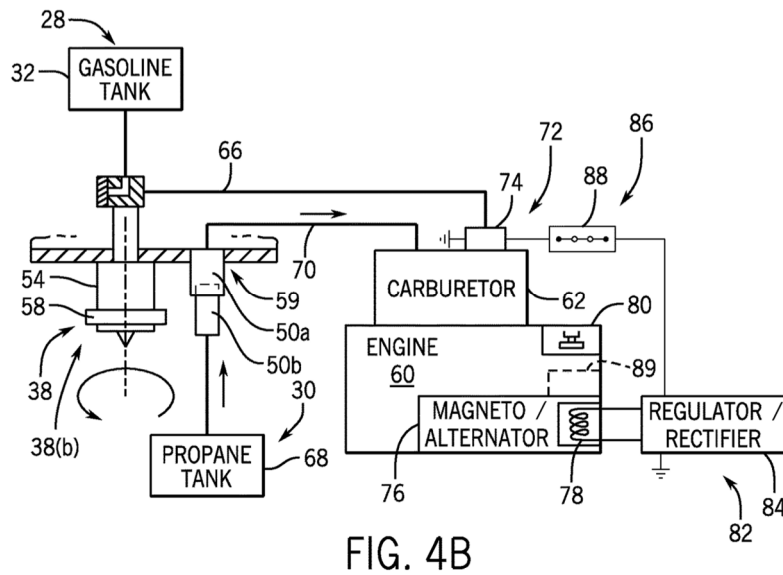


FIG. 4B

[EX1001, Fig. 4B]

136. Likewise, the '145 Patent separately recites a *liquid* fuel source, a *liquid* fuel line coupling the liquid fuel source to the carburetor, and an engine operable on *liquid* fuel. As shown below, Figure 4B of the '145 Patent depicts a liquid fuel source (Gasoline Tank 32), a liquid fuel line (First Fuel Line 66) and an engine operable on liquid fuel (Engine 60).

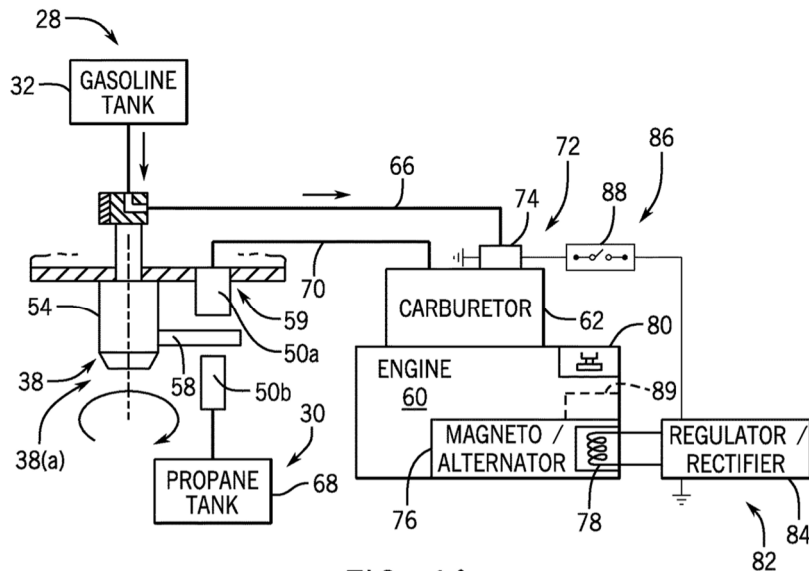


FIG. 4A

[EX1001, Fig. 4A]

137. One of Petitioner’s own exhibits teaches that one of the functions of a carburetor is the evaporation of gasoline. [EX1006, 7.] Specifically:

Liquid gasoline will not support rapid combustion without being changed to a mist or broken down or atomized into tiny drops. When liquid gasoline is introduced to the venturi, it is gasified by its collision with the rapidly moving air mass. The atomized fuel then flows to the intake manifold where the pressure is low, and any remaining liquid gasoline evaporates further. Vaporization is finally completed with the heat generated by the compression of the air-fuel mixture in the cylinder.

138. In light of this teaching (*i.e.*, that liquid fuel is atomized, and partially vaporized in the carburetor, further vaporized in the intake manifold, and completely vaporized in the cylinder), a POSITA would have understood that the “operable on”

requirement of Element [1.1] would have referred to the state of the fuel when it reaches the carburetor/engine. Therefore, a POSITA would have understood that an engine is “operable on” liquid fuel as claimed by the ’145 Patent liquid fuel even if the fuel is partially vaporized in the carburetor, intake manifold, or cylinder.

139. This is consistent with the prosecution history of the parent ’398 Patent.

140. During prosecution of the ’398 Patent, the examiner asserted that U.S. Patent Pub. No. 2007/0137591 (“Sugimoto”) teaches “the engine operable on a gaseous fuel and a liquid fuel (paragraphs 0085 – 0086 describes a first fuel in liquid phase to gas, and a second gas fuel).” [EX2137, 399.]

141. In response, Patent Owner stated that:

Sugimoto actually discloses “[t]he external fuel bottle 71 supplies the second fuel gas in gas phase to the fuel gas pressure regulator 62” and “[t]he fuel pressure regulator 62 functions as a vaporizer for vaporizing the first fuel gas supplied thereto in liquid phase.” Sugimoto, ¶ [0078]. Since the first fuel gas is vaporized by the fuel pressure regulator 62, the first fuel gas and the second fuel gas are provided in a gaseous form to the carburetor 18b. *See Id.* at ¶ [0071]. As such, the Examiner has not shown that Sugimoto discloses an engine operable on a gaseous fuel and a liquid fuel.

[EX2137, 373.]

142. Independent Claims 1 and 11 claim the state of the fuel at the fuel “source.”

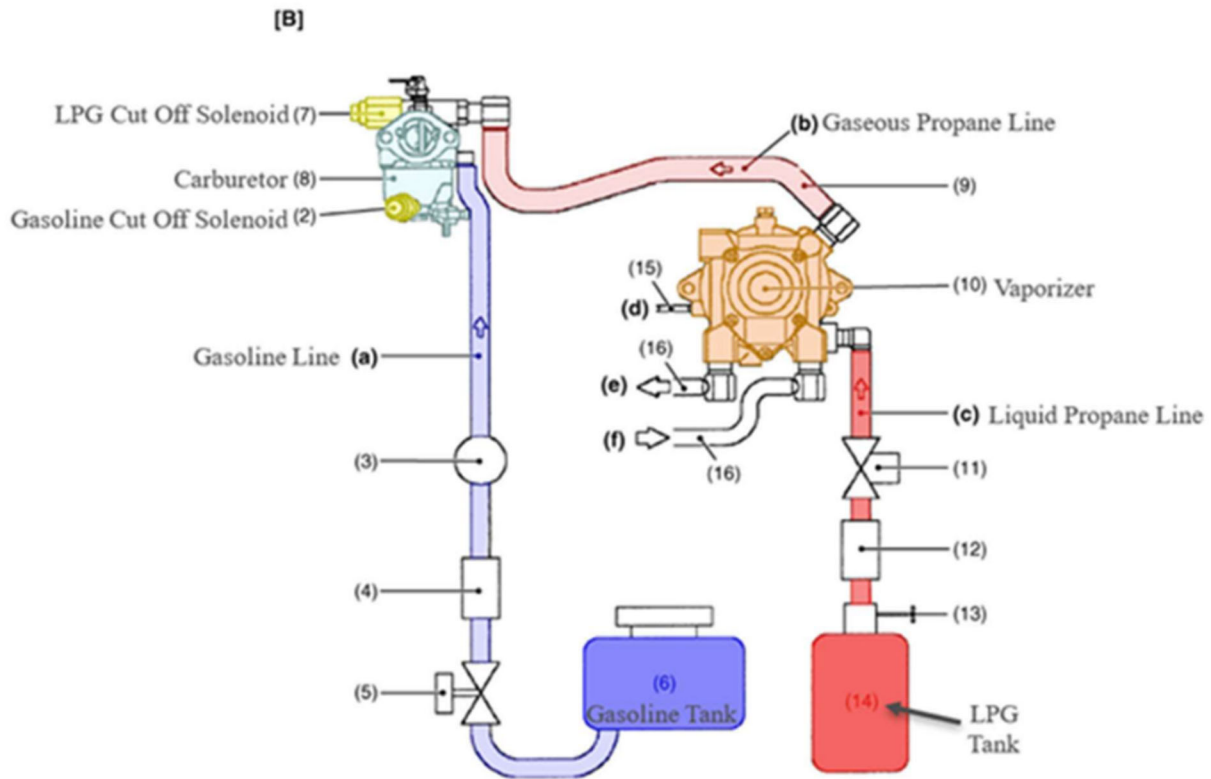
(b) The Workshop Manual does not disclose or otherwise render obvious “a gaseous fuel source.”

143. As discussed above, the Workshop Manual describes a dual fuel engine that draws fuel from two different liquid sources: Gasoline Tank (6) and LPG Tank (14). [See § VII.A, above.]

144. The Petition does not explicitly identify the alleged “gaseous fuel source” in its analysis of Element [1.4]. [Pet., 33-38.] And, Petitioner’s analysis of Element [11.2] merely incorporates its Element [1.4] analysis by reference. [Pet., 98.]

145. Instead, Petitioner’s purported “analysis” is limited to two conclusory sentences. First, Petitioner states that the “Workshop Manual also discloses that the carburetor connects to the gaseous fuel source (LPG) and a liquid fuel source (gasoline).” [Pet., 37.] Second, Petitioner restates the claim language, concluding that “A POSA would have understood that Workshop Manual teaches a carburetor attached to the engine that mixes air and fuel, that thereby connects the gaseous fuel source and the liquid fuel source.” [Pet., 38.] Neither statement actually identifies the alleged gaseous fuel source. Rather, the statements just indicate that such a source exists.

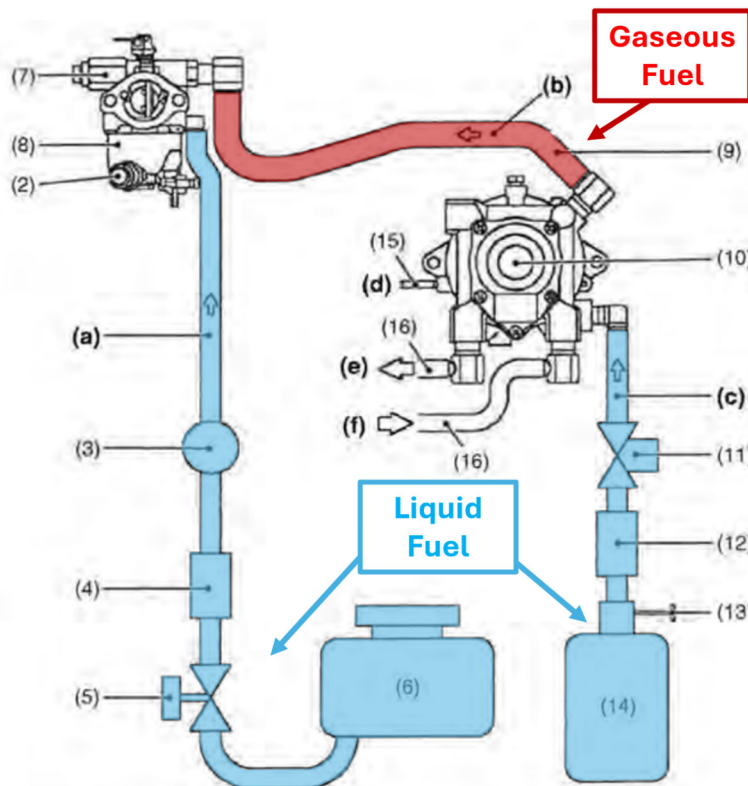
146. Petitioner also provides the following annotated figure, which (once again) does not explicitly identify the claimed gaseous fuel source.



[Pet., 38 (annotations in original).]

147. Elsewhere, Petitioner addresses Claim 2, which recites “a gaseous fuel valve along a gaseous fuel line coupling the gaseous fuel source to the carburetor.” There, Petitioner states that “Workshop Manual teaches an LPG fuel line coupling LPG Tank (14) to DF Carburetor (8).” [Pet., 42.] Thus, to the extent that the Petition identifies the claimed “gaseous fuel source,” Petitioner’s use of the term “LPG tank” in place of the claimed “gaseous fuel source” indicates that Petitioner intended to map the Workshop Manual’s “LPG Tank (14)” to the claimed “gaseous fuel source.”

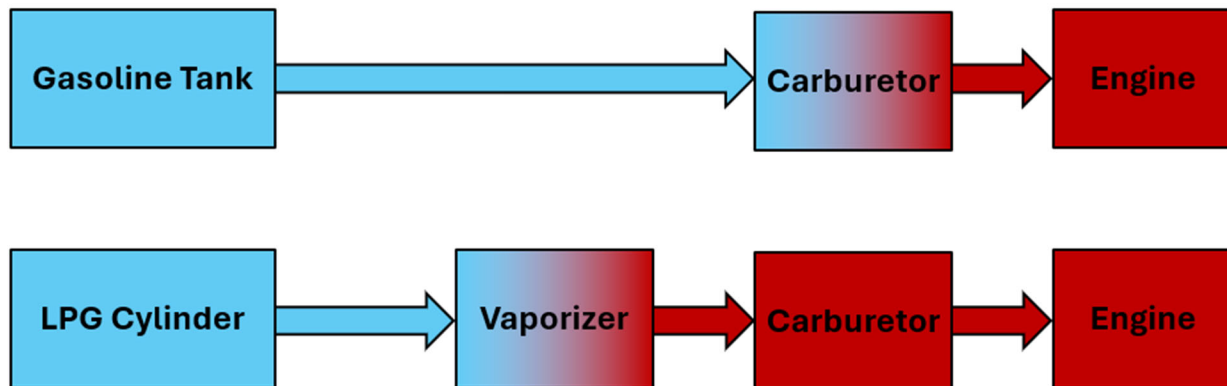
148. However, the Workshop Manual explicitly teaches that LPG Tank (14) is a source of *liquid* fuel, not *gaseous* fuel. [EX1009, 65 (“For LPG fuel, *the liquid fuel stored in the LPG tank (14) is sent to vaporizer (10)*”) (emphasis added).] Contrary to Petitioner’s representations, LPG is liquid fuel when leaving the fuel source, and only becomes gaseous fuel after passing through the vaporizer, as depicted below:



[EX1009, 65 (annotated).]

149. The relative state of the Gasoline and LPG can be appreciated more simply by considering the fuel system process timeline below, depicting liquid fuel in blue and gaseous fuel in red. The diagram shows the liquid gasoline being

supplied to the carburetor, which then vaporizes the gasoline and provides it to the engine. The liquid LPG is vaporized into a gaseous state by the vaporizer, and then passed through the carburetor to provide it to the engine.



Workshop Manual Fuel System Process.

150. As explained in the prosecution history, the fact that the liquid fuel in the LPG tank is converted to its gaseous state prior to reaching the carburetor is pertinent for addressing Element [1.1] (“an engine operable on a gaseous fuel and a liquid fuel”). However, that fact would not have led a POSITA to have understood that the LPG tank was a gaseous fuel source. Rather, a POSITA would have viewed both the Gasoline Tank (6) and LPG Tank (14) as liquid fuel sources which supply liquid fuels that get converted into a gaseous state at subsequent points in the process.

151. As further evidence that the Workshop Manual does not disclose a gaseous fuel source, the presence of the vaporizer actually precludes LPG Tank (14) from being considered a “gaseous fuel source.” For example, if an LPG tank was used improperly such that LPG vapor exited the LPG tank and was sent to the

vaporizer, then the vaporizer could not function properly to generate an appropriately-rich fluid flow into the carburetor. In such a case, the engine would die. In fact, this is exactly what happens when the LPG tank runs out of liquid LPG. Therefore, the Workshop Manual does not disclose Elements [1.4] and [11.2].

152. I note that the Petition attempts to distinguish the liquid propane in the LPG tank from the liquid gasoline by stating, “While tank (14) contains LPG in both liquid and vapor form, Workshop Manual explains ‘[t]he liquid fuel is evaporated in vaporizer and is sent to the DF [dual fuel] carburetor (8) as a gaseous fuel.’” [Pet., 31.] However, the mere fact that the liquid fuel is vaporized before reaching the carburetor has no impact on its state *at the source*.

153. In fact, virtually the same could be said about the gasoline fuel: Gasoline tank (6) contains gasoline in both liquid and vapor form, but the gasoline is atomized and vaporized prior to combustion. Therefore, the fact that liquid fuels are stored in tanks that are not completely full at all times, (and therefore necessarily contain some amount of fuel vapor), is irrelevant to the question of whether or not a POSITA would have considered the fuel source to be a gaseous fuel source.

154. A POSITA would have considered a fuel source to be a gaseous fuel source only if it was the *source* of *gaseous* fuel. Conversely, LPG Tank (14) is a source of *liquid* fuel, and is therefore not a gaseous fuel source.

2. Claims 2-10, 12-16

155. Claims 2-10 and 12-16 depend from Claims 1 and 11, respectively, and are therefore not invalid for the same reasons as those provided above for Claims 1 and 11.

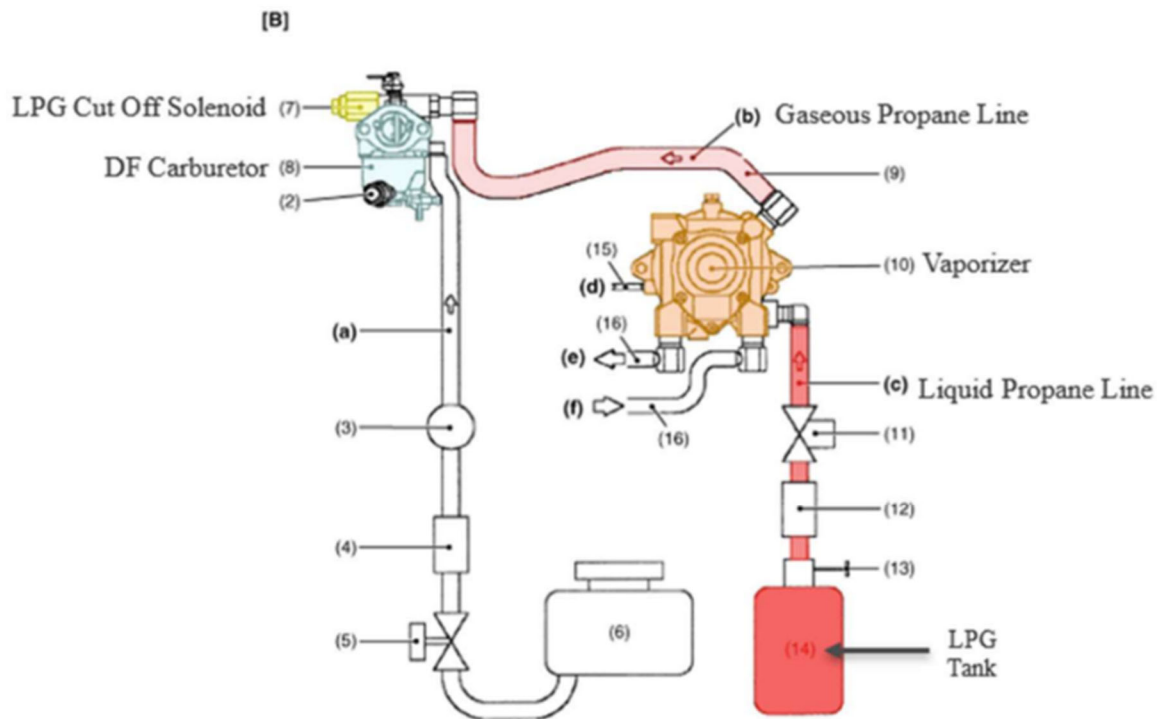
156. Additional analysis with respect to specific dependent claims is addressed below.

3. Claim 2: “The dual fuel generator of claim 1 further comprising: a liquid fuel valve along a liquid fuel line coupling the liquid fuel source to the carburetor; and a gaseous fuel valve along a gaseous fuel line coupling the gaseous fuel source to the carburetor.”

157. The Workshop Manual does not disclose or otherwise render obvious “The dual fuel generator of claim 1 further comprising: a liquid fuel valve along a liquid fuel line coupling the liquid fuel source to the carburetor; and a gaseous fuel valve along a gaseous fuel line coupling the gaseous fuel source to the carburetor.” Specifically, the Workshop Manual does not disclose “a gaseous fuel valve along a gaseous fuel line coupling the gaseous fuel source to the carburetor.”

158. Once again, Petitioner does not explicitly identify the claimed “gaseous fuel line.” [Pet., 42-46.] Instead, Petitioner refers generally to an “LPG fuel line.” [Pet., 43 (“LPG Manual Valve (13), which is a gaseous fuel valve positioned on the LPG fuel line”); *id.*, 44 (“LPG Manual Valve (13), LPG Shut Off Solenoid Valve (11), and LPG Cut Off Solenoid (7) all are positioned on the LPG fuel line”).]

However, by Petitioner’s own admission, the Workshop Manual does not have a single “LPG fuel line,” but rather separate “Liquid Propane Line (c)” and “Gaseous Propane Line (b).” [Pet., 44.] This is further depicted in Petitioner’s annotations to the Workshop Manual (reproduced below) which separately identify and color the liquid and gaseous lines.

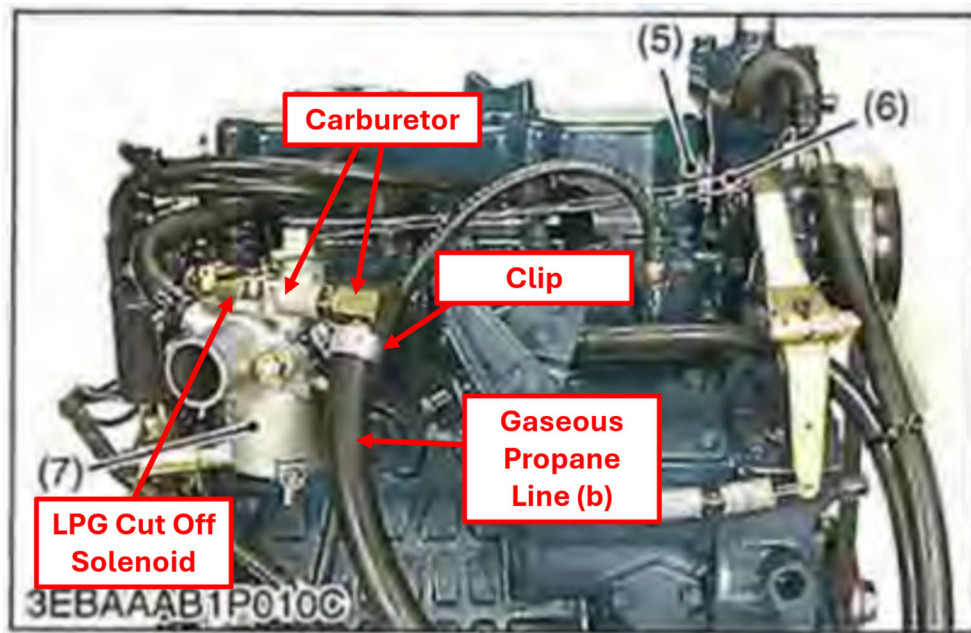


[Pet., 44 (annotations in original).]

159. Petitioner identifies three distinct valves as the alleged “gaseous fuel valve along a gaseous fuel line.” [Pet., 44 (“LPG Manual Valve (13), LPG Shut Off Solenoid Valve (11), and LPG Cut Off Solenoid (7) all are positioned on the LPG fuel line”).] However, LPG Manual Valve (13) and LPG Shut Off Solenoid Valve (11) are clearly located along a *liquid* fuel line. Therefore, neither of those valves

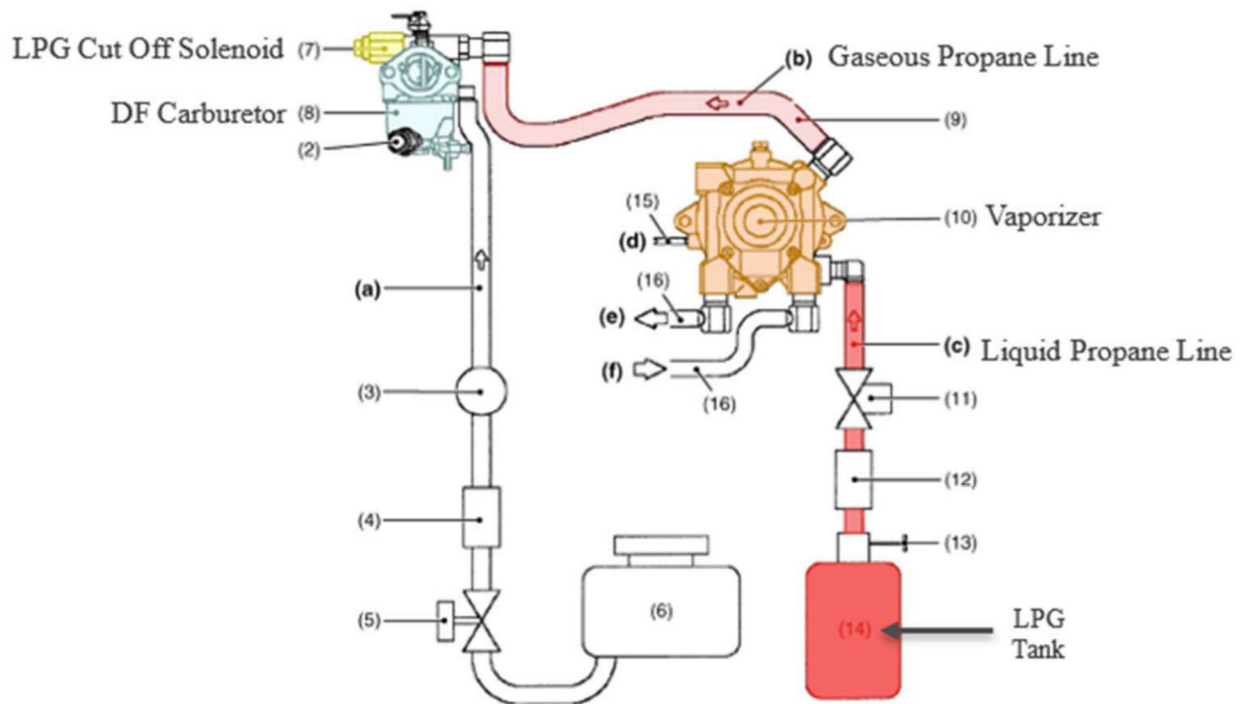
can be claimed “gaseous fuel valve along a gaseous fuel line.” [EX1009, 65 (“For LPG fuel, *the liquid fuel stored in the LPG tank (14) is sent to vaporizer (10)*”) (emphasis added); *see also* EX2136, 130:9-136:1 (“selecting the right type of the solenoid valve that is covering the gaseous fuel versus the liquid fuel, it’s an important factor”).]

160. In fact, the *only* gaseous fuel line disclosed by the Workshop Manual is “Gaseous Propane Line (b),” which consists of the black fuel line shown below attaching to the carburetor upstream of the LPG Cut Off Solenoid (7). [EX1009, 115.]



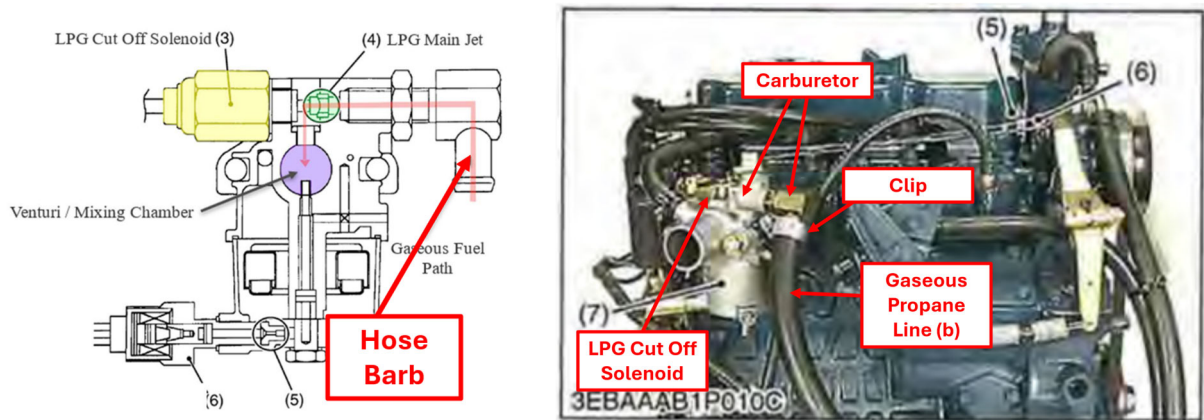
[EX1009 (Workshop Manual) at p. 115 (annotated).]

161. Petitioner’s annotations below provide further clarity regarding the relationship between Gaseous Propane Line (b) and the LPG Cut Off Solenoid (7).



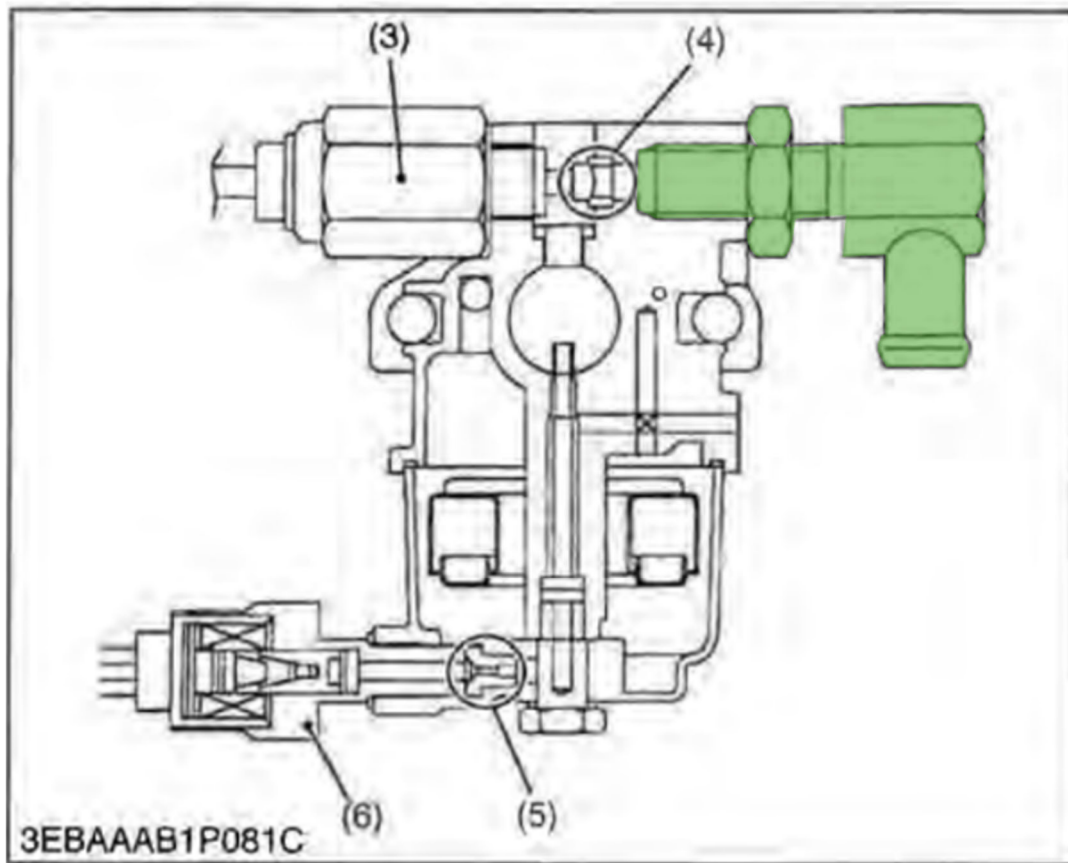
[Pet., 44 (annotations in original).]

162. Petitioner’s annotations make clear that LPG Cut Off Solenoid (7) is not located *along* Gaseous Propane Line (b). Rather, Gaseous Propane Line (b) is attached to the hose barb depicted at the top right of the below diagram (below, left), and secured with a clip (below, right). In a related proceeding regarding the parent ’398 Patent, Petitioner’s expert (Dr. Morse) testified that this was a common way to secure a fuel line. [EX2127 (Morse Depo. Tr.) at 109:11-110:8 (“It’s common to have a hose barb on the tank and then an elastomeric fuel line that attaches to the barb, and typically with a clip to secure it.”).] A “clip” is depicted in silver below, and is immediately adjacent Gaseous Propane Line (b) (black).



[Pet., 45 (annotated) (left); EX1009 (Workshop Manual) at p. 115 (annotated) (right).]

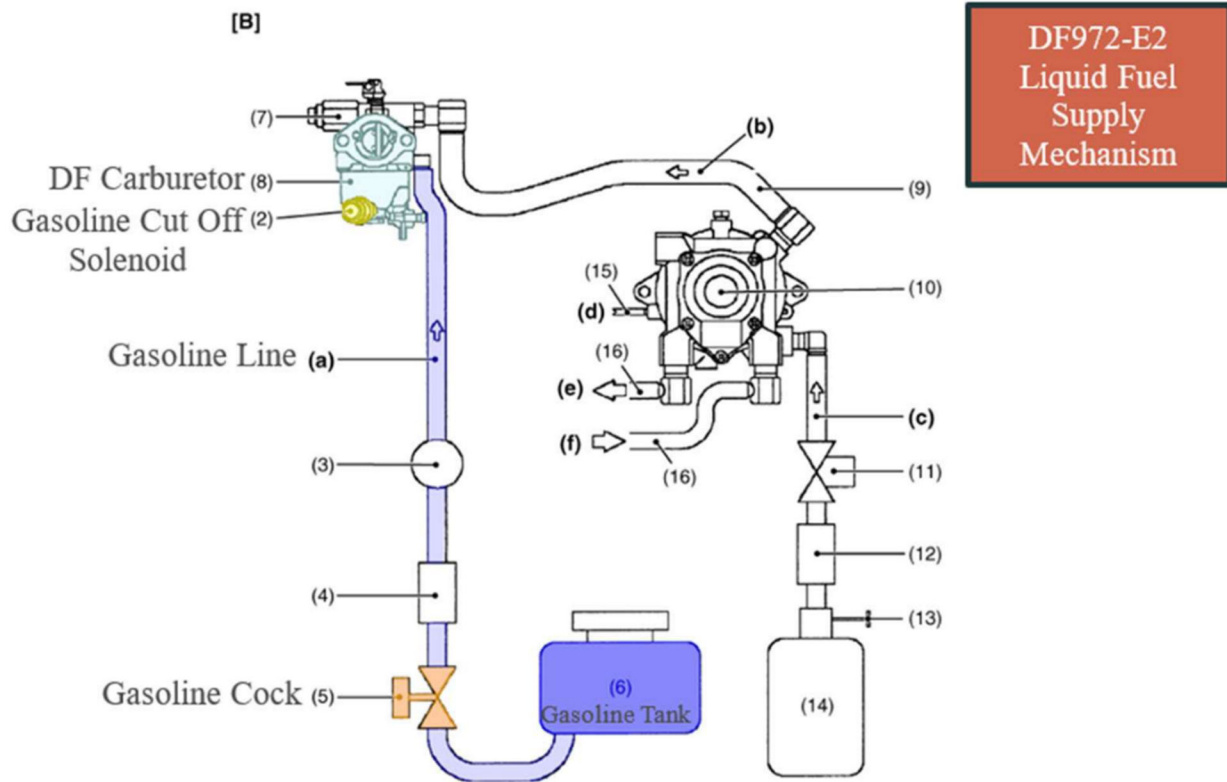
163. As shown above, Petitioner identifies the LPG Cut Off Solenoid as being located on the “gaseous fuel path,” which (while true) is irrelevant when analyzing specific claim limitations requiring the valve be located along the gaseous fuel *line*. Based on Petitioner’s annotated figure, LPG Cut Off Solenoid (3) is located *after* Gaseous Propane Line (b), rather than along it. There are several intervening components located between LPG Cut Off Solenoid (3) and Gaseous Propane Line (b). Those intervening components are highlighted in green, in the annotated figure below.



[EX1009, 68 (annotated).]

164. As further evidence, Petitioner’s analysis of the claimed “liquid fuel valve along a liquid fuel line” is instructive.

165. There, Petitioner identified the Workshop Manual’s “Gasoline Cock (5)” as the claimed “liquid fuel valve” and *explicitly identifies* “Gasoline Line (a)” as the claimed “liquid fuel line.” [Pet., 42.] Petitioner’s annotations are reproduced below:



[Pet., 42 (annotations in original).]

166. Unlike LPG Cut Off Solenoid (7) (discussed above), Gasoline Cock (5) is clearly positioned *along* the alleged liquid fuel line. For example, the alleged fuel line continues both upstream and downstream of the alleged fuel valve.

167. Conversely, LPG Cut Off Solenoid (7) identified with respect to this element is located entirely downstream of Gaseous Propane Line (b), with other intervening components positioned between Gaseous Propane Line (b) and LPG Cut Off Solenoid (7).

168. For at least the reasons set forth above, the Workshop Manual does not disclose or otherwise render obvious Claim 2.

4. Claim 3: “The dual fuel generator of claim 2, wherein each of the liquid fuel valve and the gaseous fuel valve comprises a mechanical valve.”

169. Claim 3 depends from Claim 2, and is therefore not invalid for the same reasons.

170. Moreover, the Workshop Manual does not disclose or otherwise render obvious “The dual fuel generator of claim 2, wherein each of the liquid fuel valve and the gaseous fuel valve comprises a mechanical valve.”

171. As discussed above, Petitioner identifies three distinct valves as the claimed “gaseous fuel valve.” [§X.A.3, above]. However, LPG Manual Valve (13) and LPG Shut Off Solenoid Valve (11) are clearly located along a *liquid* fuel line, and thus cannot be the claimed “gaseous fuel valve along a gaseous fuel line.” [EX1009, 65 (“For LPG fuel, *the liquid fuel stored in the LPG tank (14) is sent to vaporizer (10)*”) (emphasis added); §X.A.1.ii, above.]

172. Additionally, LPG Cut Off Solenoid (7), is not a “mechanical valve.” Petitioner does not even appear to argue that it is a mechanical valve. [*Compare* Pet., 46 (“Workshop Manual discloses a liquid fuel valve, Gasoline Cock (5), which is a mechanical valve”) *with* Pet., 47 (“Workshop Manual also discloses LPG Cut Off Solenoid (7) ... which mechanically interrupts the flow of LPG from the LPG fuel source to the carburetor.”).]

173. Instead, Petitioner argues that it “mechanically interrupts the flow of LPG.” But, the mere fact that a device “mechanically interrupts” a flow does not make it a mechanical valve. [EX2136, 107:14-108:18 (distinguishing between electrical, mechanical, and electro-mechanical systems, and noting that electro-mechanical systems have “an electrical component and a mechanical component”); *see also id.* at 49:11-50:8 (referring to a solenoid valve as having a “coil that is electrically controlled” and “mechanical movement that is caused by that plunger”).] In fact, had Patent Owner intended to claim an electro-mechanical valve, it would have done so. [EX1001, Cl. 6 (“wherein the switch is an *electro-mechanical switch*”) (emphasis added).]

174. To try and fill this gap in its analysis, Petitioner argues that “a POSA would have understood that a mechanical valve can substitute for LPG Cut Off Solenoid.” [Pet., 47.] Importantly, the Petitioner does not identify the mechanical valve which would have allegedly been substituted, which I understand is insufficient. Nor does the Petitioner provide any basis as to why a POSITA *would* have used *that* valve in place of LPG Cut Off Solenoid (7) specifically (regardless of whether or not such a substitution was possible). It is my opinion that the LPG Cut Off Solenoid (7) performs its role very well and there is no reason to change it to some other type of valve.

175. For at least the reasons set forth above, the Workshop Manual does not disclose or otherwise render obvious Claim 3.

- 5. Claim 6: “The dual fuel generator of claim 1, wherein the switch is an electro-mechanical switch connecting one fuel source to the carburetor and connected to the electrical power generator, and wherein the liquid fuel cut-off solenoid is connected to open and close a fuel path to the engine in response to reception of electrical power from the switch.”**

176. The Workshop Manual, alone or in combination with Matsushima, does not disclose or otherwise render obvious “The dual fuel generator of claim 1, wherein the switch is an electro-mechanical switch connecting one fuel source to the carburetor and connected to the electrical power generator, and wherein the liquid fuel cut-off solenoid is connected to open and close a fuel path to the engine in response to reception of electrical power from the switch.”

177. As an initial matter, Petitioner’s invalidity challenge is unclear. For example, Petitioner initially asserts that Claim 6 is obvious over the Workshop Manual alone. [Pet., 10 (addressing Claim 6 with respect to Ground 1).] However, Petitioner later argues that “a POSA would have understood that the combination of Workshop Manual and Matsushima teaches claim 6.” [Pet., 51-52.]

178. Petitioner maps the claimed “switch” to the Workshop Manual’s “Fuel Select Switch.” [Pet., 32-34.] The Workshop Manual confirms that the claimed “switch” is connected to the Workshop Manual’s battery. [EX1009, 68.] Thus, the

Workshop Manual does not disclose a switch that is “connected to the electrical power generator.”

179. However, Petitioner does not argue that it would have been obvious for a POSITA to have modified the Workshop Manual’s engine to connect the claimed “switch” to a generator. Specifically, Petitioner (1) does not identify where in the prior art it is disclosed that the claimed “switch” is connected to a generator, (2) does not identify a motivation to combine the Workshop Manual with any prior art reference disclosing the claimed “switch” connected to a generator, or (3) does not assert that a POSITA would have had a reasonable expectation of success in making the claimed modification. At best, Petitioner asserts that Matsushima’s fluid injection valve 10 is connected to its generator.

180. However, asserting that the Workshop Manual’s fuel select switch allegedly *could* be connected to a generator is not the same as asserting that a POSITA *would* have been motivated to do so, and furthermore, would have had the required expectation of success in doing so.

181. Moreover, the mere fact that Matsushima allegedly discloses that a different component is connected to its generator is not the same as disclosure of the claimed structure.

6. Claim 8: “The dual fuel generator of claim 1, wherein the liquid fuel cut-off solenoid is normally open to provide liquid fuel to the engine when the liquid fuel cut-off solenoid is unpowered”

182. The Workshop Manual (alone or in view of Matsushima and/or Olmr) does not disclose or otherwise render obvious “The dual fuel generator of claim 1, wherein the liquid fuel cut-off solenoid is normally open to provide liquid fuel to the engine when the liquid fuel cut-off solenoid is unpowered.”

183. Petitioner identifies the Workshop Manual’s Gasoline Cut Off Solenoid as the claimed “liquid fuel cut-off” and acknowledges that the “liquid fuel cut-off” is normally closed. [Pet., 32 (when “battery current stops to the gasoline cut off solenoid ... [t]hen, the gasoline flow is shut”).] Therefore, the Workshop Manual alone does not disclose this limitation.

184. Instead, Petitioner argues that it “would have been obvious to a POSA to use Olmr’s solenoid valve 42 in place of Workshop Manual’s liquid fuel cut-off solenoid. [Pet., 51.] However, Petitioner does not even attempt to articulate a motivation to replace the Workshop Manual’s normally closed liquid fuel cut-off solenoid with Olmr’s normally open solenoid. Instead, Petitioner argues that “the decision to configure a solenoid as normally open or normally closed is mere design choice.” [Pet., 53.]

185. It is my opinion that a POSITA would not have been motivated to replace the Workshop Manual's normally closed solenoid with Olmr's normally open solenoid.

186. Olmr does not relate to a dual fuel engine. As Petitioner previously acknowledged, the Workshop Manual discloses a fuel select switch (8) which determines whether current flows to the gasoline cut off solenoid (6) or the LPG cut off solenoid (3):

With the fuel select switch (8) in the "GASOLINE" position "D" and the main switch in the "ON" position, the battery current flows to the gasoline cut off solenoid (6). Therefore gasoline fuel in the float chamber flows to the mixing chamber.

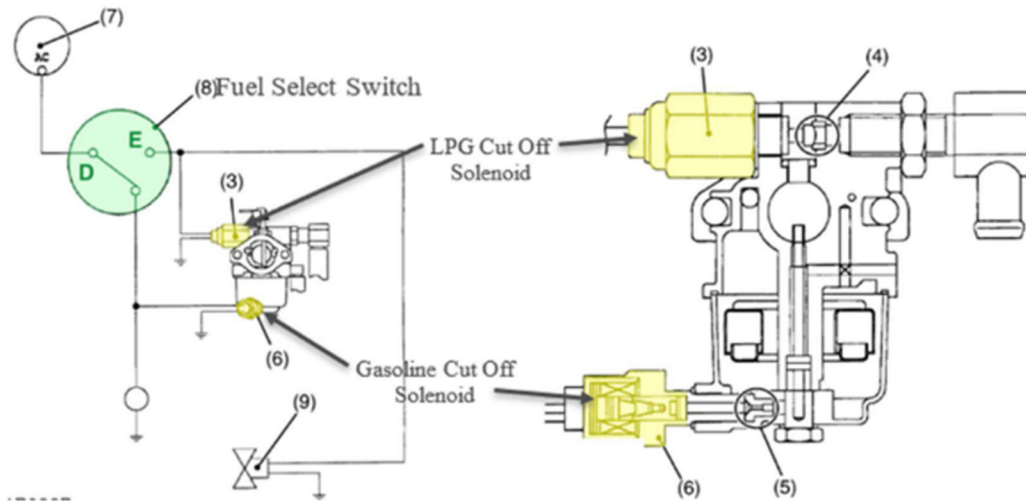
When the fuel select switch (8) is turned to the "LPG" position "E", the battery current stops to the gasoline cut off solenoid (6) and flows to the LPG cut off solenoid (3) and LPG shut off solenoid valve (9).

...

When the main switch (7) turned to the "OFF" position, the battery current stops to the both of solenoids.

[EX1009, 68; *see also* Pet., 32-33.]

187. Petitioner's annotations of the pertinent Workshop Manual figures (which detail which valve(s) are impacted by which position(s) of Fuel Select Switch (8)), are reproduced below:



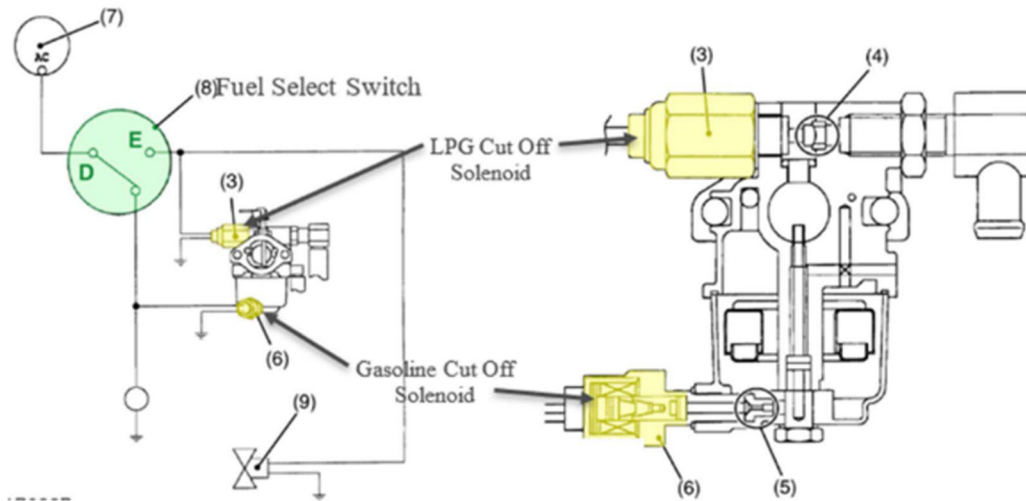
[Pet., 33 (citing EX1009, 68).]

188. Given the overall structure and layout of the Workshop Manual’s switching system, replacing the Gasoline Cut Off Solenoid with a normally-open solenoid (as allegedly suggested by Olmr) would render the resulting device inoperable.

189. The Workshop Manual teaches that “[w]hen the main switch (7) turned to the ‘OFF’ position, the battery current stops to the both of solenoids.” [EX1009, 68.] Under Petitioner’s proposed combination, turning the main switch to “off” would result in *stopping* current to the (now) normally-open Gaseous Cut Off Solenoid, resulting in the solenoid opening and allowing gasoline to flow into the carburetor. This is precisely the opposite of the desired result (i.e., no fuel reaches the carburetor when the switch is “off”).

190. Petitioner does not attempt to address this deficiency. Moreover, the Workshop Manual's inoperable "Off" switch is not the only issue caused by Petitioner's proposed combination. The Workshop Manual's "Fuel Select Switch" identified by Petitioner as allegedly anticipating Element [1.3] (Pet., 32-33) operates by directing current *either* to the LPG Cut Off Solenoid *or* the Gasoline Cut Off Solenoid, both of which are normally closed in the configuration disclosed by the Workshop Manual. [EX1009, 68.] Petitioner's proposed combination suggests replacing the Workshop Manual's Gasoline Cut Off Solenoid with a normally open solenoid. [Pet., 53.] However, this also renders the Kubota DF972 Engine inoperable.

191. Fuel Select Switch (8) functions by providing current either to Gasoline Cut Off Solenoid (6) or LPG Cut Off Solenoid (3) (but not both simultaneously). Due to the normally-closed configuration disclosed by the Workshop Manual, the *powered* solenoid is the only open solenoid, and turning off main switch (7) removes power from both solenoids and prevents any fuel flow into the carburetor. Petitioner's annotations of this configuration are reproduced below:



[Pet., 33 (citing EX1009, 68).]

192. Under Petitioner’s proposed modification (ostensibly based on the teachings of Olmr) the Gaseous Cut Off Solenoid would be normally open, and the LPG Cut Off Solenoid would be normally closed. Thus, when the Fuel Select Switch (8) is in Position “D” (“Gasoline”) as shown above, on the left, current is provided to the normally open Gasoline Cut Off Solenoid (meaning the solenoid is closed). However, current is not provided to the normally closed LPG Cut Off Solenoid (meaning the solenoid is also closed).

193. Conversely, when the Fuel Select Switch (8) is in Position “E” (“LPG”), current is provided to the normally closed LPG Cut Off Solenoid (meaning the solenoid is open). However, current is not provided to the normally open Gasoline Cut Off Solenoid (meaning the solenoid is also open).

194. The impact of Fuel Select Switch (8) on the alleged Gaseous Cut Off Solenoid and LPG Cut Off Solenoid under Petitioner’s proposed modification in view of Olmr is represented in the table below:

	Powered Solenoid	Gasoline Cut Off Solenoid Position	LPG Cut Off Solenoid Position
Switch Position “D” (“GASOLINE”)	Gasoline Cut Off Solenoid	Closed	Closed
Switch Position “E” (“LPG”)	LPG Cut Off Solenoid	Open	Open

195. Simply put, under Petitioner’s proposed configuration, the Workshop Manual’s engine either receives both fuels simultaneously when in Switch Position “D” (resulting in problematic engine “flooding”) [(EX1001, 8:33-44)], or the engine receives no fuel at all when in Switch Position “E”. Neither outcome is desirable and results in an inoperable system. Once again, Petitioner does not provide any explanation regarding how this problem would have been resolved.

7. **Claim 9: “The dual fuel generator of claim 8, wherein the dual fuel generator is a batteryless dual fuel generator and the engine is a pull-start engine, the batteryless dual fuel generator further comprising a pull-starter that drives the electrical power generator to power and close the liquid fuel cut-off solenoid while starting the engine on gaseous fuel.”**

196. Claim 9 depends from Claim 8, and is therefore not invalid for the same reasons.

197. Moreover, the Workshop Manual (alone or in view of Matsushima) does not disclose or otherwise render obvious “generator of claim 8, wherein the

dual fuel generator is a batteryless dual fuel generator and the engine is a pull-start engine, the batteryless dual fuel generator further comprising a pull-starter that drives the electrical power generator to power and close the liquid fuel cut-off solenoid while starting the engine on gaseous fuel.”

198. Petitioner acknowledges that the Workshop Manual discloses a DF972 engine with a battery start (as opposed to a pull start) and argues that it “would have been obvious to a POSA to incorporate Matsushima’s pull-start to supply electrical power in Workshop Manual’s engine.” [Pet., 54.] Specifically, Petitioner argues for replacing the battery start with a pull start. [Pet., 55 (arguing for “[i]ncorporating a pull-start into the Workshop Manual’s dual fuel engine and removing the battery.”).]

199. However, the Petition lacks sufficient motivation to replace the battery start with a pull start.

200. Specifically, Petitioner makes two statements regarding the alleged motivation for replacing the Workshop Manual’s battery start with Matsushima’s recoil starter. First, Petitioner argues that “[i]ncorporating a pull-start into Workshop Manual’s dual fuel engine and removing the battery would improve reliability in cold or remote applications, and reduce cost and weight of the generator.” [Pet., 55.]

201. However, Petitioner’s arguments are conclusory, and there is no evidentiary support in either the Petition or Dr. Shahbakhti’s declaration that replacing the Workshop Manual’s battery start system with a pull start would

improve its reliability in cold or remote applications, or otherwise reduce costs. Moreover, given that the Workshop Manual relies on powered solenoid valves for many applications, it is unclear how removing the battery (which is used to power those valves) would reduce costs, much less result in a functional device.

202. Second, Petitioner argues that “Workshop Manual and Matsushima both relate to the same class of small spark-ignition engines.” [Pet., 55.]

203. However, Petitioner does not provide any support for its implication that Matsushima and the Workshop Manual belong “to the same class of small spark-ignition engines.” [Pet., 55.] Matsushima teaches that its “invention relates to a fuel injection system for an internal combustion engine for supplying fuel to an intake system thereof, and more particularly to an electronically-controlled fuel injection system of this kind which is adapted for use in *small-sized engines equipped with no battery*.” [EX1012, 1:6-11 (emphasis added).] U.S. Patent No. 3,465,740 (cited by Matsushima as an appropriate “known type” of recoil starter) provides further guidance, referring “particularly to rewind type pull-rope starters for small internal combustions engines such as those commonly employed to power lawn mowers, garden tractors, snow blowers and the like.” [EX1012, 4:63-68; *see also* EX2128 (U.S. Patent No. 3,465,740), 1:36-40.]

204. The Workshop Manual discloses a 962cc engine. [EX1009, 8.] However, Petitioner’s expert Dr. Mahdi Shahbakhti explicitly defined small engines

as engines having a displacement of less than 0.5 liters (500 cc). [EX1003 (Shahbakhti Decl.) at ¶[0006]; *see also* EX1003 (Shahbakhti CV) at 497; EX2136 (Shahbakhti Depo. Tr.) at 20:11-21:15.] Similarly, Petitioner’s expert in a related proceeding (Dr. Morse) testified that a 962cc engine such as the engine disclosed by the Workshop Manual “would be a large engine” “[i]f you use it on a lawn mower.” [EX2127 (Morse Depo. Tr.) at 130:9-131:15.] A POSITA would have understood that a 962cc engine would have been substantially more difficult to start with a pull-starter than the smaller engines contemplated by Matsushima.

205. For example, a POSITA would have understood that the typical engine for a lawn mower, garden tractor, snow blower, or similar device in 1990 (Matsushima’s priority date) would have been smaller than the Workshop Manual by a large factor. [*See e.g.*, EX2130 (U.S. Patent No. 4,707,017) at 5:7-18 (referring to motorcycle engines over 170 cubic centimeters as “relatively large”).]

206. Furthermore, the Workshop Manual discloses a water-cooled engine. [EX1009, 8.] Therefore, the pull start would have needed to turn the water pump in addition to the engine itself, significantly increasing the difficulty of pull-starting the DF972 engine.

207. Petitioner’s conclusory analysis of the purported motivation to combine the Workshop Manual and Matsushima is particularly deficient in light of Petitioners’ experts’ deposition testimony. For example, Dr. Shahbakhti testified

that “Engine performance will always be affected by the type of the design and how variable are adjusted for the performance of that engine,” that “there are so many metrics in terms of the design that will have an impact on the engine performance,” that “there are many, many metrics that have -- and will have an impact on the performance of the engine,” and “there are so many types of engines and for different applications, and also depending on their designs, you will have the choices of the parts that you can vary in order to affect the performance.” [EX2136, 14:11-16:8.]

208. Likewise, in a related proceeding, Petitioner’s expert Dr. Morse repeatedly emphasized that the particular characteristics of an engine are incredibly relevant when analyzing the operation of said engine. [EX2127 (Morse Depo. Tr.) at 50:17-51:8 (agreeing that “the decision of how to configure the transfer piping and all the associated equipment is dictated by the specific application”); 67:2-9 (“[t]he specific problems that could arise [from drawing liquid propane instead of gaseous propane] would depend on the specific engine being evaluate and the specific configuration”); 121:6-15 (increased fuel pressure may or “may not be an advantage in all cases, depending on how you’ve configured everything”); 122:15-123:3 (“the particular mass flow rate of fuel is dictated by the specific configuration of the engine” and “the fluid properties of the fuel and the configuration of the tank where the fuel is stored and the configuration of the fuel line from the tank to the

engine”); 176:4-13 (“certainly the working fluid is something that is taken into account when designing a piping system”)].

209. In light of Petitioner’s experts’ repeated emphasis on specific engine characteristics and applications, Petitioner’s conclusory assertion of a motivation to combine based on allegedly belonging to “the same class of small spark-ignition engines” is particularly deficient, especially where Petitioner provided no evidence that the engines in question actually belong to the “same class.”

210. Finally, Petitioner’s analysis of a reasonable expectation of success is deficient, at least because it does not account for the difficulties in adding a pull start to a large, water-cooled engine. For example, Petitioner has not introduced any evidence to establish that an operator would physically be able to start a 962cc water-cooled engine using a pull start. My opinion, based on at least i) my education and experience as a POSITA, ii) my understanding of the forces required to force an engine revolution and initiate a compression/ignition cycle while manually activating a dry water pump, and iii) my many years of pull-starting lawn mowers, chainsaws, and the like, is contrary to this suggestion. It would be, at minimum, very difficult to pull start the large, water-cooled engine presented in the Workshop Manual.

211. Additionally, pull start engines often require priming the engine with fuel and choking the air flow. However, Petitioner’s proposed combination removes

both the battery and electric start system from the Workshop Manual's engines, and the Workshop Manual *does not* disclose a manual choke or any mechanism to manually prime the engine. As such, a POSITA would not have understood the Workshop Manual's engine to be operable with a pull start. For these reasons, Petitioner's proposed motivation to combine and reasonable expectation of success analysis is not sufficient to render Claim 9 obvious.

B. The Nakafushi Grounds: The '145 Patent is Not Obvious over Nakafushi, Alone or in Combination with Other References

212. Petitioner has not established that the Challenged Claims are obvious over Nakafushi, alone or in combination with other references. I address Petitioner's challenges on a limitation-by-limitation basis below.

1. Independent Claims 1, 11

i. Element [1.0] & Element [11.0]: "A dual fuel generator"

213. The term "dual fuel generator" gives meaning to Claims 1 and 11 and properly defines the invention. [§X.A.1.i(a); EX2136, 120:1-121:24 (testifying that Element [1.1] ("an engine operable on a gaseous fuel and a liquid fuel") "is connected to Element 1, which is a dual-fuel generator.".)].

214. Nakafushi, alone or in combination with Matsushima, does not disclose or otherwise render obvious a dual fuel generator. Nakafushi does not disclose or otherwise render obvious a dual fuel generator. Rather, as discussed above, it

discloses a Mazda engine, not a generator. Nowhere in the reference is any device that a POSITA would consider to be the claimed generator. Therefore, the obviousness allegation fails at a foundational level.

215. Petitioner’s entire “analysis” of this limitation is reproduced below:

Nakafushi and Matsushima disclose a [sic] dual fuel engines. It would have been obvious to a POSA to have implemented a dual fuel engine in a generator, as dual fuel generators were well known as of the earliest priority date of the ‘145 Patent. Ex.1016; Ex.1003, [0154].⁷

[Pet., 56.]

216. Petitioner’s obviousness “analysis” is based on a single conclusory sentence alleging it would have been generally obvious to implement a dual fuel engine in a generator because “dual fuel generators were well known as of the earliest priority date of the ‘145 Patent.” [Pet., 56 (citing EX1016; EX1003, [0145]).]

217. Once again, Petitioner’s purported “analysis” is deficient for several reasons. First, Petitioner does not even establish which engine (Nakafushi’s or Matsushima’s) is allegedly being implemented in a dual fuel generator.

⁷ Paragraph 154 of Dr. Shahbakhti’s declaration repeats this paragraph verbatim without any additional analysis. [EX1003, ¶[0154]; *see also* Pet., 113; EX1003, ¶[0307].]

218. Second, like with the Workshop Manual, the mere fact that dual fuel generators were allegedly well known says nothing about whether a POSITA would have been motivated to implement the specific prior art engines at issue here in a specific generator. [§X.A.1.i(b)]. The Petition’s conclusory recitation that dual fuel generators were well known in the art is insufficient to show that a POSITA would have been motivated to make the proposed implementation.

219. Third, it is unclear from the Petition whether Petitioner proposed implementing the alleged prior art dual fuel engines in a generic, hypothetical “dual fuel generator,” or specifically combining each engine with the DuroMax XP4400EH generator described EX1016. Both approaches are deficient for the same reasons as discussed with respect to the Workshop Manual. [§X.A.1.i(b)].

220. Petitioner’s conclusory expert testimony is not sufficient to salvage its deficient obviousness analysis. Because the cited prior art does not disclose Elements 1.0 and 11.0, Petitioner’s obviousness analysis is deficient.

ii. Element [1.4] & Element [11.2]: “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”

221. Nakafushi does not disclose “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.”

222. Specifically, Nakafushi does not disclose a “gaseous fuel source.”

223. As discussed above, a POSITA would have understood Claims 1 and 11 distinctly claimed the state of the fuel (i.e., gaseous or liquid) at two separate locations: the *source* of the fuel and the *engine*. [See §X.A.1.ii(a), above.]

224. As discussed above, Nakafushi describes a dual fuel engine that draws fuel from two different sources of liquid fuel: Gasoline Tank 11 and LPG Cylinder 16. [See §VII.B, above.]

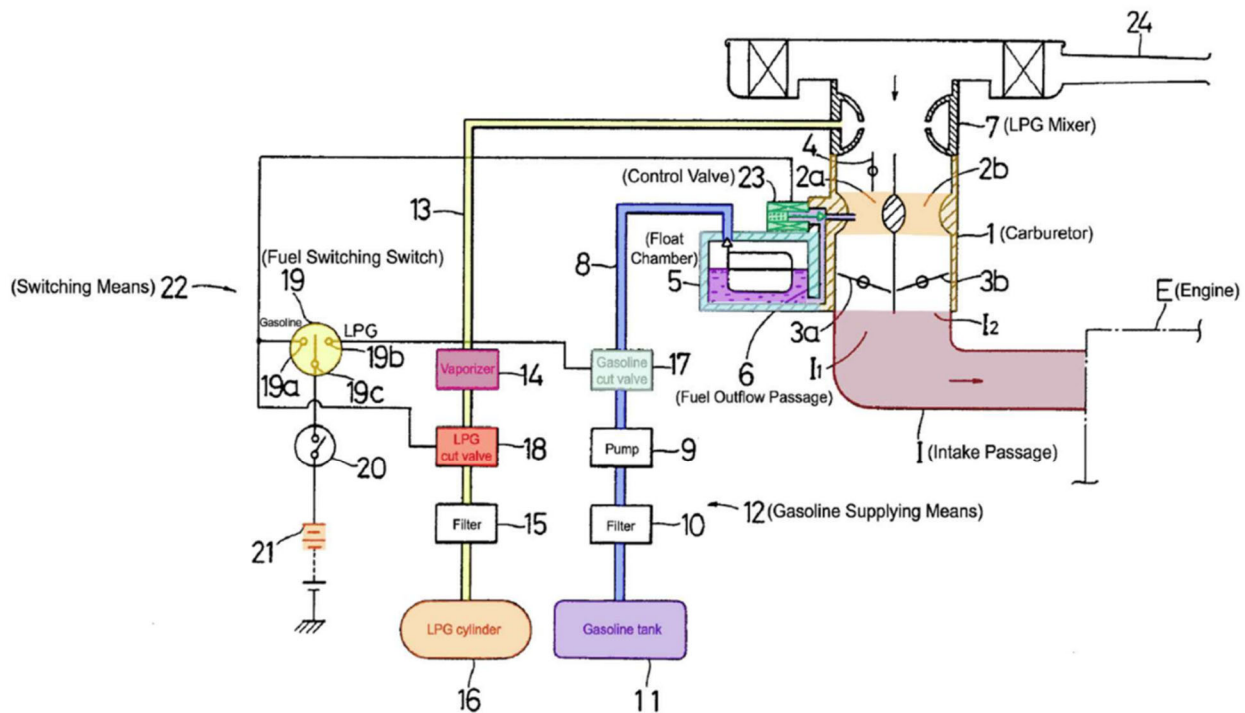
225. The Petition does not explicitly identify the alleged “gaseous fuel source” in its analysis of Element [1.4]. [Pet., 60-62.] And, Petitioner’s analysis of Element [11.2] merely incorporates its Element [1.4] analysis by reference. [Pet., 113.]

226. Instead, Petitioner’s purported “analysis” is limited to two conclusory sentences. First, Petitioner states that a POSITA “would have recognized Nakafushi’s disclosure of a dual fuel engine that mixed air with the gaseous fuel (i.e., LPG) or liquid fuel (i.e., gasoline) in the carburetor.” [Pet., 61-62.] However, identifying the gaseous fuel is not the same as identifying the alleged gaseous fuel *source*. Second, Petitioner restates the claim language, concluding that “A POSA would have understood that Nakafushi teaches carburetor 1 attached to an intake of the engine to mix air and fuel, that thereby connects the gaseous fuel source and the

liquid fuel source.” [Pet., 62.] Neither statement identifies the alleged gaseous fuel source.

227. Petitioner also provides the following annotated figure, which (once again) does not explicitly identify the claimed gaseous fuel source.

FIG. 1

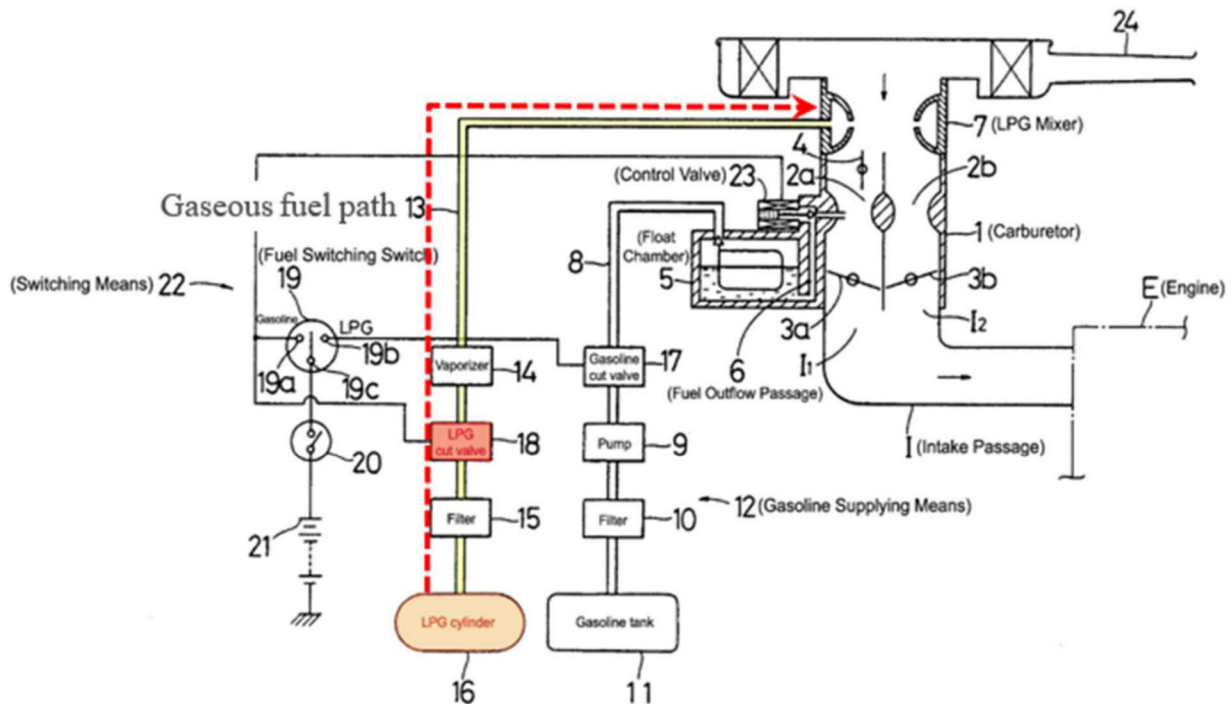


[Pet., 60 (annotations in original).]

228. Elsewhere, Petitioner addresses Claim 2, which recites “a gaseous fuel valve along a gaseous fuel line coupling the gaseous fuel source to the carburetor.” There, Petitioner states “FIG. 1 shows LPG cut valve 18 positioned on the LPG supplying passage 13, which begins at the LPG cylinder 16, leading to vaporizer 14,

which in turn is connected to carburetor 1.” [Pet., 69.] Petitioner’s corresponding annotations are reproduced below:

FIG. 1

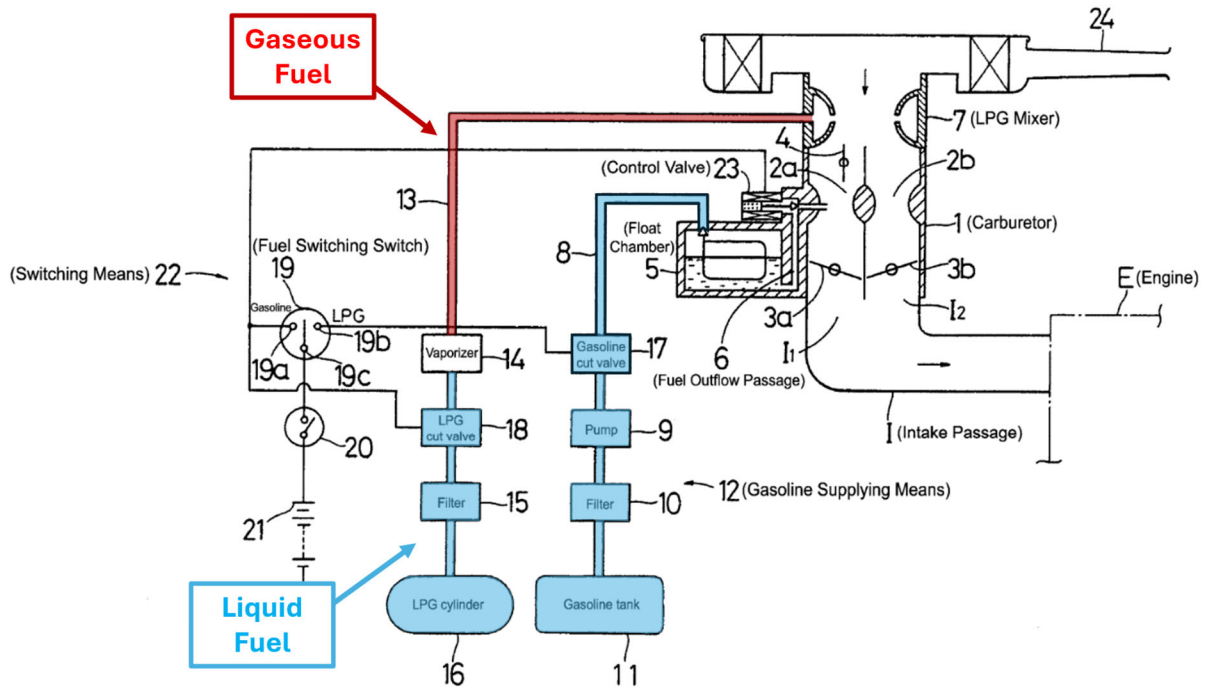


[Pet., 70 (annotations in original).]

229. Petitioner’s statement that “LPG supplying passage 13 ... begins at the LPG cylinder 16” indicates that Petitioner intended to map Nakafushi’s “LPG cylinder 16” to the claimed “gaseous fuel source.”

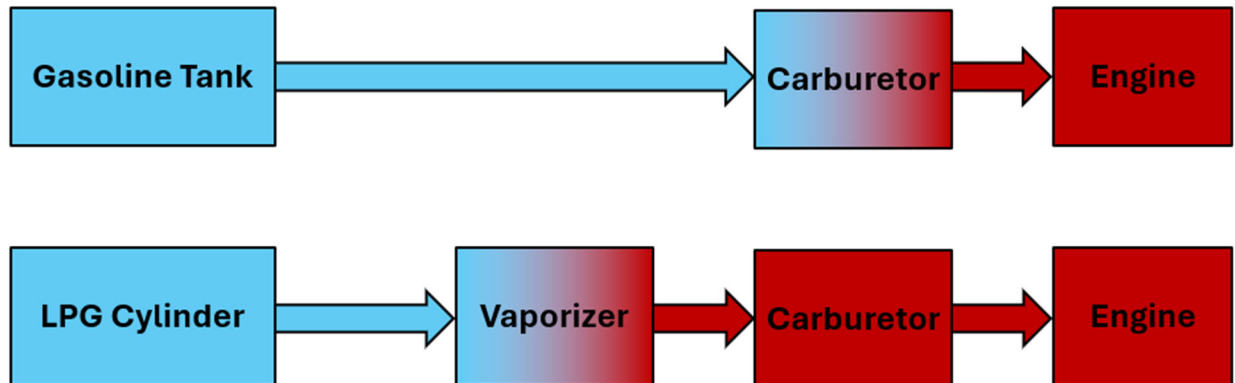
230. Regardless, LPG is liquid fuel when leaving the fuel source, and only becomes gaseous fuel after passing through the vaporizer, as depicted below:

FIG. 1



[EX1005, Fig. 1 (annotated)]

231. The relative state of the Gasoline and LPG at various points in the system can be appreciated more simply by considering the fuel system process timeline below, depicting liquid fuel in blue and gaseous fuel in red.



Nakafushi's Fuel System Process.

232. The diagram shows the liquid gasoline being supplied to the carburetor, which then vaporizes the gasoline and provides it to the engine. Meanwhile, the liquid LPG is vaporized into a gaseous state by the vaporizer, and then passed through the carburetor to provide it to the engine.

233. As explained in the prosecution history, the mere fact that the liquid fuel in the LPG tank is converted to its gaseous state prior to reaching the carburetor would not have led a POSITA to believe that the LPG tank was a gaseous fuel source. Rather, a POSITA would have viewed both Gasoline Tank 11 and LPG Cylinder 16 as liquid fuel sources which supply liquid fuels that get converted into a gaseous state at subsequent points in the process.

234. As further evidence that Nakafushi does not disclose a gaseous fuel source, the presence of the vaporizer actually precludes LPG Cylinder 16 from being considered a “gaseous fuel source.” For example, if an LPG cylinder was used improperly such that LPG vapor exited the LPG tank and was sent to the vaporizer, then the vaporizer could not function properly to generate an appropriately-rich fluid flow into the carburetor. In such a case, the engine would die. In fact, this is exactly what happens when the LPG cylinder runs out of liquid LPG. Therefore, Nakafushi does not disclose these elements.

235. A POSITA would have considered a fuel source to be a gaseous fuel source only if it provided gaseous fuel. Conversely, LPG Cylinder 16 provides *liquid* fuel, and is therefore not a gaseous fuel source.

2. Claims 2-10, 12-16

236. Claims 2-10 and 12-16 depend from Claims 1 and 11, respectively, and are therefore not invalid for the same reasons.

237. Additional analysis with respect to specific dependent claims is addressed below.

3. Claim 2: “The dual fuel generator of claim 1 further comprising: a liquid fuel valve along a liquid fuel line coupling the liquid fuel source to the carburetor; and a gaseous fuel valve along a gaseous fuel line coupling the gaseous fuel source to the carburetor.”

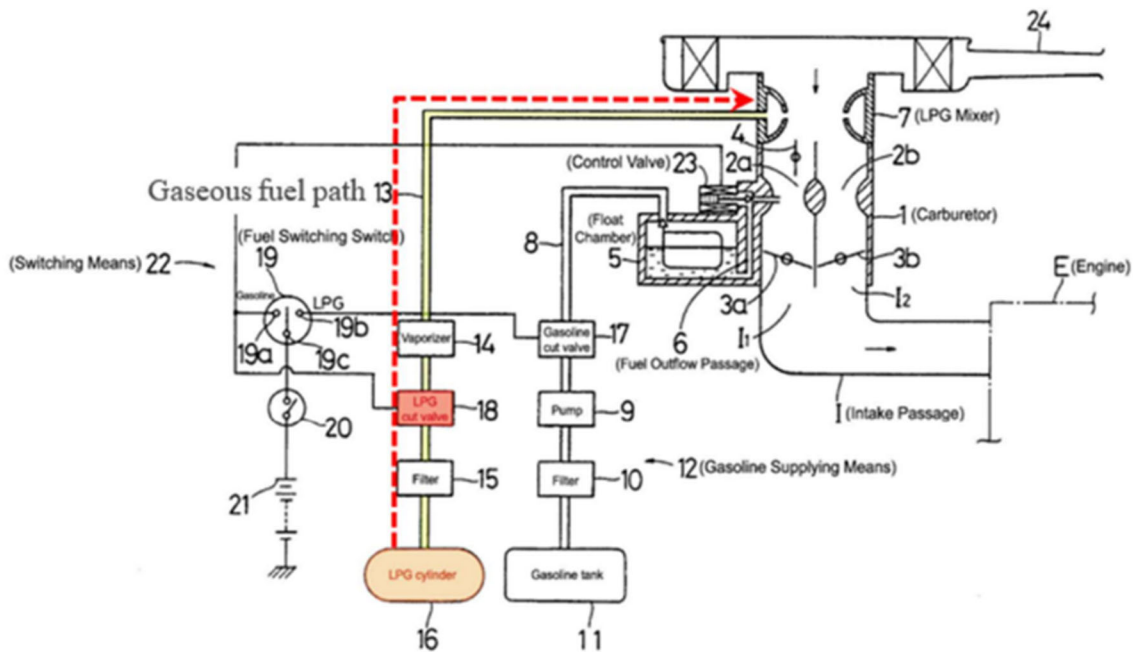
238. Nakafushi does not disclose or otherwise render obvious “The dual fuel generator of claim 1 further comprising: a liquid fuel valve along a liquid fuel line coupling the liquid fuel source to the carburetor; and a gaseous fuel valve along a gaseous fuel line coupling the gaseous fuel source to the carburetor.” Specifically, Nakafushi does not disclose “a gaseous fuel valve along a gaseous fuel line coupling the gaseous fuel source to the carburetor.”

239. Petitioner identifies “LPG supplying passage 13” as the alleged “gaseous fuel line.” [Pet., 69-70.] Petitioner likewise identifies Nakafushi’s “LPG

cut valve 18” as the alleged “gaseous fuel valve along a gaseous fuel line.” [Pet., 69-70.]

240. Petitioner’s annotations identifying the alleged “gaseous fuel line” and “gaseous fuel valve” are reproduced below:

FIG. 1

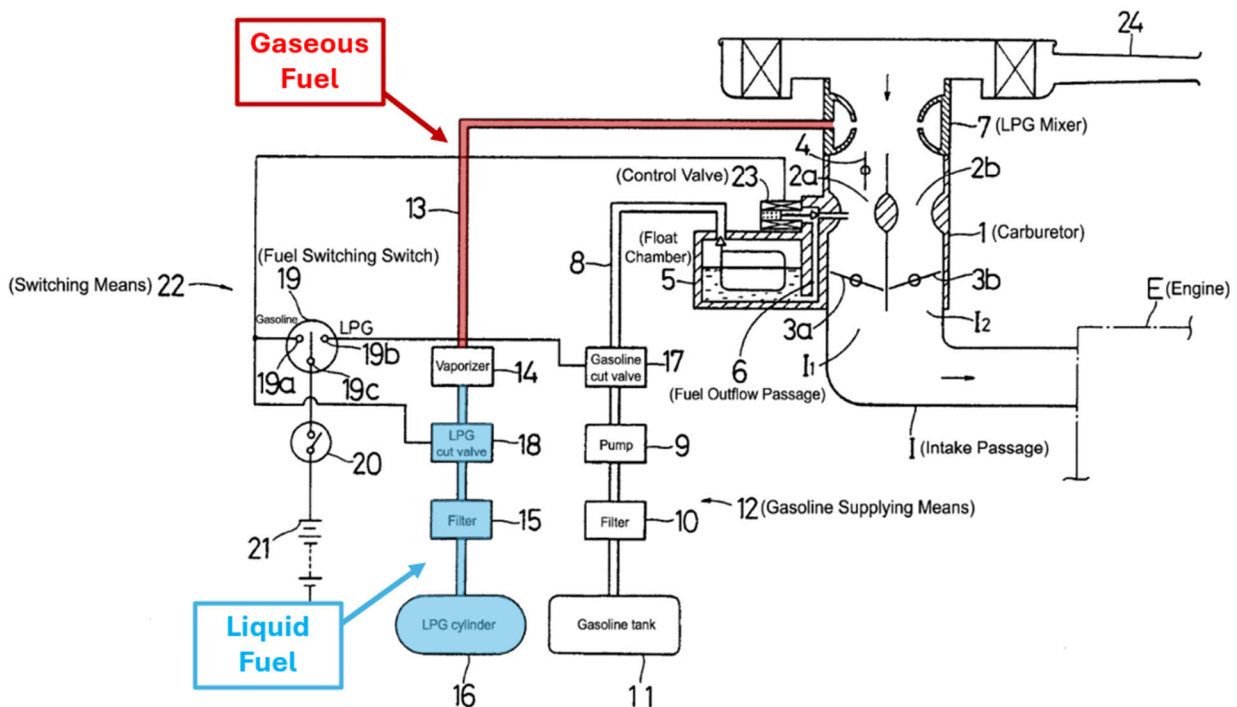


[Pet., 70 (annotations in original).]

241. Petitioner asserts that “FIG. 1 shows LPG cut valve 18 positioned on the LPG supplying passage 13.” [Pet., 69.] However, contrary to Petitioner’s representations, LPG cut valve 18 is not a *gaseous* fuel valve located *along* a gaseous fuel line coupling the gaseous fuel source to the carburetor. [EX2136, 130:9-136:1 (“selecting the right type of the solenoid valve that is covering the gaseous fuel versus the liquid fuel, it’s an important factor”).] As depicted in the annotated figure

below, LPG cut valve 18 is located between LPG cylinder 16 and vaporizer 14, and is, therefore, a *liquid* fuel valve located along a *liquid* fuel line (blue) and not a gaseous fuel line (red).

FIG. 1



[EX1005, Fig. 1 (annotated).]

242. For at least the reasons set forth above, Nakafushi does not disclose Claim 2 (“a gaseous fuel valve along a gaseous fuel line coupling the gaseous fuel source to the carburetor.”).

4. Claim 3: “The dual fuel generator of claim 2, wherein each of the liquid fuel valve and the gaseous fuel valve comprises a mechanical valve.”

243. Claim 3 depends from Claim 2, and is therefore not invalid for the same reasons.

244. Moreover, Nakafushi does not disclose or otherwise render obvious “The dual fuel generator of claim 2, wherein each of the liquid fuel valve and the gaseous fuel valve comprises a mechanical valve.”

245. As discussed above, Petitioner identifies Nakafushi’s LPG cut valve 18 as the claimed “gaseous fuel valve.” [§X.B.3.] However, LPG cut valve 18 is not a “mechanical valve,” and Petitioner does not even appear to argue that it is a mechanical valve. [Pet., 71 (“Nakafushi discloses a gaseous fuel valve (LPG cut valve 18), which mechanically interrupts the flow of LPG to the carburetor.”).] However, the mere fact that a device “mechanically interrupts” a flow does not make it a mechanical valve. [EX2136, 107:14-108:18 (distinguishing between electrical, mechanical, and electro-mechanical systems, and noting that electro-mechanical systems have “an electrical component and a mechanical component”); *see also id.* at 49:11-50:8 (referring to a solenoid valve as having a “coil that is electrically controlled” and “mechanical movement that is caused by that plunger”).] In fact, had Patent Owner intended to claim an electro-mechanical valve, it would have done so.

[EX1001, Cl. 6 (“wherein the switch is an *electro-mechanical switch*”) (emphasis added).]

246. To try and fill this gap in its analysis, Petitioner once again argues that “a POSA would have understood that a mechanical valve can substitute for LPG cut valve 18.” [Pet., 71.] Importantly, Petitioner does not provide any support for this assertion. The Petition merely incorporates its analysis with respect to the Workshop Manual by reference. [Pet., 71, (citing §VII.A.3).]

247. However, the Workshop Manual is a different reference (with a different valve), and Petitioner has failed to provide any analysis as to (1) which mechanical valve would have allegedly been substituted, or (2) why a POSITA would have used that valve in place of LPG cut valve 18 specifically (regardless of whether or not such a substitution was possible). Furthermore, Petitioner provides no expectation of success in making this substitution. It is my opinion, that there is no motivation to make such a substitution because the valve in question performs its function very well.

248. Moreover, Petitioner’s analysis is deficient for the same reasons as discussed with respect to the Workshop Manul. [§X.A.4.]

249. For at least the reasons set forth above, Nakafushi does not disclose or otherwise render obvious Claim 3.

5. **Claim 6: “The dual fuel generator of claim 1, wherein the switch is an electro-mechanical switch connecting one fuel source to the carburetor and connected to the electrical power generator, and wherein the liquid fuel cut-off solenoid is connected to open and close a fuel path to the engine in response to reception of electrical power from the switch.”**

250. Nakafushi, alone or in combination with Matsushima, does not disclose or otherwise render obvious “The dual fuel generator of claim 1, wherein the switch is an electro-mechanical switch connecting one fuel source to the carburetor and connected to the electrical power generator, and wherein the liquid fuel cut-off solenoid is connected to open and close a fuel path to the engine in response to reception of electrical power from the switch.”

251. Petitioner maps the claimed “switch” to Nakafushi’s “fuel switching switch 19.” [Pet., 73-74.] Nakafushi confirms that the claimed “switch” is connected to the Workshop Manual’s battery. [Pet., 73 (citing EX1005, [0013]) (“Nakafushi’s fuel selecting switch 19 is connected to battery 21”).] Thus, Nakafushi does not disclose a switch that is “connected to the electrical power generator.”

252. However, Petitioner does not argue that it would have been obvious for a POSITA to have modified Nakafushi’s engine to connect the claimed “switch” to a generator. Specifically, Petitioner does not (1) identify where in the prior art it is disclosed that the claimed “switch” is connected to a generator, (2) identify a motivation to combine Nakafushi with any prior art reference disclosing the claimed

“switch” connected to a generator, or (3) assert that a POSITA would have had a reasonable expectation of success in making the claimed modification. At best, Petitioner asserts that Matsushima’s fluid injection valve 10 is connected to its generator.

253. However, asserting that the Workshop Manual’s fuel select switch allegedly *could* be connected to a generator is not the same as asserting that a POSITA *would* have been motivated to do so. [Pet., 73 (“A POSA would have understood that the fuel selecting switch *could* be connected to the generator in the absence of the battery”) (emphasis added).]

254. Moreover, the mere fact that Matsushima allegedly discloses that a different component is connected to its generator is not the same as disclosure of the claimed structure.

6. Claim 8: “The dual fuel generator of claim 1, wherein the liquid fuel cut-off solenoid is normally open to provide liquid fuel to the engine when the liquid fuel cut-off solenoid is unpowered”

255. Nakafushi (alone or in view of Matsushima and/or Olmr) does not disclose or otherwise render obvious “The dual fuel generator of claim 1, wherein the liquid fuel cut-off solenoid is normally open to provide liquid fuel to the engine when the liquid fuel cut-off solenoid is unpowered.”

256. Petitioner separately identifies Nakafushi’s gasoline cut valve 17 and control valve 23 as the claimed “liquid fuel cutoff solenoid.” [Pet., 75.]⁸ According to Petitioner, “[g]asoline cut valve 17 of Nakafushi is normally open” and “[c]ontrol valve 23 of Nakafushi is normally closed.” [Pet., 75.] As such, neither structure alone “is normally open to provide liquid fuel to the engine when the liquid fuel cut-off solenoid is unpowered” as required by Claim 8.

257. First, Petitioner concedes that Nakafushi’s control valve 23 is normally closed. Therefore, Petitioner argues that a POSITA “would have been motivated to use Olmr’s normally-open solenoid rather than a normally-closed solenoid based on the express teachings of Olmr.” [Pet., 75 (citing §VII.B.1).] However, Petitioner’s analysis in §VII.B.1 does not address Olmr *at all*. [See Pet., 52 (“a POSA would have understood that the combination of the Workshop Manual and Matsushima teaches claim 6”).]

⁸ Petitioner previously argued that a POSITA would have been motivated to replace both Nakafushi’s gasoline cut valve 17 and control valve 23 with Olmr’s solenoid valve 42. [Pet., §VII.C.2.f.] Although I disagree, my opinions with respect to Claim 8 are not impacted by that analysis.

258. Presumably, Petitioner intended to incorporate its prior assertion that a POSITA would have been motivated to replace the Workshop Manual's Gasoline Cut Off Solenoid with Olmr's solenoid valve 42, and then apply that to a combination involving Nakafushi and Olmr. [Pet., §VII.B.3] However, Petitioner has not established that any alleged motivation to combine the Workshop Manual and Olmr is equally applicable to Nakafushi and Olmr.

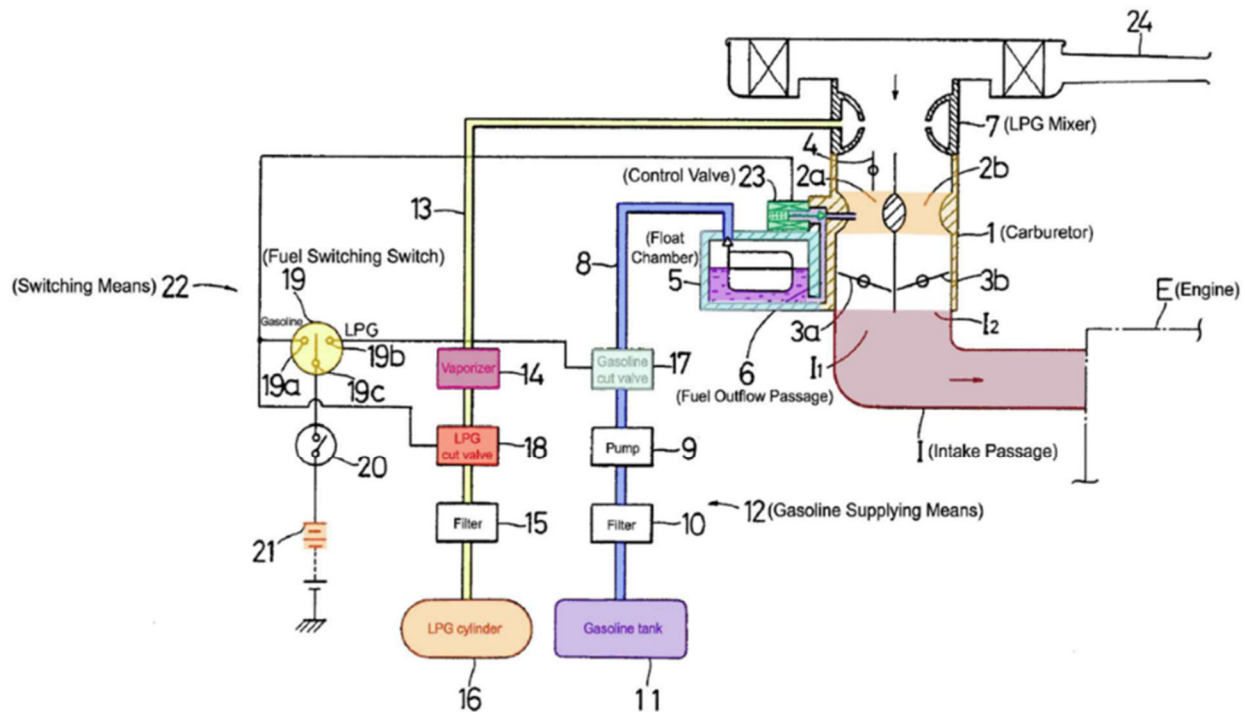
259. For example, Petitioner does not address the differences between the power systems disclosed by the Workshop Manual and Nakafushi. [*Compare* EX2127 (Morse Depo. Tr.) at 104:7-13 (testifying that Nakafushi's "gasoline cut valve 17 and the LPG cut valve 18 are both normally open") *with id.* at 143:5-15 (testifying that the Workshop Manual's "valve 6" and "valve 3" are normally closed"); *see also id.* at 102:12-103:3 (referring to Nakafushi's power system as "a little trickier than I first thought").] Regardless, Petitioner's proposed motivation to "use Olmr's solenoid valve 42 as Nakafushi's control valve 23" is also deficient for the same reasons set forth with respect to the Workshop Manual. [*See* §X.A.6, above.]

260. Second, merely replacing Nakafushi's gasoline cut valve 17 (which Petitioner asserts is already normally open) with Olmr's normally open solenoid valve 42 does not result in a solenoid that "is normally open to provide liquid fuel to

the engine when the liquid fuel cut-off solenoid is unpowered” as required by Claim 8.

261. Petitioner concedes that Nakafushi’s control valve 23 (which is located between gasoline cut valve 17 and the engine) is normally closed. [Pet., 75.]
Petitioner’s annotations depicting Nakafushi’s fuel system are reproduced below.

FIG. 1



[Pet., 22 (citing EX1005, Fig. 1).]

262. Because of the relative placement of gasoline cut valve 17 and control valve 23, a POSITA would have understood that as long as control valve 23 is normally closed, liquid fuel could not be provided “to the engine when the liquid fuel cut-off solenoid is unpowered,” regardless of any modifications made to

Nakafushi's gasoline cut valve 17. A normally open gasoline cut valve 17 would have allowed fuel flow to the *float bowl* when gasoline cut valve 17 is unpowered; however, it would have had no impact on fuel flow *to the engine*.

263. Petitioner does not attempt to address this deficiency. Presumably, Petitioner will argue that its conclusory assertion that the proposed combination “would have involved a simple substitution and a rewiring of Nakafushi's switch” is sufficient to resolve this deficiency. However, Petitioner does not explain at any point what the proposed “rewiring” entails. In fact, generically asserting that a POSITA would have been able to “rewire” the prior art to match the configuration disclosed by the challenged patent—without any explicit disclosure of the “rewired” configuration—is the very definition of hindsight.

264. Finally, the Petition seems devoid of any meaningful explanation as to why a POSITA would have an expectation of success in attempting the proposed combination. Given that Nakafushi is a “tricky” Mazda engine that requires some type of unexplained “rewiring,” it is my opinion that there is no expectation of success in this combination.

C. The Holzapfel Grounds: The '145 Patent is Not Obvious over Holzapfel, Alone or in Combination with Other References

265. Petitioner has not established that the Challenged Claims are obvious over Holzapfel, alone or in combination with other references. I address Petitioner's challenges on a limitation-by-limitation basis below.

1. Independent Claims 1, 11

i. Element [1.0] & Element [11.0]: "A dual fuel generator"

266. The term "dual fuel generator" gives meaning to Claims 1 and 11 and properly defines the invention. [§X.A.1.i(a); EX2136, 120:1-121:24 (testifying that Element [1.1] ("an engine operable on a gaseous fuel and a liquid fuel") "is connected to Element 1, which is a dual-fuel generator.").]

267. Holzapfel, alone or in combination with Matsushima, does not disclose or otherwise render obvious a dual fuel generator. Holzapfel does not disclose or otherwise render obvious a dual fuel generator. Rather, as discussed above, it discloses a depression-era car engine, not a generator. Nowhere in the reference is any device that a POSITA would consider to be the claimed generator. Therefore, the obviousness allegation fails at a foundational level.

268. Petitioner's entire "analysis" of this limitation is reproduced below:

Holzapfel and Matsushima discloses a [sic] dual fuel engines. It would have been obvious to a POSA to have implemented a dual fuel engine

in a generator, as dual fuel generators were well known as of the earliest priority date of the ‘145 Patent. Ex.1016; Ex.1003, [0219].⁹

[Pet., 79.]

269. Petitioner’s obviousness “analysis” is based on a single conclusory sentence alleging it would have been generally obvious to implement a dual fuel engine in a generator because “dual fuel generators were well known as of the earliest priority date of the ‘145 Patent.” [Pet., 79 (citing EX1016; EX1003, [0219]).]

270. Once again, Petitioner’s purported “analysis” is deficient for several reasons. First, Petitioner does not even establish which engine (Holzapfel’s or Matsushima’s) is allegedly being implemented in a dual fuel generator. That is, there is no clear statement of what the combination includes.

271. Second, like with the Workshop Manual, the mere fact that dual fuel generators were allegedly well known says nothing about whether a POSITA would have been motivated to implement the specific prior art engines at issue here in a specific generator. [§X.A.1.i(b)]. The Petition’s conclusory recitation that dual fuel

⁹ Paragraph 219 of Dr. Shahbakhti’s declaration repeats this paragraph verbatim without any additional analysis. [EX1003, ¶[0219]; *see also* Pet., 116; EX1003, ¶[0333].]

generators were well known in the art is insufficient to show that a POSITA would have been motivated to make the proposed implementation.

272. Third, it is unclear from the Petition whether Petitioner proposed implementing the alleged prior art dual fuel engines in a generic, hypothetical “dual fuel generator,” or specifically combining each engine with the DuroMax XP4400EH generator described in EX1016. Both approaches are deficient for the same reasons as discussed above with respect to the Workshop Manual. [§X.A.1.i(b)].

273. Petitioner’s conclusory expert testimony is not sufficient to salvage its deficient obviousness analysis. The cited prior art does not disclose Elements 1.0 and 11.0 and Petitioner’s obviousness analysis is deficient.

ii. Element [1.2]: “an electrical power generator driven by the engine and comprising a charging coil”

274. Holzapfel, alone or in combination with Matsushima, does not disclose or otherwise render obvious “an electrical power generator driven by the engine and comprising a charging coil.”

275. Holzapfel does not disclose an electrical power generator. In fact, other than Petitioner’s expert’s understanding that the disclosure of Holzapfel implies use of (undisclosed) electrical spark plugs, Holzapfel does not disclose an electrical system at all. [EX2136, 153:19-155:8.] Furthermore, a device like a spark plug or a

Van de Graaff generator would never be considered an electrical generator in light of the '145 patent specification and claims. Such devices simply have no ability to generate electricity that compensates for the lack of an electrical grid.

276. Once again, Petitioner's analysis of this element is unclear. Notably, Petitioner's sole cite is to Matsushima, but Petitioner provides no analysis of how or why a POSITA would have been motivated to combine Holzapfel and Matsushima, nor any explicit analysis that a POSITA would have had a reasonable expectation of success in the combination. In fact, Petitioner does not even explain which feature(s) it is proposing a POSITA would have combined from each engine.

277. Petitioner points to nothing in either reference which suggests a combination. Rather, Petitioner relies entirely on the conclusory statement that a POSITA "would have been motivated to combine Holzapfel and Matsushima, and would have had a reasonable expectation of success in combining Holzapfel and Matsushima, because both relate to internal combustion engines." [Pet., 78-79.] I note that there are innumerable devices, components, mechanisms, sensors, and controllers that all "relate to internal combustion engines." However, many of those items are not physically or functionally compatible. Therefore, such a generic statement lacking specific details provides no motivation to combine, nor justifies any expectation of success.

278. In fact, Petitioner does not provide any meaningful analysis regarding how or why a POSITA would have been motivated to implement an “electrical power generator” as disclosed by Matsushima in the Holzapfel engine. As such, Petitioner has failed to show that Element [1.2] is obvious over Holzapfel in view of Matsushima.

iii. Element [1.4] & Element [11.2]: “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”

279. Holzapfel does not disclose “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.”

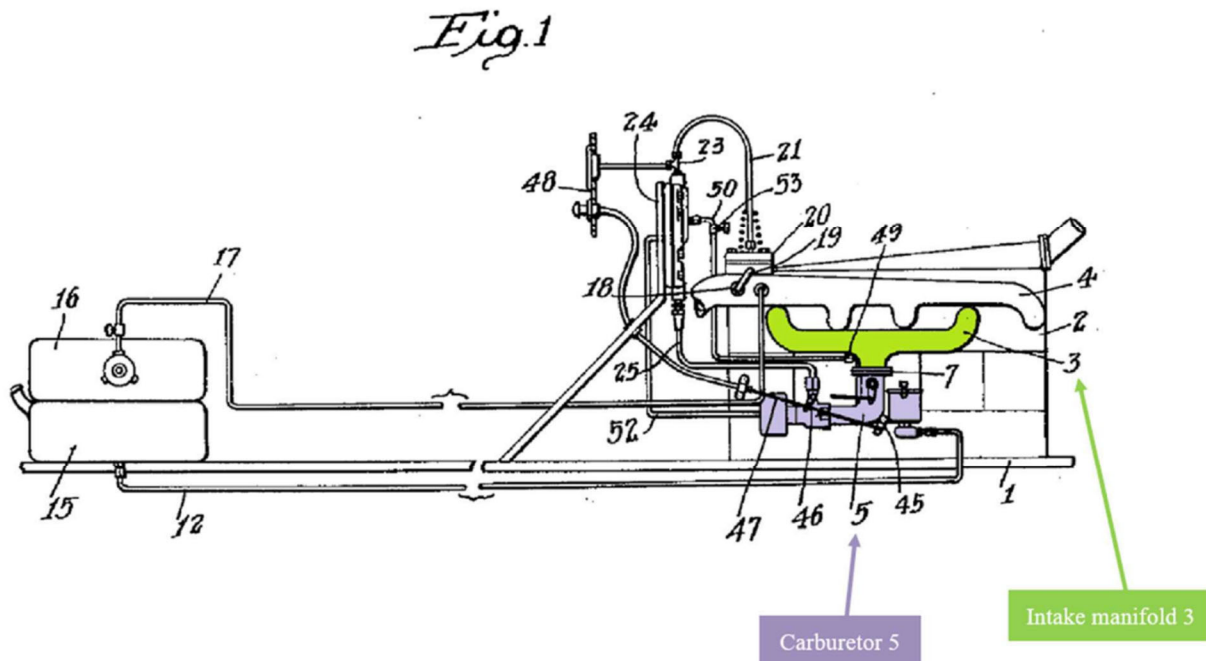
280. Specifically, Holzapfel does not disclose a “gaseous fuel source.”

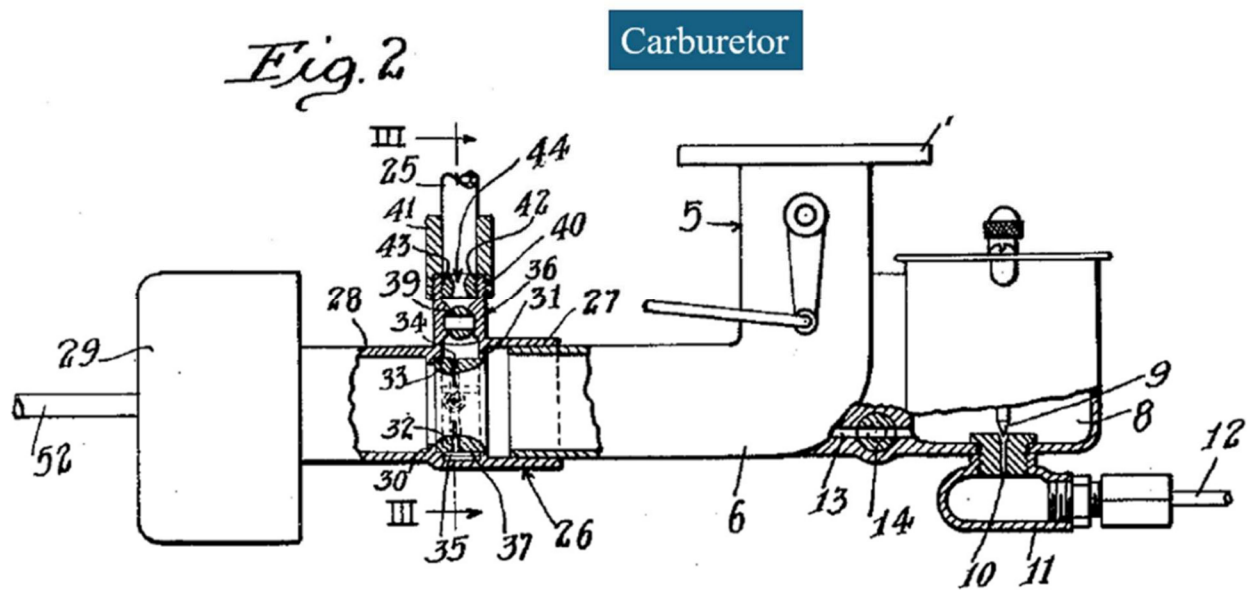
281. As discussed above, a POSITA would have understood Claims 1 and 11 distinctly claimed the state of the fuel (i.e., gaseous or liquid) at two separate locations: the *source* of the fuel and the *engine*. [See §X.A.1.ii(a), above.]

282. The Petition does not explicitly identify the alleged “gaseous fuel source” in its analysis of Element [1.4]. [Pet., 82-84.] And, Petitioner’s analysis of Element [11.2] merely incorporates its Element [1.4] analysis by reference. [Pet., 116.]

283. Instead, Petitioner’s purported “analysis” is limited to a single conclusory sentence paraphrasing the claim language, which *does not* identify the alleged gaseous fuel source. [Pet., 84 (“Thus, a POSA would have understood that Holzapfel teaches carburetor 5 attached to the engine that mixes air and fuel, that thereby connects the gaseous fuel source and the liquid fuel source.”).]

284. Petitioner also provides the following annotated figures, which (once again) do not explicitly identify the claimed gaseous fuel source.

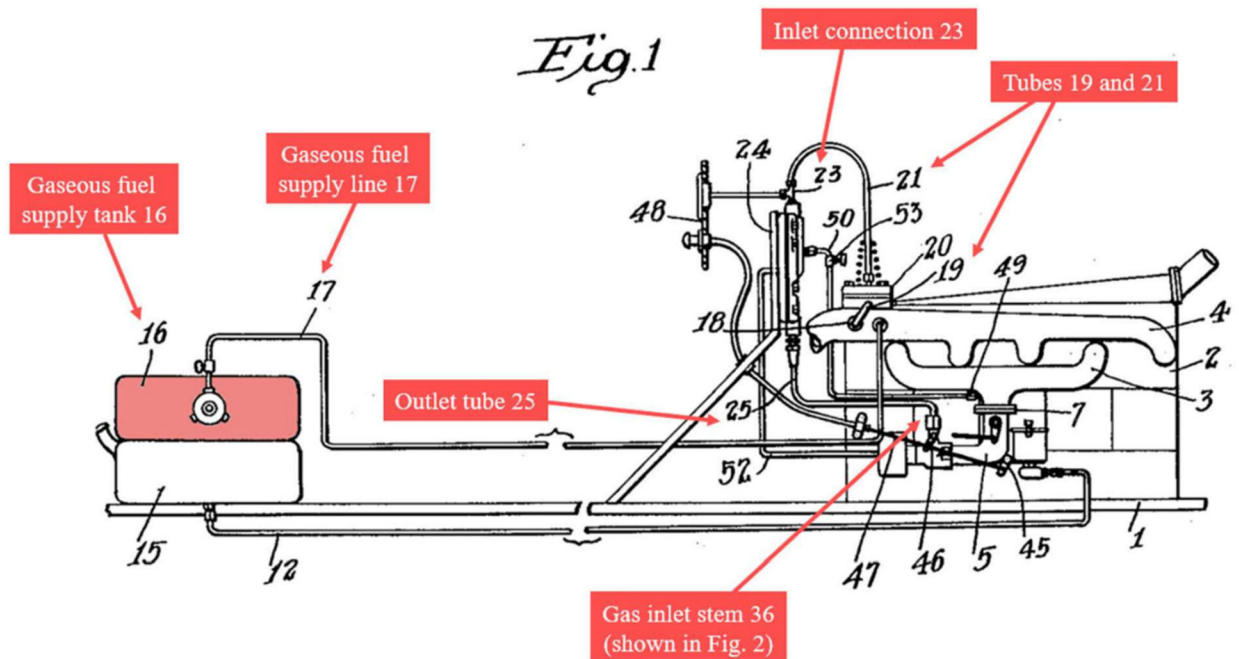




[Pet., 83 (annotations in original).]

285. Elsewhere, Petitioner addresses Claim 2, which recites “a gaseous fuel valve along a gaseous fuel line coupling the gaseous fuel source to the carburetor.” There, Petitioner states that “cut off valve 39 is positioned on the gaseous fuel line, which begins at gaseous fuel supply tank 16,¹⁰ leading to gas inlet stem 39, which in turn is connected to carburetor 5 via tube 6.” [Pet., 91.] Petitioner’s annotations of the same are reproduced below:

¹⁰ Holzapfel refers to numeral 16 as “fuel supply tank 16.” EX1008, 2:8-12. Petitioner added the modifier “gaseous” when describing Holzapfel’s fuel supply tank 16.

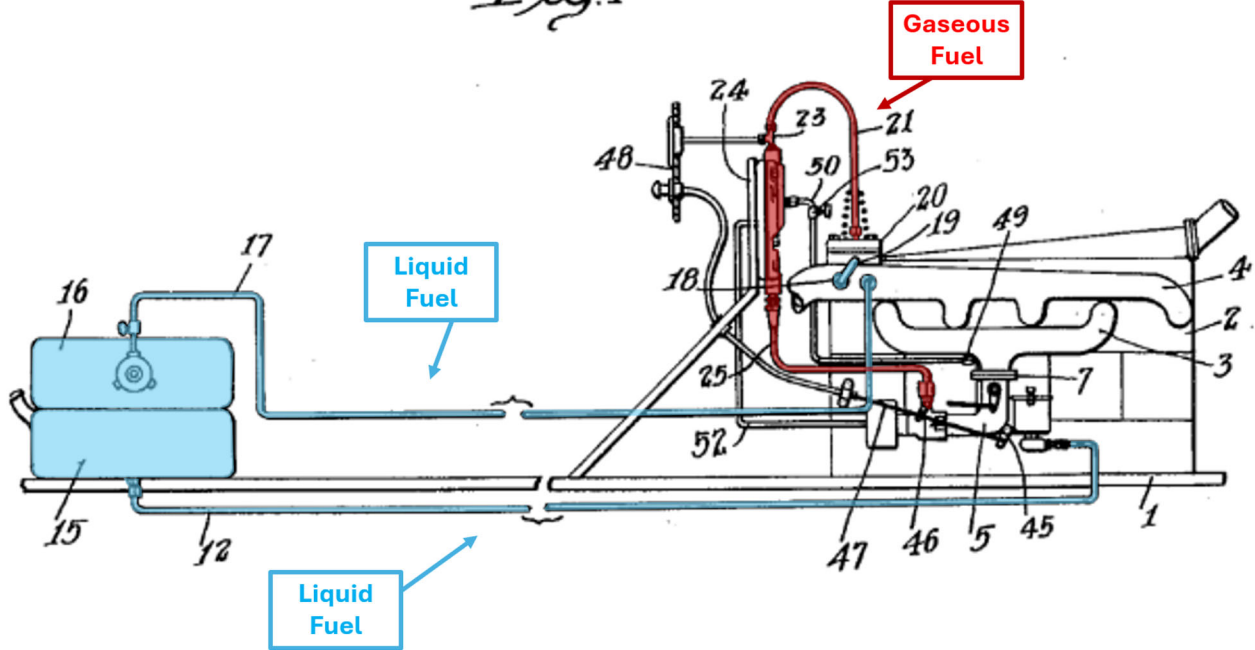


[Pet., 90 (annotations in original).]

286. Thus, to the extent that the Petition identifies the claimed “gaseous fuel source,” a POSITA would have understood that Petitioner intended to refer to Holzapfel’s fuel supply tank 16 as the claimed “gaseous fuel source” with respect to Claims 1 and 2 of the ’145 Patent.

287. As discussed above, Holzapfel describes a dual fuel engine that draws liquid fuel from two different sources: main liquid supply tank 15 and fuel supply tank 16. [See §VII.C, above.]. Both of these tanks supply liquid fuel, as illustrated below in an annotated version of Holzapfel Figure 1, wherein fuel in the liquid state has been highlighted in blue and fuel in a gaseous state has been highlighted in red.

Fig.1



Holzapfel Fuel System Shown in Fig. 1 (Annotated to Show Liquid and Gaseous States of the Two Fuels).]

288. Specifically, Holzapfel explicitly teaches that “From tank 16 there extends a suitable gaseous fuel supply tube 17 extending to the bottom of the tank 16, so as to draw off the liquid *and not gas*.” [EX1008, 2:12-16 (emphasis added).] Furthermore, Holzapfel teaches that this fuel remains in the liquid state until it “changes to a gas on the release of pressure.” [EX1008, 2:125.] A POSITA would have known that pressure was not released on this fuel until it entered the heat exchanger 20 and the pressure reducing valve 24.

289. Holzapfel explicitly teaches that fuel supply tank 16 does not supply gaseous fuel. A POSITA would have considered a fuel source to be a gaseous fuel

source only if it provided gaseous fuel. Conversely, fuel supply tank 16 provides *liquid* fuel, and is therefore not a gaseous fuel source.

iv. Element [1.5]: “a liquid fuel cut-off solenoid to interrupt liquid fuel flow to the engine upon actuation of the switch from liquid fuel to gaseous fuel”

290. Holzapfel, alone or in combination with Olmr, does not disclose or otherwise render obvious “a liquid fuel cut-off solenoid to interrupt liquid fuel flow to the engine upon actuation of the switch from liquid fuel to gaseous fuel.”

291. Petitioner asserts that a POSITA “would have found it obvious to use a solenoid, such as that disclosed by Olmr, in place of Holzapfel’s valve 14.” As explained in additional detail, below, Petitioner’s analysis is based on hindsight.

292. Holzapfel discloses “a fuel system in which a gaseous fuel supply shall be auxiliary to the liquid fuel supply now commonly employed in connection with automobiles and similar vehicles.” [EX1008, 1:24-28.] Specifically, Holzapfel is designed to function with *automobile engines in the 1930s*. [EX1008.] Petitioner has failed to provide any argument or evidence supporting the conclusion that implementation of a complex, electrically-actuated solenoid valve would have been beneficial for an automobile engine (and corresponding fuel system) designed for 1930s automobiles.

293. As discussed above, Holzapfel does not disclose a power system sufficient to operate a solenoid valve. In fact, other than Petitioner’s expert’s

understanding that the disclosure of Holzapfel implies use of (undisclosed) electrical spark plugs, Holzapfel does not disclose an electrical system at all. [EX2136, 153:19-155:8.]

294. Petitioner's explicit use of hindsight is revealed by its purported "reasonable expectation of success" analysis. In that section, Petitioner explains that Olmr's solenoid could have been implemented in Holzapfel's engine, so long as a POSITA also replaced Holzapfel's combination of rod/wire 47 and lever 45 with Olmr's control circuit 52 and switch 82. [Pet., 87.] And, according to Petitioner, the result of this extensive modification to Holzapfel, which is clearly modeled after the Challenged Claims is a solenoid valve that "accomplish[es] the same liquid fuel cutoff function [already] described in Holzapfel." [Pet., 86.]

295. Moreover, Holzapfel expressly teaches that its "rod or wire 47 ... extends to a point of convenient access to the operator of the vehicle such as, for example, the dashboard 48." [EX1008, 2:100-107.] Rod or wire 47 exists to allow an operator to change fuel sources while operating an automobile. By replacing it with a control circuit and switch, Petitioner either (1) inhibits the operation of Holzapfel's engine in its proposed use case, or (2) requires further modifications to Holzapfel's automobile, to allow an operator to manually actuate Olmr's solenoid while operating the vehicle. Notably, Petitioner did not address either concern.

296. Furthermore, Petitioners forgot to address how a user sitting behind an automobile dashboard, which is where rod or wire 47 is positioned, can access and actuate Olmr's control circuit 52 and switch 82. (See Holzapfel describing the positioning of its fuel switch, such as "a rod or wire 47 which extends to a point of convenient access to the operator of the vehicle such as, for example, the dashboard 48." [Holzapfel, 2:103-105.]). Indeed, the Petition is totally silent on how an operator of its proposed combination would actually operate the proposed device with its new circuitry and switch.

297. Holzapfel's rod or wire 47 also serves to actuate valve 39, which "may be operated to either open the inlet passage 36 to the passage of gas therethrough, or to close the same so that gas cannot pass therethrough." [EX1008, 2:86-90.] Petitioner, however, does not suggest that a POSITA would have been motivated to replace valve 39 with a solenoid. [Pet., 85 (proposing replacing "Holzapfel's valve 14" with a solenoid but not referencing valve 39).] Thus, under Petitioner's proposed combination, once rod or wire 47 is removed an operator would have had no mechanism to actuate valve 39, and therefore would have had no mechanism to either allow or prevent operation on the fuel that flows through valve 39.

298. Petitioner's motivation to combine analysis is equally deficient and steeped in hindsight. First, Petitioner does not articulate any reasons that a POSITA *would* have been motivated to implement Olmr's solenoid (and supporting electrical

circuitry) in Holzapfel's engine. Instead, Petitioner merely explains that (1) "solenoid valves provide fast response times and precise control in fuel flow applications" and (2) "*can be substituted* for mechanical valves in such applications." [Pet., 86 (emphasis added).] But, asserting that a POSITA *could* have made a substitution is not the same as asserting that they *would* have been motivated to do so. Petitioner has not established that the alleged benefit of "fast response times and precise control" associated with implementing electrically actuated solenoid valves in Holzapfel's engine is worth the risk of increased complexity and potential failures, particularly where there is no indication that "fast response times and precise control" actually provide *any* benefit to Holzapfel's depression-era automobile engine (and corresponding fuel system).

299. Furthermore, a user would need some undisclosed mechanism for triggering the actuator of the solenoid. The complexity and uncertainty of the user interface of the proposed combination eliminates any motivation to combine and injects expectation of failure. Finally, it is my opinion that Holzapfel's fuel switching mechanism works well for its intended purpose. It is a robust physical mechanism placed in an ideal location for a user to access and actuate when needing to change fuel sources.

300. Second, Petitioner's assertion that "Holzapfel and Olmr both relate to engines and both seek to prevent the flow of gasoline from the float bowl to the

engine intake” has no bearing on whether a POSITA would have been motivated to implement the precise configuration proposed by Petitioner.

301. Simply put, Petitioner does not provide any analysis regarding how or why a POSITA would have been motivated to implement Olmr’s “solenoid valve” and corresponding electrical systems in the Holzapfel engine. Furthermore, no expectation of success has been articulated. As such, Petitioner has failed to show that Element [1.5] is obvious over Holzapfel in view of Olmr.

v. Element [1.6]: “a voltage regulator coupled to the charging coil to receive power therefrom and that operates to provide a regulated voltage to the liquid fuel cut-off solenoid”

302. Holzapfel, alone or in combination with Matsushima, does not disclose or otherwise render obvious “a voltage regulator coupled to the charging coil to receive power therefrom and that operates to provide a regulated voltage to the liquid fuel cut-off solenoid.”

303. Holzapfel does not disclose a voltage regulator. In fact, other than Petitioner’s expert’s understanding that the disclosure of Holzapfel implies use of (undisclosed) electrical spark plugs, Holzapfel does not disclose an electrical system at all. [EX2136, 153:19-155:8.]

304. Once again, Petitioner’s analysis of this element is unclear. Again, Petitioner’s sole cite is to Matsushima; however, Petitioner provides no new

motivation to combine analysis. Nor has an expectation of success been articulated. As such, Petitioner's analysis is deficient for the same reasons set forth with respect to Element [1.2]. [§X.C.1.ii.]

305. Petitioner does not provide any analysis regarding how or why a POSITA would have been motivated to implement a "voltage regulator" as disclosed by Matsushima in the Holzapfel engine. As such, Petitioner has failed to show that Element [1.6] is obvious over Holzapfel in view of Matsushima.

2. Claims 2-10, 12-16

306. Claims 2-10 and 12-16 depend from Claims 1 and 11, respectively, and are therefore not invalid for the same reasons.

307. Additional analysis with respect to specific dependent claims is addressed below.

3. Claim 2: "The dual fuel generator of claim 1 further comprising: a liquid fuel valve along a liquid fuel line coupling the liquid fuel source to the carburetor; and a gaseous fuel valve along a gaseous fuel line coupling the gaseous fuel source to the carburetor."

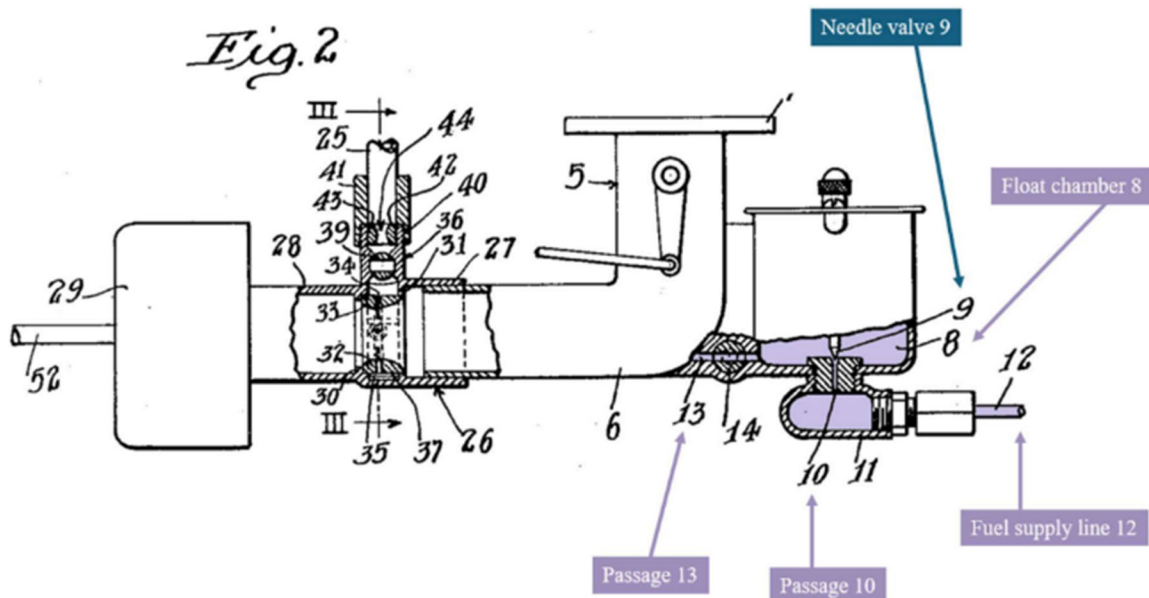
308. Holzapfel does not disclose or otherwise render obvious "The dual fuel generator of claim 1 further comprising: a liquid fuel valve along a liquid fuel line coupling the liquid fuel source to the carburetor; and a gaseous fuel valve along a gaseous fuel line coupling the gaseous fuel source to the carburetor." Specifically,

Holzapfel does not disclose “a liquid fuel valve along a liquid fuel line coupling the liquid fuel source to the carburetor.”

309. Petitioner identifies “Fuel supply line 12” as the alleged “liquid fuel line.” [Pet., 88-89.]

310. Petitioner likewise identifies Holzapfel’s “needle valve 9” as the alleged “liquid fuel valve along a liquid fuel line.” [Pet., 88-89.]

311. Petitioner’s annotations identifying the alleged “liquid fuel line” and “liquid fuel valve” are reproduced below:



[Pet., 89 (annotations in original).]

312. Petitioner’s annotations make clear that needle valve 9 is not located along Fuel supply line 12. Specifically, Holzapfel discloses its needle valve is

located after Fuel supply line 12. It further discloses an intervening inlet connection 11 and passage 10 between fuel supply line 12 and needle valve 9.

313. For at least the reasons set forth above, Holzapfel does not disclose Claim 2.

4. **Claim 6: “The dual fuel generator of claim 1, wherein the switch is an electro-mechanical switch connecting one fuel source to the carburetor and connected to the electrical power generator, and wherein the liquid fuel cut-off solenoid is connected to open and close a fuel path to the engine in response to reception of electrical power from the switch.”**

314. Holzapfel, alone or in view of Matsushima and/or Olmr does not disclose or otherwise render obvious “The dual fuel generator of claim 1, wherein the switch is an electro-mechanical switch connecting one fuel source to the carburetor and connected to the electrical power generator, and wherein the liquid fuel cut-off solenoid is connected to open and close a fuel path to the engine in response to reception of electrical power from the switch.”

315. Petitioner’s purported analysis of Claim 6 is just a combination of its conclusory and unsupported assertion that a POSITA would have been motivated to combine Holzapfel’s engine with Matsushima’s ([§X.C.1.ii]), coupled with its hindsight assertion that a POSITA would have been motivated to implement Olmr’s solenoid and corresponding electrical system into Holzapfel’s depression-era

automobile engine ([§X.C.1.iv]), and is deficient for the same reasons as discussed above for those previous assertions.

5. Claim 8: “The dual fuel generator of claim 1, wherein the liquid fuel cut-off solenoid is normally open to provide liquid fuel to the engine when the liquid fuel cut-off solenoid is unpowered.”

316. Holzapfel, alone or in view of Matsushima and/or Olmr does not disclose or otherwise render obvious “The dual fuel generator of claim 1, wherein the liquid fuel cut-off solenoid is normally open to provide liquid fuel to the engine when the liquid fuel cut-off solenoid is unpowered.”

317. First, Petitioner has not established that a POSITA would have been motivated to replace Holzapfel’s valve 14 (and corresponding switching system) with Olmr’s solenoid valve 42, nor that a POSITA would have had a reasonable expectation of success in the proposed combination. [§X.C.1.iv.]

318. Second, Petitioner relies on the conclusory assertion that “A POSA would have been motivated to use Olmr’s normally-open solenoid and would have had a reasonable expectation of success in doing so based on the teachings of Olmr.” [Pet., 95 (citing §VII.B.1).] However, Petitioner’s analysis in §VII.B.1 does not address Olmr *at all*. [See Pet., 52 (“a POSA would have understood that the combination of the Workshop Manual and Matsushima teaches claim 6”).]

319. Presumably, Petitioner intended to incorporate its prior assertion that a POSITA would have been motivated to replace the Workshop Manual's Gasoline Cut Off Solenoid with Olmr's solenoid valve 42. [Pet., §VII.B.3]

320. However, Petitioner has not established that any alleged motivation to combine the Workshop Manual and Olmr is equally applicable to Holzapfel and Olmr. For example, Petitioner does not address the fact that Holzapfel *does not have a power system*. [EX2136, 153:19-155:8.] Regardless, Petitioner's proposed motivation to "use Olmr's solenoid valve 42 in place of Holzapfel's valve 14" is also deficient for the same reasons set forth with respect to the Workshop Manual. [See §X.A.6, above.]

321. Furthermore, Petitioner's analysis is deficient at least because it does not account for problems created by Petitioner's proposed combination. If Holzapfel's valve 14 is replaced with Olmr's normally-open solenoid, then valve 14 will be open in the event the valve loses power, allowing gasoline to flow to the engine. However, Holzapfel also discloses a normally gaseous fuel system, which is controlled independently of Olmr's normally-open solenoid. In the event that power to Olmr's normally-open solenoid fails while Holzapfel's engine is operating on normally gaseous fuel, the engine will be flooded with gasoline, resulting in an overly-rich fuel.

322. Finally, Petitioner has not articulated an expectation for success in this proposed combination.

6. **Claim 9: “The dual fuel generator of claim 8, wherein the dual fuel generator is a batteryless dual fuel generator and the engine is a pull-start engine, the batteryless dual fuel generator further comprising a pull-starter that drives the electrical power generator to power and close the liquid fuel cut-off solenoid while starting the engine on gaseous fuel.”**

323. Claim 9 depends from Claim 8, and is therefore not invalid for the same reasons.

324. Moreover, Holzapfel (alone or in view of Matsushima and/or Olmr) does not disclose or otherwise render obvious “generator of claim 8, wherein the dual fuel generator is a batteryless dual fuel generator and the engine is a pull-start engine, the batteryless dual fuel generator further comprising a pull-starter that drives the electrical power generator to power and close the liquid fuel cut-off solenoid while starting the engine on gaseous fuel.”

325. Petitioner asserts that it “would have been obvious to a POSA to incorporate Matsushima’s pull-start to supply electrical power in Holzapfel’s engine.” [Pet., 96.] Confusingly, Holzapfel’s engine does not actually have a need for electrical power. In fact, other than Petitioner’s expert’s understanding that the disclosure of Holzapfel implies use of (undisclosed) electrical spark plugs, Holzapfel does not disclose an electrical system at all. [EX2136, 153:19-155:8.]

326. Petitioner asserts that Matsushima’s pull-starter assembly is needed “to drive a generator to power and close Holzapfel’s valve 14 (a solenoid when combined with Olmr) while starting the engine on gaseous fuel.” [Pet., 96.] However, as discussed above, Petitioner’s decision to replace Holzapfel’s mechanical, manually actuated valve 14 with Olmr’s solenoid is itself grounded in hindsight. [§X.C.1.iv]. Now, to solve a problem caused by its modifications, Petitioner again modifies Holzapfel’s depression-era automobile engine—using the ’145 Patent as a guide—to add an unnecessary pull-start.

327. However, the Petition lacks sufficient motivation to implement a pull start.

328. Specifically, Petitioner makes two statements regarding the alleged motivation for replacing Holzapfel’s starter with Matsushima’s recoil starter.¹¹ First,

¹¹ Confusingly, both of Petitioner’s proposed motivations to combine Matsushima’s pull-start with Holzapfel are nearly verbatim to Petitioner’s proposed motivations regarding replacing the Workshop Manual’s battery with Matsushima’s pull start, despite the fact that (1) they are different references, and (2) the proposed combination involves different modifications. [*Compare* Pet., 97 *with* Pet., 55.]

Petitioner argues that “[i]ncorporating a pull-start into Holzapfel’s dual fuel engine would improve reliability in cold or remote applications and reduce cost.” [Pet., 97.]

329. However, Petitioner’s arguments are conclusory, and there is no evidentiary support in either the Petition or Dr. Shahbakhti’s declaration that implementing Matsushima’s pull-start system in Holzapfel’s engine would improve its reliability in cold or remote applications, or otherwise reduce costs. In fact, the best way to improve reliability in cold/remote applications and reduce costs is to remove the electrically-powered solenoid (and corresponding generator) entirely, as taught by Holzapfel.

330. Second, Petitioner argues that “Holzapfel and Matsushima both relate to the same class of small spark-ignition engines.” [Pet., 97.]

331. However, Petitioner does not provide any support for its implication that Matsushima and Holzapfel belong “to the same class of small spark-ignition engines.” [Pet., 97.] Matsushima describes an engine developed by the Honda Motor Company in the 1990s, while Holzapfel describes a 1930s depression-era engine. Furthermore, Matsushima teaches that its “invention relates to a fuel injection system for an internal combustion engine for supplying fuel to an intake system thereof, and more particularly to an electronically-controlled fuel injection system of this kind which is adapted for use in *small-sized engines equipped with no battery*.” [EX1012, 1:6-11 (emphasis added).] U.S. Patent No. 3,465,740 (cited by

Matsushima as an appropriate “known type” of recoil starter) provides further guidance, referring “particularly to rewind type pull-rope starters for small internal combustions engines such as those commonly employed to power lawn mowers, garden tractors, snow blowers and the like.” [EX1012, 4:63-68; *see also* EX2128 (U.S. Patent No. 3,465,740), 1:36-40.]

332. However, Petitioner’s expert Dr. Mahdi Shahbakhti explicitly defined small engines as engines having a displacement of less than 0.5 liters (500 cc). [EX1003 (Shahbakhti Decl.) at ¶[0006]; *see also* EX1003 (Shahbakhti CV) at 497; EX2136 (Shahbakhti Depo. Tr.) at 20:11-21:15.] Holzapfel, meanwhile, discloses an *automobile* engine. Petitioner has identified no evidence that a POSITA would have understood that a 1930s automobile engine would have been less than 0.5 liters, nor am I aware of any such evidence. In my experience, even a very small automobile often has a displacement of at least one liter, and many automobiles utilize substantially larger engines.

333. As such, a POSITA would have understood that an automobile engine would have been substantially more difficult to start with a pull-starter than the smaller engines contemplated by Matsushima.

334. Petitioner’s conclusory analysis of the purported motivation to combine Holzapfel and Matsushima is particularly deficient in light of Petitioners’ experts’ deposition testimony. For example, Dr. Shahbakhti testified that “Engine

performance will always be affected by the type of the design and how variable are adjusted for the performance of that engine,” that “there are so many metrics in terms of the design that will have an impact on the engine performance,” that “there are many, many metrics that have -- and will have an impact on the performance of the engine,” and “there are so many types of engines and for different applications, and also depending on their designs, you will have the choices of the parts that you can vary in order to affect the performance.” [EX2136, 14:11-16:8.]

335. Likewise, in a related proceeding, Petitioner’s expert, Dr. Morse repeatedly emphasized that the particular characteristics of an engine are incredibly relevant when analyzing the operation of said engine. [EX2127 (Morse Depo. Tr.) at 50:17-51:8 (agreeing that “the decision of how to configure the transfer piping and all the associated equipment is dictated by the specific application”); 67:2-9 (“[t]he specific problems that could arise [from drawing liquid propane instead of gaseous propane] would depend on the specific engine being evaluate and the specific configuration”); 121:6-15 (increased fuel pressure may or “may not be an advantage in all cases, depending on how you’ve configured everything”); 122:15-123:3 (“the particular mass flow rate of fuel is dictated by the specific configuration of the engine” and “the fluid properties of the fuel and the configuration of the tank where the fuel is stored and the configuration of the fuel line from the tank to the

engine”); 176:4-13 (“certainly the working fluid is something that is taken into account when designing a piping system”)].

336. In light of Petitioner’s experts’ repeated emphasis on specific engine characteristics and applications, Petitioner’s conclusory assertion of a motivation to combine based on allegedly belonging to “the same class of small spark-ignition engines” is particularly deficient, especially where Petitioner provided no evidence that the engines in question actually belong to the “same class.” In my opinion, the 1930s engine described in Holzapfel and the 1990s Honda engine are in very different classes such that their means for starting would be very different.

337. Finally, Petitioner’s analysis of a reasonable expectation of success is deficient, at least because it does not account for the difficulties in adding a pull start to an automobile engine. For example, Petitioner has not introduced any evidence to establish that an operator would physically be able to start Holzapfel’s engine using a pull start. My opinion, based on at least i) my education and experience as a POSITA, ii) my understanding of the forces required to force an engine revolution and initiate a compression/ignition cycle, and iii) my many years of pull-starting lawn mowers, chainsaws, and the like, is contrary to this suggestion. It would be, at minimum, very difficult to pull start Holzapfel’s engine.

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1101 of Title 18 of the United States Code.

June 9, 2026


Dr. William E. 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.