

Filed on Behalf of: Generac Power Systems, Inc.

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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GENERAC POWER SYSTEMS, INC.

Petitioner,

- vs. -

CHAMPION POWER EQUIPMENT, INC.,

Patent Owner

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**DECLARATION OF DR. MAHDI SHAHBAKHTI  
IN SUPPORT OF REPLY TO PATENT OWNER RESPONSE IN  
INTER PARTES REVIEW OF U.S. PATENT NO. 11,143,145**

Case No.: IPR2025-01457

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I, Mahdi Shahbakhti, declare as follows:

**I. INTRODUCTION**

1. I have been retained as an expert on behalf of Petitioner Generac Power Systems, Inc. ("Petitioner" or "Generac") as an independent expert consultant in support of Petitioner's reply to Champion Power Equipment Inc.'s ("Patent Owner" or "Champion") Patent Owner Response ("POR") submitted in Inter Partes Review No. IPR2025-01457 relating to U.S. Patent No. 11,143,145 ("the '145 Patent;" EX1001).

2. I was previously retained by former Petitioners Harbor Freight Tools, Inc. ("Harbor Freight") and MWE Investments, LLC ("MWE"), along with Generac, in support of Generac and former Petitioners' request for Inter Partes Review of the '145 Patent. I understand that Harbor Freight and MWE withdrew from this proceeding. My relationship with Harbor Freight and MWE in this proceeding has terminated, and I am now retained solely by Generac in relation to this proceeding.

3. I am being compensated through DOAR, Inc. in connection with this matter. DOAR, Inc. is being compensated for my time in connection with this matter at a rate of \$550 per hour. My compensation is in no way based on the outcome of this investigation or on the opinions that I provide. I have no interest, financial or otherwise, in the outcome of this matter. I have no financial interest in, or affiliation with, any of the parties in this matter.

4. I previously executed a declaration, which I understand was filed in connection with the above captioned Inter Partes Review proceeding. EX1003. In that declaration, I provided opinions regarding whether Claims 1-16 of the '145 Patent are invalid. This declaration sets forth the opinions I have formed regarding Claims 1-16 in response to the POR and materials cited therein, based on the information available to me as of the date below. The opinions and facts set forth in the declaration are based upon my analysis of the '145 Patent and its claims, the prior art, the state of the art at the time of the invention, and my knowledge and extensive experience in this field.

5. My analysis of the materials submitted in this proceeding is ongoing and I will continue to review any new material that is provided. This declaration is indicative of only those opinions that I have formed to date. I reserve the right to amend, revise, and/or supplement my opinions stated herein based on any new information that may become available to me or my continuing analysis of the materials already provided.

6. I am not currently and have not at any time in the past been an employee of Generac or former Petitioners Harbor Freight and MWE. I have no financial interest in Generac, Harbor Freight, or MWE outside of assisting Generac (and previously Harbor Freight and MWE) as an expert in this and any related matters.

7. My qualifications and experience are summarized in my previously filed declaration, which also includes a copy of my curriculum vitae (“CV”).

## **II. MATERIALS AND OTHER INFORMATION CONSIDERED**

8. The opinions contained in this declaration are based on the documents I have reviewed and my professional judgment, as well as my education, experience, and professional knowledge. I am not an attorney, and I am not offering any purely legal opinions in this declaration. In forming the opinions expressed in this declaration, I relied upon my education, knowledge, and experience in the relevant field of art, and have considered the viewpoint of a person having ordinary skill in the relevant art.

9. I have considered all the materials referenced herein and the materials referenced in my prior declaration.

10. My opinions are additionally guided by my appreciation and understanding of how a POSA would have understood the claims of the '145 Patent at the time of the earliest possible priority date of the '145 Patents, which I understand is June 12, 2015. My opinions would not change if any claim of the '145 Patent is not entitled to its earliest possible priority date.

### **III. UNDERSTANDING OF PATENT LAW**

11. I am not an attorney. For purposes of this report, I have an understanding about certain aspects of the law that are relevant to my opinions, as described in my prior declaration in this proceeding. EX1003, ¶¶25-48.

### **IV. LEVEL OF ORDINARY SKILL IN THE ART**

12. As explained in my prior declaration (EX1003, ¶¶26-28), I have come to the conclusion that a person of ordinary skill in the art of the '145 Patent would hold a college degree in mechanical engineering, physics, or related fields, and three years of work experience in combustion engines.

13. I understand that Champion contends that a person of ordinary skill “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.” EX2133, ¶110.

14. Champion’s POSA definition requires only one year of experience. In my opinion, a definition requiring three years of experience is more appropriate. Champion has stated that fuel delivery system components are not taught at the undergraduate level. Work experience would be the natural way for a person to gain

skill in the art relating to these topics, which are central to every claim of the '145 Patent. Based on my experience teaching and working with undergraduate and graduate students, acquiring the relevant technical expertise requires approximately three years. This timeline reflects the interdisciplinary complexity of internal combustion (IC) engine systems, which demands mastery across several core domains:

- Fuel-Air Dynamics & Calibration: Managing dynamic air-fuel ratio control across variable speeds and loads, alongside engine calibration parameters (e.g., spark timing, fuel enrichment, cold/warm start routines, and knock control);
- ECU & Control Systems: Designing engine control strategies and developing Engine Control Unit (ECU) architecture;
- Fuel Hardware & Delivery: Differentiating gaseous versus liquid fuel dynamics and selecting specialized components, including valves, pumps, regulators, vaporizers, mixers, and heat exchangers; and
- Emissions Control: Managing and mitigating engine-out emissions.

15. Additionally, my review of the educational and experiential background of the inventors of the '145 Patent indicates that at least five of the six inventors appear to have had at least three years of work experience on combustion engines prior to the filing of the '398 Patent. *See, e.g.,* EX1102 (listing Kendall J.

Collie as an inventor and a filing date of April 30, 2012); EX1103 (listing Mark J. Sarder as an inventor and a filing date of July 27, 1994); EX1104 (listing Aleko D. Sotiriades as an inventor and a filing date of October 20, 2009); EX1105 (listing James J. Dehn as an inventor and a filing date of March 3, 2009); EX1106 (listing nearly four years of experience as a “Senior Engineer Product Development” responsible for “design and development of multiple generator product lines” prior to 2015 for Leigh A. Jenison).

16. Although my qualifications and experience exceed those of the hypothetical person having an ordinary level of skill in the art, my analysis and conclusions herein are from the perspective of a person of ordinary skill in the art. My opinions would not change if the perspective of a person of ordinary skill in the art according to Champion’s POSA definition were applied.

## **V. CLAIM CONSTRUCTION**

17. In my previous declaration, I did not identify any claim terms that required construction to address the arguments raised in the Petition. EX1003, ¶87.

18. In the POR, Champion and its expert have raised a claim construction issue regarding the meaning of “liquid fuel” and “gaseous fuel.” I understand that the Board also weighed in on this issue in the ’034 Patent IPR in the time since I submitted my previous declaration.

19. Champion argues that whether a fuel is “liquid” or “gaseous” depends on the phase of the fuel at any given location. Under Champion’s construction:

(1) “engine operable on a gaseous fuel and a liquid fuel” means an engine operable on a fuel that is in gas phase in the engine and a fuel that is in liquid phase in the engine (*see, e.g.*, POR 5-7; EX2133 ¶¶135-141);

(2) “gaseous fuel source” means a fuel source containing fuel in gas phase, while “liquid fuel source” means a fuel source containing fuel in liquid phase (*see, e.g.*, POR 25-27, 48-51, 63-66; EX2133 ¶¶144-154, 222-235, 280-289);

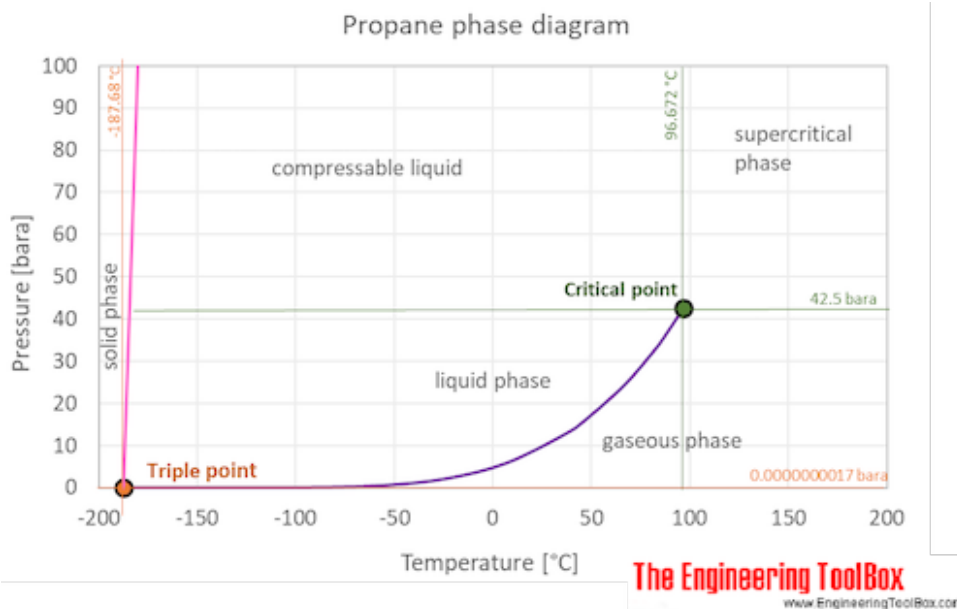
(3) “gaseous fuel line” means a fuel line containing fuel in gas phase; while “liquid fuel line” means a fuel line containing fuel in liquid phase (*see, e.g.*, POR 25-26, 29-32, 52-53, 64; EX2133 ¶¶134-145, 157-160, 171, 239-242); and

(4) “gaseous fuel valve” means a fuel valve containing fuel in gas phase, while “liquid fuel valve” means a fuel valve containing fuel in liquid phase (*see, e.g.*, POR 25-26, 29-32, 52-53, 64; EX2133 ¶¶134-145, 157-160, 239-245).

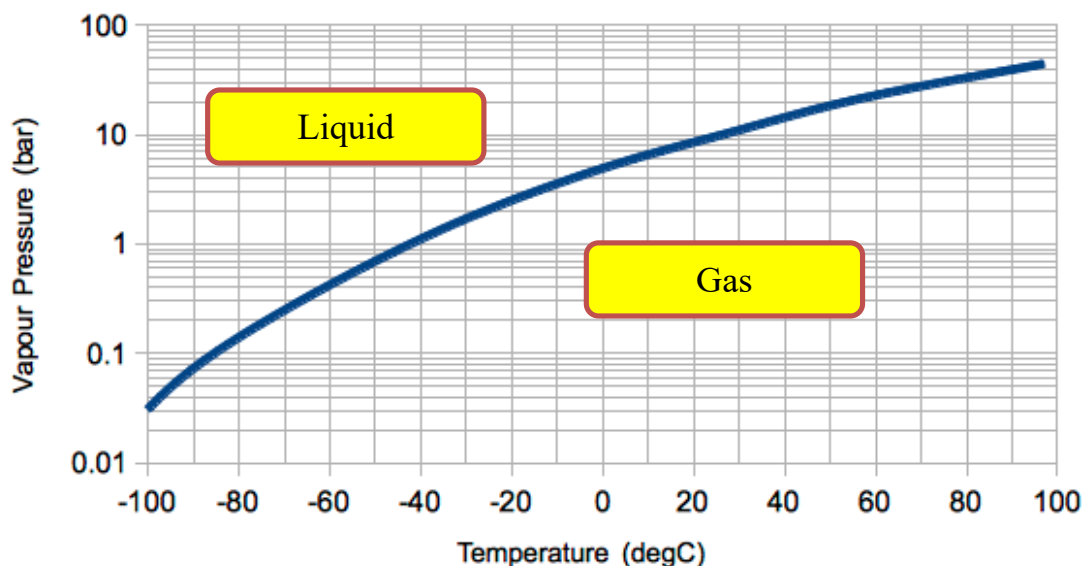
20. As explained further in this declaration, the Grounds set forth in the Petition invalidate the challenged claims even under Champion’s construction. The Board explained in the ’034 IPR that Champion defines the fuel “source” too narrowly. Additionally, “liquid service” results in a mixture of liquid phase and gas phase fuel. Some amount of liquid phase fuel will vaporize during fuel delivery prior to reaching the vaporizer.

21. Champion’s claim construction position is incorrect. Having reviewed the intrinsic evidence and pertinent extrinsic evidence, it is my opinion that the terms “liquid fuel” and “gaseous fuel” are immutable classifications based on the fuel’s state at standard temperature and pressure.

22. The phase of a substance varies based on temperature and pressure. For example, the propane phase diagram below depicts the temperature/pressure combinations in which propane exists in liquid phase and in gas phase. As shown in the propane phase diagram, propane exists in gas phase at standard temperature and pressure. A logarithmically scaled version of the liquid-gas transition portion of the phase diagram is also included below.



EX1123.



EX1126 (annotated).

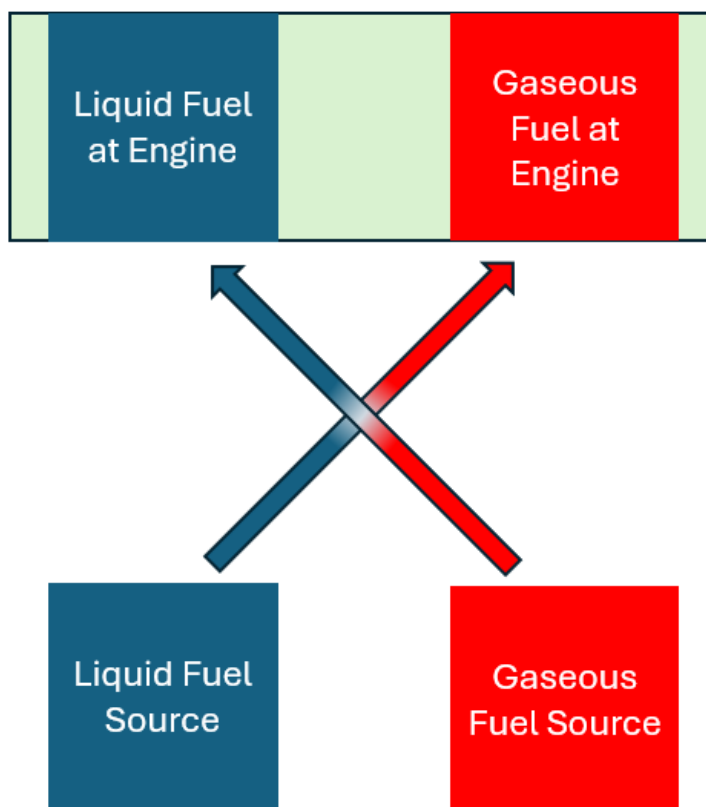
23. Whether a fuel is gaseous or liquid at standard temperature and pressure is determined by chemical composition of the fuel, including its molecular weight, its molecular “shape,” and the strength of its intermolecular forces. Generally, heavier molecules are more likely to be liquid at standard conditions, certain molecular shapes are more conducive to the “packing” required for liquification, and stronger intermolecular bonds make a fuel more likely to be liquid at standard conditions.

24. The claims refer to liquid fuel and gaseous fuel without referring to a particular location where the fuel phase must be determined. For example, Claims 5 and 13 of the '145 Patent state that the gaseous fuel is LPG and the liquid fuel is gasoline without specifying a location where the fuel phase must be determined.

25. A POSA would have understood that each use of the phrase “gaseous fuel” in the claims refers to the *same* fuel, regardless of the fuel’s phase at any point in the system. Specifically, the gaseous fuel that the engine is operable on is the same gaseous fuel that passes through carburetor, the gaseous fuel valve, the gaseous fuel line, and the gaseous fuel source. Similarly, a POSA would have understood that each use of the phrase “liquid fuel” in the claims refers to the same fuel, regardless of the fuel’s phase at any point in the system. The liquid fuel that the engine is operable on is the same fuel that passes through the carburetor, liquid fuel cutoff solenoid, liquid fuel valve, liquid fuel line, and liquid fuel source. This understanding is consistent with a construction in which “liquid fuel” and “gaseous fuel” are immutable classifications based on the fuel’s state at standard temperature and pressure.

26. On the other hand, Champion’s construction is inconsistent with this understanding. Under Champion’s construction, the “gaseous fuel source” does not need to be the source of *the* gaseous fuel that the engine operates on and instead is a source of fuel that happens to be in gas phase within the source or as it exits the source. This gas phase fuel could travel through the gaseous fuel line and gaseous fuel valve in gas phase but condense into liquid phase at the engine or at the carburetor intake, for example if the ambient temperature is below the tank temperature. This would render the fuel a “liquid fuel” when the engine operates on

it, despite traveling through the gaseous fuel line from the gaseous fuel valve. Indeed, Dr. Singhose acknowledges that Champion's construction is unworkable with such a configuration. EX1091, 147:13-22 ("I don't know how to apply the claim terms to [a fuel delivery system that draws gasoline vapor that recondenses before entering the carburetor]."). Similarly, under Champion's construction, the "liquid fuel source" does not need to be the source of *the* liquid fuel that the engine operates on. For example, Champion argues that engines operate on gas phase LPG that is stored in liquid form.



27. The specification also demonstrates that “gaseous fuel” and “liquid fuel” classify types of fuel based on the fuel’s state at standard temperature and pressure. The specification defines “dual fuel generator” as a generator “configured to operate on a liquid fuel for a period of operation and an alternative fuel for another period of operation.” EX1001, 1:39-44. The alternative fuel source is generally a gaseous fuel that “*exist[s] in a gaseous state at normal temperature and pressure* and can be any one of liquefied petroleum gas, compressed natural gas, hydrogen, or the like.” *Id.*, 1:39-47 (emphasis added). The specification explains that gaseous fuels are not always in gas phase and “can be conveniently stored under pressure in a liquid state” in a gaseous fuel source. *Id.*, 1:47-50.

28. The specification describes advantages of gaseous fuel that result from its state at standard temperature and pressure. For example, the specification states that liquid fuels degrade over time, leaving gum and varnish deposits. EX1001, 1:27-31. This degradation results in part from oxidation, the absorption of water (especially in fuels with strong intermolecular bond interactions), and polymerization of the heavier molecules in a liquid fuel.

29. The specification also explains that gaseous fuels tend to “contain[] fewer impurities” than liquid fuel. EX1001, 1:50-55. Gaseous fuels are easier to purify because there are fewer permutations of light molecules and because gaseous fuels tend to have weaker intermolecular forces.

30. The specification explains that liquid fuels also may be unavailable during power outages—a time when generators are often used to supply backup power. EX1001, 1:33-36. Gasoline stations and other liquid fuel dispensing systems generally require electricity and may be nonfunctional during power outages. Gaseous fuels, such as natural gas, may be delivered directly to homes through pipelines or, in the case of propane, supplied from onsite storage tanks, and they generally remain available during power outages because fuel delivery can be driven by pressure within the distribution or storage system.

31. Thus, gaseous fuels, *even when stored in liquid form and regardless of the phase in which they are extracted*, exhibit material benefits compared to liquid fuels.

32. Dr. Singhose agrees that “[t]he patent distinguishes the **types** of fuel” (liquid or gaseous)—as opposed to the state of fuel—and states that “there are advantages to being able to use different **types** of fuel.” EX2133, ¶¶75, 77 (emphasis added).

33. The prior art cited on the ’145 Patent and its parents applies Generac’s construction of “gaseous fuel” and “liquid fuel,” including Welsh, Deutsch, Dunn, and Tsuda. EX1001; EX1114.

34. For example, Welsh teaches a “method and apparatus for utilizing gaseous and liquid fuels in an internal combustion engine.” EX1097, Title. Welsh

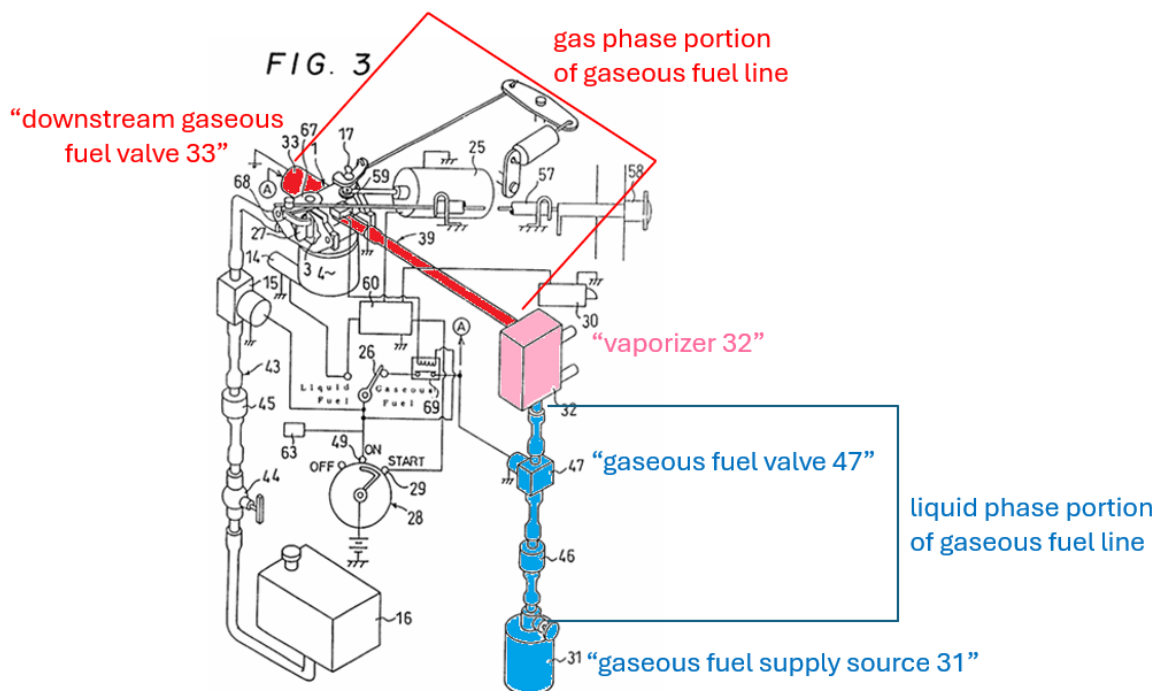
states that “[t]he term gaseous fuels as used herein means combustible fuels which are gaseous at standard temperature and pressure.” *Id.*, 2:8-10. Welsh defines “liquid fuel” as “fuel which is in the liquid phase at ambient atmospheric pressure and temperature.” *Id.*, 2:1-3. Welsh uses the terms “liquid fuel” and “gaseous fuel” to distinguish between states at standard temperature and pressure, and “liquid phase” and “gas phase” to distinguish between states at a particular location. For example, Welsh discloses a “gaseous fuel storage reservoir” containing “liquid phase ***gaseous fuel***.” *Id.*, 11:39-43 (emphasis added). Welsh also discloses a “separator means for separating the gas phase portion of gaseous fuel from any liquid phase which may be present in gaseous fuel from said gaseous fuel storage reservoir.” *Id.*, 6:62-64.

35. Deutsch states that “[g]aseous fuels comprise combustible fuels which are gaseous at standard temperature and pressure.” EX1095, 1:27-28. Like Welsh, Deutsch uses “liquid fuel” and “gaseous fuel” to distinguish between states at standard temperature and pressure, and “liquid phase” and “gas phase” to distinguish between states at a particular location. For example, Deutsch states that “[t]he term gaseous fuels ... includes liquified petroleum gas (LPG) .... [which] may be either in the gaseous phase, the liquid phase, or both.” *Id.*, 1:31-35.

36. Dunn states that “gaseous fuel can be compressed natural gas, methane, hydrogen or other fuels that are in a gaseous phase at room temperature and atmospheric pressure.” EX1096, ¶[0034]. Dunn’s storage vessel 150 contains a

“multiphase fluid” containing “liquefied gaseous fuel” as well as “vapor.” *Id.*, ¶¶[0034], [0046].

37. Tsuda, which is a patent describing the product embodied by the Workshop Manual (Paper 10 at 17-18), discloses a “gaseous fuel supply source 31” and a “gaseous fuel valve 47” upstream of vaporizer 32. EX2062, 3:20-27. Tsuda thus characterizes both its fuel source and fuel valve as “gaseous” despite containing liquid phase gaseous fuel.



EX2062, FIG. 3 (annotated).

38. My review of the pertinent extrinsic evidence supports my opinion that the terms “liquid fuel” and “gaseous fuel” are immutable classifications based on the fuel’s state at standard temperature and pressure.

39. The EPA defines “gaseous fuel” as “a material that is in the gaseous state at standard atmospheric temperature and pressure conditions and that is combusted to produce heat and/or energy.” 40 C.F.R. § 98.6 (2015). The EPA is comprised of many POSAs. Further, POSAs in the industry use EPA definitions to streamline regulatory compliance from the most significant regulatory body influencing design choices.

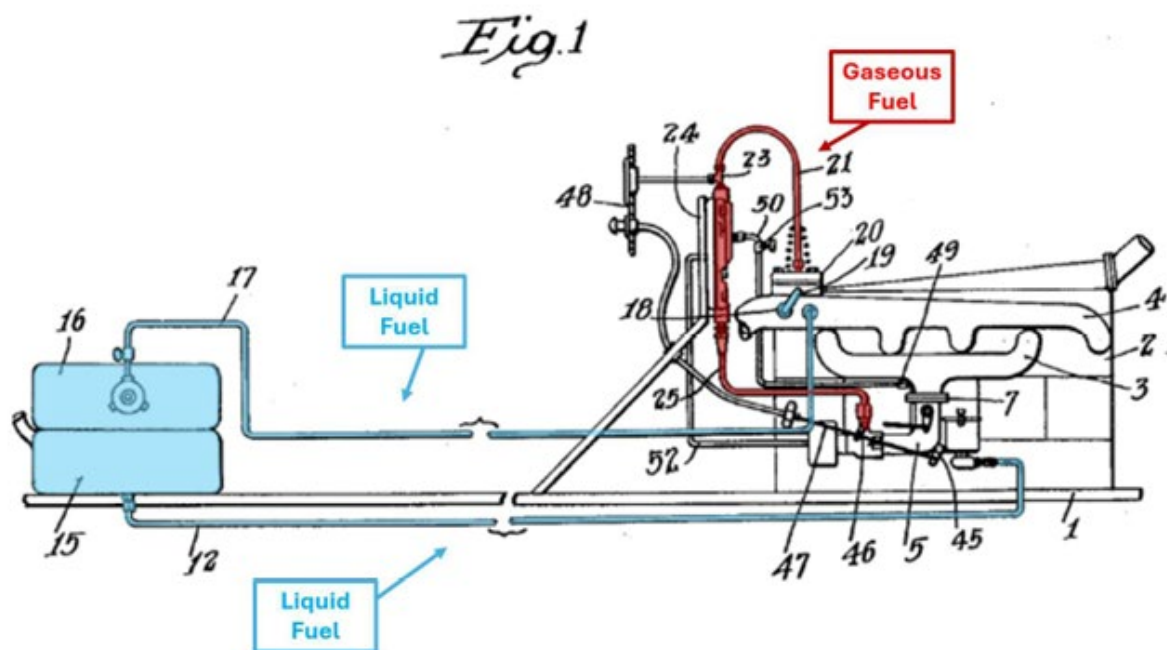
40. In its patent classifications, the Patent Office itself applies distinguishes between liquid and gaseous fuels based on state at standard conditions. The ’145 Patent is a member of class F02D 19/0647. EX1001. This class relates to “engines working with pluralities of fuels ... characterised by the type of fuels ... at least one fuel being gaseous, the other fuels being gaseous or liquid *at standard conditions* ... the gaseous fuel being liquefied petroleum gas.” EX1093, 4-5 (emphasis added).

41. Holzapfel teaches a “fuel system embodying the supplying of liquid fuel and gaseous fuel to an engine in alternation at will.” EX1008, 1:1-5. Holzapfel usage “liquid fuel” and “gaseous fuel” is based on the fuel’s state at normal temperature and pressure—it describes the gaseous fuel as a “*normally* gaseous fuel.” *Id.*, 2:8-12. Specifically, Holzapfel’s “additional fuel supply system employ[s]

a normally gaseous fuel ... in which normally gaseous fuel is compressed and thereby maintained in liquefied condition.” *Id.* Holzapfel claims this fuel supply system supplying liquid phase gaseous fuel as a “source of gaseous fuel.” EX1008, Claim 2. Liquid phase gaseous fuel travels through “gaseous fuel supply tube 17” before it is vaporized. *Id.*, 2:12-27. Holzapfel describes the fuel as a “gaseous fuel” in heat exchanger 20. *Id.*, 2:21-25. Thus, Holzapfel characterizes the fuel as a “gaseous fuel” at a point in the fuel delivery system where Dr. Singhose admits the fuel is in liquid phase and supposedly constitutes a “liquid fuel” under Champion’s construction. (EX2133, ¶¶287-288.)<sup>1</sup>

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<sup>1</sup> Although Dr. Singhose annotates fuel line segment 21 between heat exchanger 20 and pressure reducing valve 24 as “gaseous fuel” (EX2133, ¶287), he states that the fuel remains in liquid state until pressure is released at pressure reducing valve 24 (*id.*, ¶288). Either way, according to Dr. Singhose, Holzapfel’s “gaseous fuel” at heat exchanger 20 is in liquid phase.



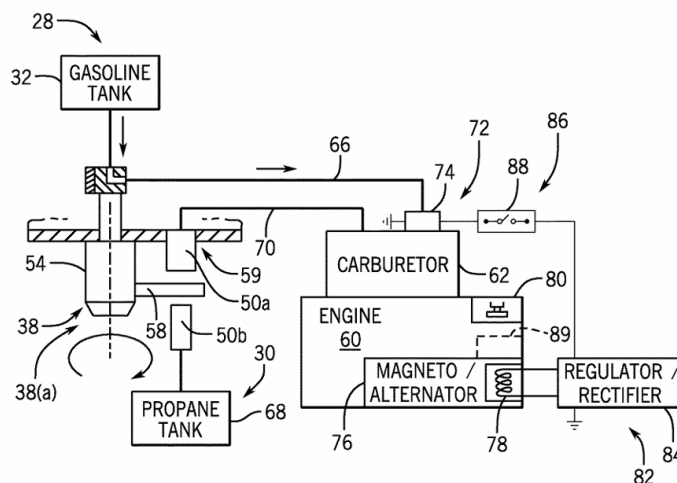
EX2133, ¶287 (Dr. Singhose’s annotations).

42. Holzapfel is inconsistent with Champion’s construction—Champion’s position suggests that Holzapfel’s self-described “source of gaseous fuel” is not a “gaseous fuel source,” Holzapfel’s self-described “gaseous fuel supply tube” is not a “gaseous fuel line,” and Holzapfel’s self-described “gaseous fuel” is not a gaseous fuel.

43. Champion’s application of its own construction is incoherent. Champion first states that the relevant location for “engine operable on a gaseous fuel and a liquid fuel” is the engine. POR, 4, 24; EX2133, ¶223 (stating that “Claim 1 and Claim 11 distinctly claimed the state of the fuel (i.e., gaseous or liquid) **at ... the engine**” (bold emphasis added, italicization in original)). This does not make

sense: in carbureted engines, liquid fuels are vaporized into gas phase at the carburetor before they reach the engine intake. POR, 6 (citing EX1006, 7); EX2133, ¶137 (Dr. Singhose stating that “one of the functions of a carburetor is the evaporation of gasoline”). Attempting to resolve this contradiction, Champion argues that the relevant location is not the engine as its own construction demands but instead is actually the inlet where the fuel “reaches the carburetor[.]” POR, 6; EX2133, ¶138.

44. However, the claim language itself states that carburetor is not a component of the engine and instead connects to the engine intake. EX1001, Claims 1 and 11. Figures 4A and 4B show that carburetor 62 is separate from engine 60. Under Champion’s second application of its construction, the word “engine” in the claim limitation is not the controlling location, and a POSA must infer that the relevant location is instead the inlet to the carburetor.

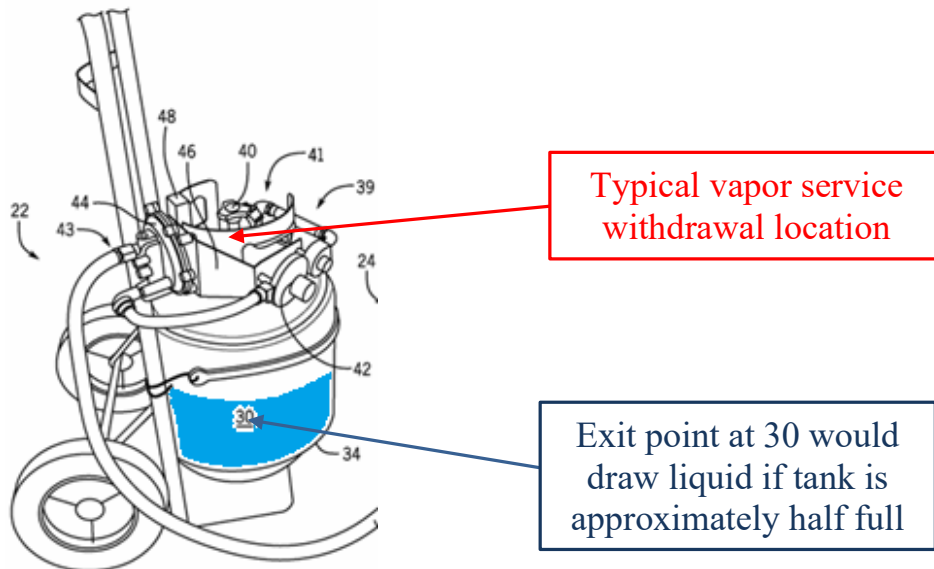


45. Champion’s alternative position also fails because the carburetor is not a required element of the fuel delivery system. Fuel delivery systems can use other fuel mixing methods such as electronic fuel injection. *See, e.g.*, EX1097, 9:41-53. Indeed, there are several claims in this patent family that recite an “engine configured to operate on a liquid fuel ... and a gaseous fuel” that do not claim a carburetor. *See, e.g.*, EX1112, Claim 12. Champion’s alternative position forces such claims to implicitly require that both fuels pass through a carburetor to evaluate whether the fuel is liquid or gaseous.

46. Similarly, Champion states that the relevant location for “gaseous fuel source” and “liquid fuel source” is “the source of the fuel.” POR, 4; EX2133, ¶134. Champion acknowledges that LPG supply tanks contain a mixture of liquid-phase and gas-phase LPG. POR, 13-14; EX2133, ¶¶64-65. Thus, under Champion’s construction, LPG supply tanks contain both liquid and gaseous fuel and therefore comprise *both* liquid and gaseous fuel sources.

47. Champion attempts to avoid this contradiction by narrowly defining the “source” as the specific point where the fuel leaves the tank. *See, e.g.*, POR, 26-27. This is directly contradicted by the specification—first fuel source 28 and second fuel source 30 refer to the entire tank. If the fuel source were confined to a specific point in the tank, Figure 1 of the ’145 Patent suggests that the specific point is not where the fuel leaves the tank. Reference number 30 for the fuel source is positioned

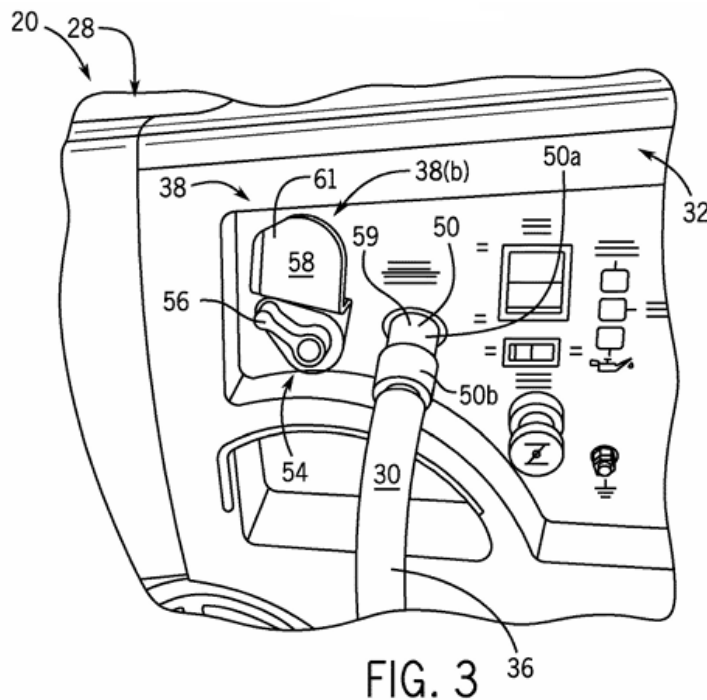
nowhere near the point where LPG is drawn from pressurized fuel container 34 (assuming vapor service). If anything, the location of reference number 30 suggests that liquid is drawn from pressurized fuel container 34. Thus, according to Champion's construction, either the fuel delivery system in Figure 1 does not depict vapor service such that the tank is not a gaseous fuel source in spite of the specification's disclosure, or the figure incorrectly labels the position of the fuel source.



EX1001, FIG. 1 (annotated).

48. The Board has already recognized this inconsistency. Once the relevant locations under Champion's proposal are shifted away from the literal engine and tank, there is no reason to place the relevant locations at the carburetor inlet or the point where fuel exists the tank. Thus, when instituting the '034 Patent IPR, the

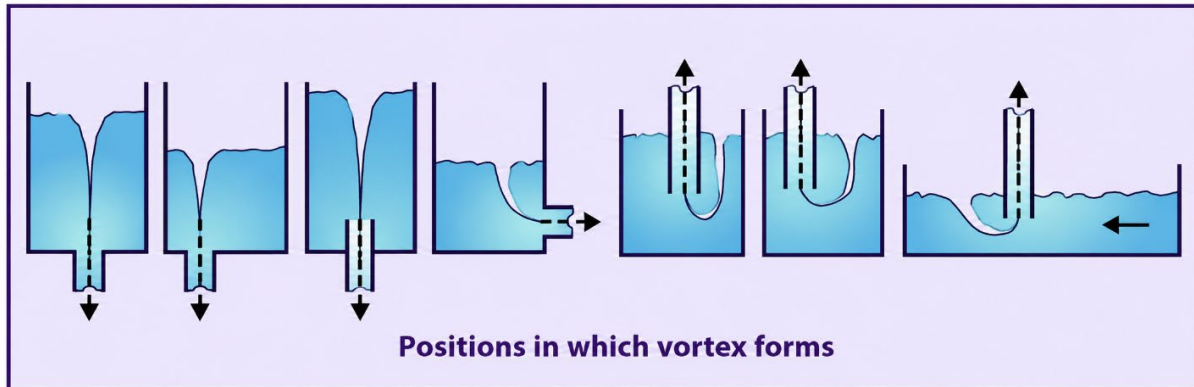
Board stated that it would “not exclude supply lines containing LPG in a gaseous state from the scope of the phrase ‘gaseous fuel source.’” IPR2025-00805, Paper 24 at 22-23. Indeed, Figure 3 suggests that fuel source 30 includes LPG supply hose 36.



49. Furthermore, Champion's alternative position does not resolve the issue. In addition to existing inside the tank as a mixture of liquid and vapor, gaseous fuels in liquid service applications also generally exit the tank as a mixture of liquid and vapor. Similarly, gaseous fuels are generally present within the fuel lines and valves as mixture of liquid and vapor. Champion's construction would result in such fuel lines and valves being *both* liquid and gaseous fuel lines/valves.

50. For example, drawing fuel from the liquid phase portion of a tank can generate a vortex from the liquid surface to the withdrawal point. This results in

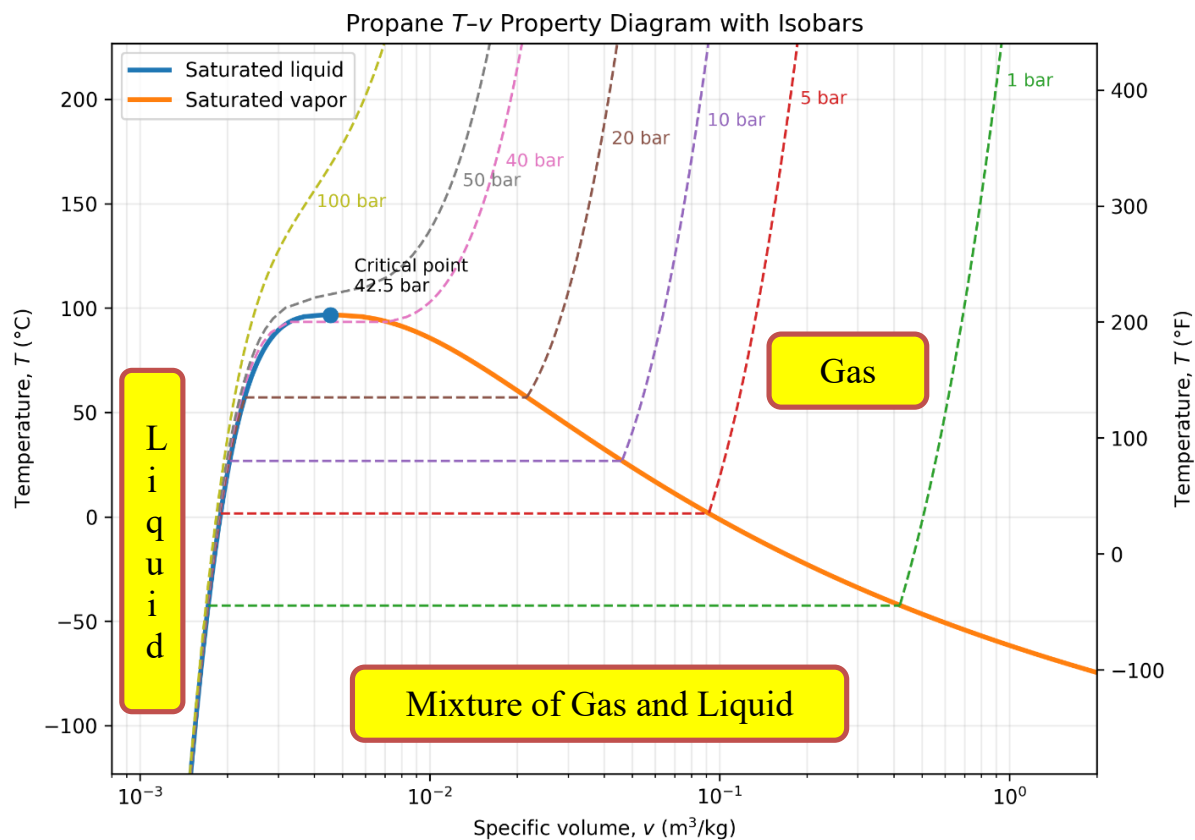
“vapor entrainment” where vapor from the surface enters the withdrawal tube, resulting in a mixture of liquid and vapor exiting the tank.



51. Liquid phase fuel will also tend to undergo “flash vaporization” and “cavitation” along the fuel line or in a fuel valve. Flash vaporization occurs when localized pressure drops at certain points in the fuel path (for example due to bends in the fuel line) below the vapor pressure of the fuel. Cavitation is the formation of vapor bubbles within a liquid as pressure drops along the fuel line. Similarly, opening the tank valve during liquid service increases the total volume available to be occupied by the fuel (now including the fuel line) and thereby decreases pressure, resulting in partial vaporization. EX1100, 5-6 (noting that “liquid entering the dip tube/inlet piping carries some of the [vapor] bubbles with it” and “[a]ll typical propane transfer applications operate with some degree of vapor in the suction line”).

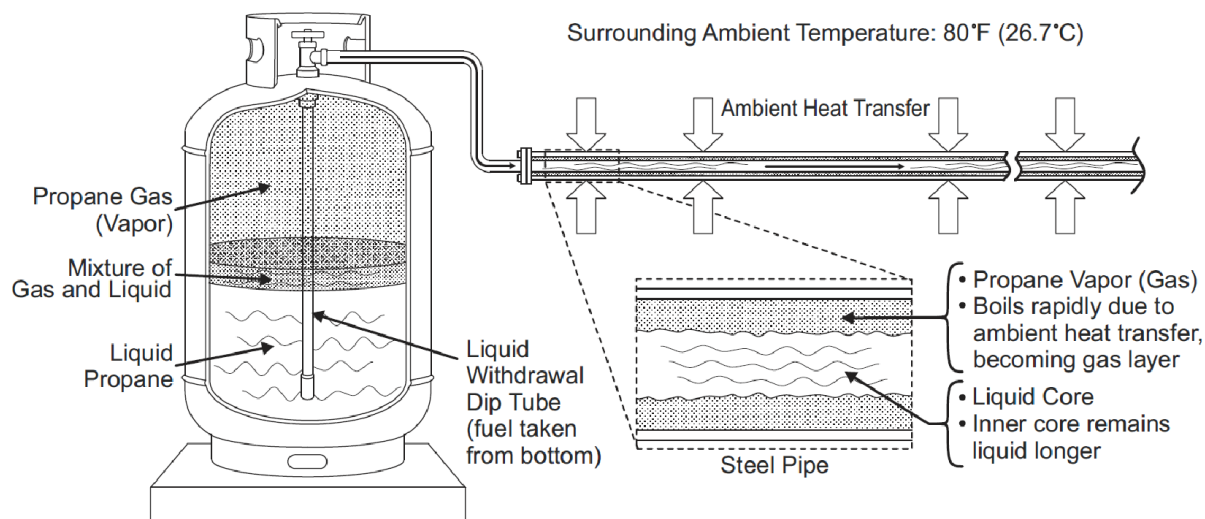
52. For example, the T-v property diagram for propane below shows that a pressure reduction or temperature increase will result in partial or complete

vaporization of the propane. This diagram was plotted using saturation data from the CoolProp open source thermophysical property library. EX1130. In the T-v property diagram, the region beneath the saturation dome represents a two-phase mixture of liquid and vapor. Propane stored in a tank typically exists within this region unless it is fully vaporized (on or to the right of the saturated vapor line) or fully liquefied (on or to the left of the saturated liquid line). At a given temperature (isothermal behavior), propane vaporizes into a gas if the pressure drops below the saturation pressure. Conversely, it condenses into a liquid if the pressure rises above the saturation pressure. At a given pressure (isobaric behavior), propane vaporizes if its temperature exceeds the saturation temperature. Conversely, it condenses into a liquid if its temperature drops below the saturation temperature.



53. Similarly, as liquid phase fuel flows through a pipe, heat transfer from the pipe to the fuel will cause some of the fuel to vaporize, as illustrated in the example schematic below. The pressure inside a propane tank depends on both the stored propane mass and its temperature. As shown in the T-v property diagram above, propane at a pressure of 5 bar (72.5 psi) must remain below 1.7°C (35°F) to stay in a liquid state. When liquid propane at 1.7°C (35°F) leaves the tank, heat transfers from the surrounding environment through the pipe walls and into the fluid. If the ambient temperature exceeds that of the liquid propane—for example, at an

ambient temperature ( $T_{\text{ambient}}$ ) of 26.7°C (80°F)—this heat input elevates the propane’s temperature, causing a portion of the liquid to vaporize into gas.



54. Such flash vaporization, cavitation, entrainment, and/or heat transfer will lead to a mixed-phase flow (gas and liquid phase) of gaseous fuel from the storage container in a liquid service application of a gaseous fuel.

55. Champion argues that “propane vapor service and propane liquid service are completely different from one another.” POR, 14; EX2133, ¶67. Champion does not cite any portion of the ’145 Patent that explains these differences or relies upon these differences. Instead, Champion relies on the Propane 101 website. POR, 14; EX2133, ¶67 (both citing EX2081.B).

56. Propane vapor service and propane liquid service have similarities. The same problems must be solved in both service methods: depressurizing the gaseous fuel, delivering a controlled amount of pressurized fuel to yield a desired air-to-fuel

ratio, delivering fuel only when said fuel is selected, sealing the fuel lines and valves to prevent leakage, and ensuring that the fuel received by the engine is fully vaporized.

57. Because both gaseous fuel service methods face the same problems and gaseous fuels may exist as a mixture of liquid and gas phase within the fuel delivery system, gaseous fuel tanks, valves, lines, etc. must be able to seal both liquid and gas phase gaseous fuel to prevent leakage. There is no difference in requirements (in terms of fuel mass flow rate) for the components of the delivery systems, and a POSA would have understood how to optimize the delivery systems for either liquid or vapor service (e.g. to ensure desired flow rates) to provide desired air-to-fuel mass ratio to the engine cylinders. Such optimization would simply involve accounting for the difference in rates of fuel delivery of gaseous fuel in liquid and vapor service methods, as liquid service simply provides a denser fuel per unit time than vapor service. Even Dr. Singhose admits that the fuel delivery rate is the only material difference between vapor and liquid service of LPG. EX1091, 141:5-142:25. Champion's argument that using liquid propane in a vapor service system for an engine "could result in fire" is incorrect. POR, 14. Propane 101 (EX2081) and Dr. Morse (EX2127, 197:9-199:19) both discuss *burner* applications such as grills and furnaces, and the dangers of injecting liquid phase propane directly into a burner. In contrast, the pressure regulation and metering systems in *engine* applications prevent

the engine from being overloaded by liquid phase fuel and cause any liquid phase propane to vaporize before it reaches the engine.

58. The main difference between the liquid and gaseous fuel delivery systems in the '145 Patent is the inclusion of pressure regulators in the gaseous fuel delivery system. Pressure regulation is a requirement shared between propane liquid and vapor service. Conversely, the liquid fuel delivery system in the '145 Patent would *not* work with propane liquid service due to the lack of pressure regulation. Thus, liquid service of gaseous fuel shares more in common with vapor service of gaseous fuel than with the delivery of normally liquid fuel such as gasoline.

59. Sugimoto (EX1115)—a prior art reference that Champion contends is relevant to the construction of liquid vs gaseous fuel—provides an example of a system in which liquid phase gaseous fuel and gas phase gaseous fuel pass through the same structures. Butane (a gaseous fuel) is drawn from fuel bottles 61 in liquid phase and travels down line A1 to valve 12. Propane (a gaseous fuel) is drawn from external fuel bottle 71 in gas phase and travels down lines A5 and A4. Both fuels pass through selector valve 12 and line A2 to “fuel pressure regulator 62 [which] functions as a vaporizer” for liquid phase butane (and any condensed propane). Thus, selector valve 12, line A2, and regulator 62 all handle both liquid (labeled in blue below) and vapor service (labeled in red below) of gaseous fuel with shared structural components. EX1115, ¶¶[0072], [0078]-[0079], FIG. 1.



Sugimoto *because* line A2 is a single pipe. EX1101, 150 (“[F]uel system selector valve 12 comprises a single outlet coupled to pipe A2 that provides fuel from both the first fuel system and the second fuel system to the fuel pressure regulator 62.”).

61. Thus, Champion’s statement that “propane vapor service and propane liquid service are completely different from one another” is incorrect. However, even if there is a material distinction between liquid and vapor service, a POSA would not have used the terms “liquid fuel” and “gaseous fuel” to convey that distinction.

62. Therefore, a POSA would have understood that the terms “liquid fuel” and “gaseous fuel,” including as used in “engine operable on a gaseous fuel and a liquid fuel,” “[liquid]/[gaseous] fuel source,” “[liquid]/[gaseous] fuel line,” and “[liquid]/[gaseous] fuel valve,” refers to the state of the fuel at standard temperature and pressure rather than the phase of the fuel at particular locations.

**VI. GROUNDS 1, 2, AND 5: CLAIMS 1-16 ARE RENDERED OBVIOUS BY THE WORKSHOP MANUAL ALONE OR IN COMBINATION WITH MATSUSHIMA, OLMR, AND WINBERG**

**A. Elements 1.0 and 11.0**

63. Champion argues that the preambles of Claims 1 and 11 are limiting. I have been informed that a preamble is not limiting where a patentee defines a structurally complete invention and uses the preamble only to state a purpose or intended use for the invention.

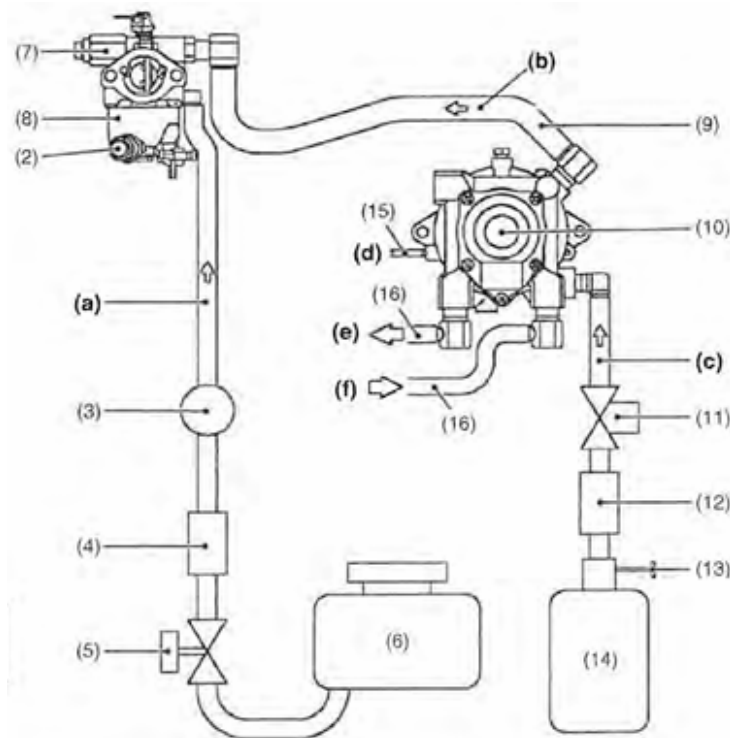
64. A POSA would have understood that the bodies of Claims 1 and 11 describe structurally complete inventions. The body of Claim 1 recites a dual fuel engine, an electrical power generator driven by the engine, a switch to change between fuels, a carburetor attached to the engine intake, a liquid fuel cut-off solenoid, and a voltage regulator. Similarly, the body of Claim 11 recites a dual fuel engine, a carburetor attached to the engine intake; and a manually actuated fuel shutoff coupled to the carburetor. These limitations define a structurally complete invention accomplishing the patent's goal of preventing simultaneous fuel delivery, especially during fuel switching.

65. Both the title and abstract of the '145 Patent demonstrate that the scope of the invention includes dual fuel engines. Similarly, at the beginning of the Detailed Description, the specification expressly states that “the invention is equally applicable for use with *any* dual fuel internal combustion engine.” EX1001, 3:61-64 (emphasis added). Thus, the preambles describe a nonlimiting intended use of the engine described in the claim body, and other uses of the invention are contemplated by the specification and claims.

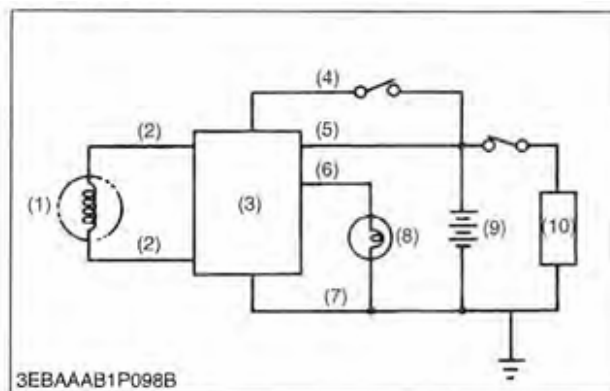
66. Champion takes my testimony out of context. POR, 20-21. I explained that the preamble provides context of the intended use of the invention, which can assist a POSA in understanding the meaning of the claim body, such as the meaning of “liquid fuel” and “gaseous fuel.” Specifically, the structure of the claim and the

stated intended use suggest that “liquid fuel” and “gaseous fuel” refer to two types of fuel used by the engine/generator rather than the phase of the fuel at particular points in the system. EX2136, 120:1-121:24.

67. Even if the preambles were limiting, it is unclear what additional structural limitation is imposed by the preambles with respect to claim 1. The body of Claim 1 already requires a dual fuel engine “operable on a gaseous fuel and a liquid fuel” which drives an “electrical power generator” (alternator) comprising a “charging coil.” Thus, as explained in the Petition and my prior declaration, the Workshop Manual teaches Elements 1.1 and 1.2 and therefore teaches a dual fuel generator. To the extent the preambles were found to be limiting and narrower than the limitations of Elements 1.1 and 1.2, the Petition and my prior declaration further explain that generators driven by engines, including generators driven by dual fuel engines, were well known.



EX1009, 65 (depicting the Workshop Manual's dual fuel delivery system).



*Id.*, 77 (depicting the Workshop Manual's alternator (1)).

## B. Elements 1.4 and 11.2

68. Champion argues that the Workshop Manual fails to disclose a gaseous fuel source because LPG leaves the LPG tank (14) in liquid phase. Champion is

wrong. First, its arguments are based on its incorrect “gaseous fuel” claim construction positions. Second, it misunderstands what the state of the LPG fuel is in the various sections of the fuel delivery system. Third, it narrowly confines the “gaseous fuel source” as being just LPG Tank (14) or the exit point therein, which the Board rejected when instituting the ’034 IPR.

69. First, as explained above, the “gaseous fuel” terms are properly understood to refer to components that interact with fuel that is in the gaseous state at standard temperature and pressure. *Supra* §V. The Workshop Manual discloses that the engine is configured to run on LPG, which is a gaseous fuel. LPG Tank (14) stores LPG and is the source of this gaseous fuel. Therefore, LPG Tank (14) is properly considered a “gaseous fuel source” regardless of the phase of the LPG inside the LPG Tank or when it exits the tank.

70. Tsuda—a patent describing the product embodied by the Workshop Manual (Paper 10 at 17-18)—expressly states that the Workshop Manual’s LPG fuel source is a “gaseous fuel supply source 31.” EX2062, 3:20-27.

71. Second, even accepting Champion’s argument that LPG Tank (14) can only be considered a “gaseous fuel source” if LPG exits the LPG Tank in gas phase, at least a portion of the LPG would be in gas phase upon exiting LPG Tank, at least in part due to entrainment, flash vaporization, cavitation, heat transfer, and similar effects due to localized pressure or temperature changes. *Supra* §V. Regardless of

where the LPG is drawn from the LPG tank, LPG will flow into gaseous fuel line (c) as a mixture of gas phase LPG and liquid phase LPG. Thus, even under Champion's incorrect claim construction arguments, because the LPG tank (14) supplies LPG in gas phase, it is properly understood to be a "gaseous fuel source."

72. Third, if the "gaseous fuel source" must *only* provide gaseous fuel in a gas phase, the Board found in the '034 Patent IPR that the LPG tank and vaporizer, taken together, supply a "gaseous fuel" in the form of gas phase LPG. IPR2025-00805, Paper 24 at 30-32. The carburetor (8) is connected to the output of the vaporizer (10) and thereby receives the gas phase LPG from the vaporizer.

### **C. Claim 2**

73. As explained in my previous declaration, the Workshop Manual discloses an LPG Cut Off Solenoid (7) that opens and closes the LPG pathway to the carburetor. Furthermore, LPG Shut Off Solenoid Valve (11) and LPG Manual Valve (13) open and close the LPG pathway to the carburetor.

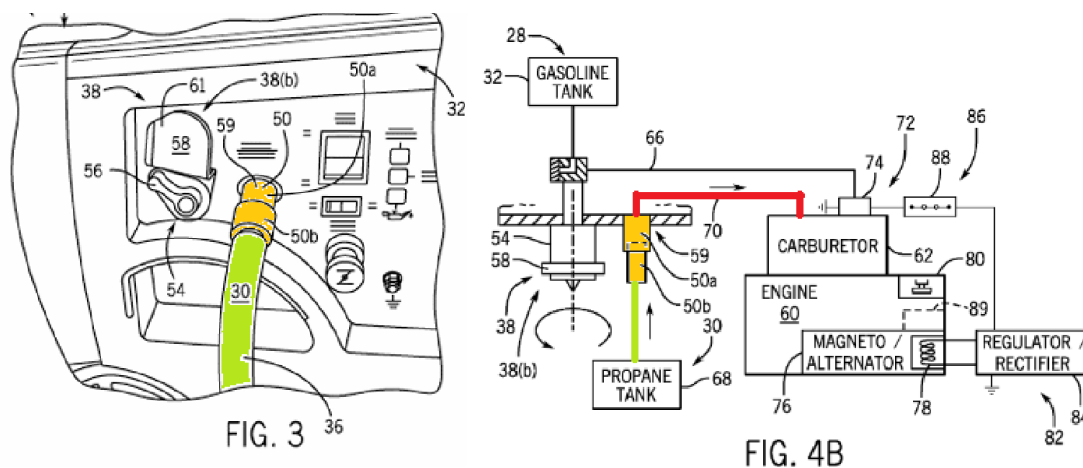
74. Champion argues that the LPG Cut Off Solenoid is not positioned "along a gaseous fuel line." Champion is wrong. Champion restrictively reads the "gaseous fuel line" as referring to the black elastomeric tube shown on Page 115 of the Workshop Manual and nothing else. POR, 29-30. But Champion's position is undermined by the '145 Patent. Specifically, the claim language indicates that the gaseous fuel line "coupl[es] the gaseous fuel source to the carburetor." EX1001,

Claim 2. Dr. Singhose also confirmed that the claim language “teach[es] us what the claimed gaseous fuel line is. It’s something that couples the gaseous fuel source to the carburetor.” EX1091, 37:6-9; *see also id.*, 36:2-6, 56:11-18 (identifying LPG supply hose 36 as part of the gaseous fuel line because it connects the gaseous fuel source to the carburetor). Dr. Singhose agrees that the gaseous fuel line is not limited to hoses (*id.*, 53:9-13) but also includes “other conduits” (*id.*, 57:6-10).

75. Likewise, the written description states that gaseous fuel line “provide[s] a flow path for second [gaseous] fuel source 30 to carburetor 62.” EX1001, 11:19-23. A POSA would have understood from these disclosures that the claimed fuel line includes the entire flow path from the fuel source to the carburetor and is not limited to tubing. For example, a valve positioned in the middle of the liquid fuel line, as depicted in Figures 4A and 4B, does not bisect the flow path into two separate liquid fuel lines. The valve, along with the pipes/tubes on either side of the valve, comprise a single fuel line.

76. For example, the ’145 Patent describes fuel inlet 59 as part of the gaseous fuel line 70. EX1001, 8:21-22, 8:5-7. Fuel inlet 59 includes the first end 50a of the quick-connect hose coupling, and the first end 50a includes a valve. *Id.*, 7:23-24, 10:54-56. Thus, the claimed “gaseous fuel line” refers not only to the conduit forming the second fuel line 70 but includes other structures such as valves and inlets along the way.

77. Like the “barb” and the brass fitting that Champion argues are distinct from the Gaseous Propane Line in the Workshop Manual, the coupling 50 comprises an inlet structure and is a distinct component from the LPG supply hose 36 and on-board tubing of the gaseous fuel line. Furthermore, coupling 50 is positioned at the end of the second fuel line 70.



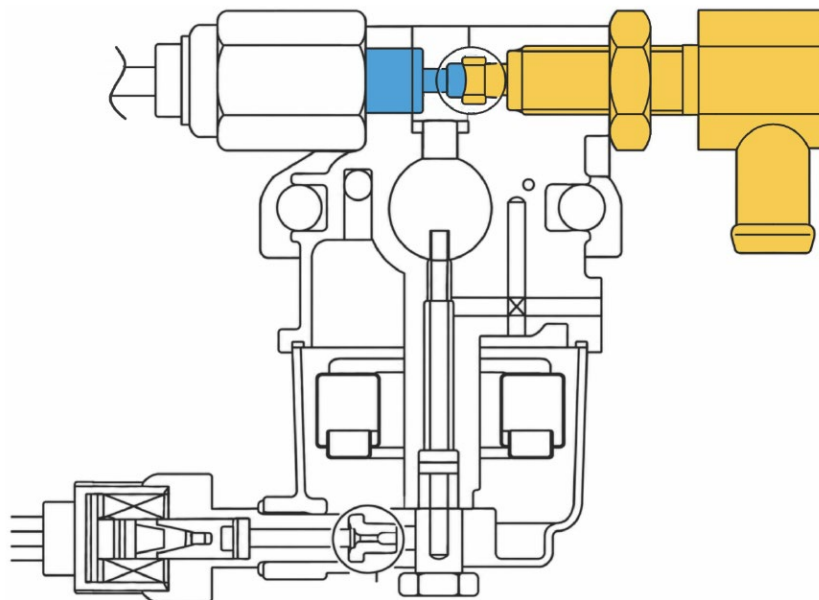
EX1001, FIGS. 3, 4B (annotated).

78. Thus, what is clear from the '145 Patent is that the claimed “gaseous fuel line” refers not only to the LPG supply hose 36 or the second fuel line 70 but to the broader flow path between the gaseous fuel source 30 and the carburetor 62.

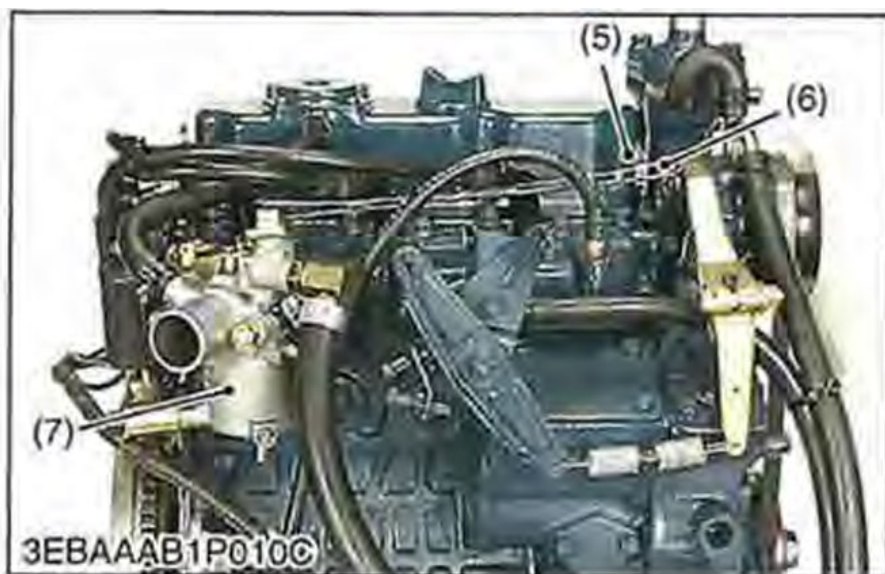
79. Like the '145 Patent, the Workshop Manual discloses a barb along the flow path between the gaseous fuel source and the carburetor. EX1009, 68. The Workshop Manual further discloses an LPG Cut Off Solenoid (7) that includes a plunger that extends into the opening of the barb to interrupt the gaseous fuel path before that fuel flows into the Venturi of the carburetor. *Id.* This extension into the

barb that forms the end of the gaseous fuel line results in the gaseous fuel valve being positioned “along the gaseous fuel line,” just as the quick connect valve in the coupling 50 of the ’145 Patent is arranged along the second fuel line.

80. Champion divorces Dr. Morse’s deposition testimony from its context. Dr. Morse testified that hoses are often secured using barbs, clips, and/or threaded connectors. EX2127, 110:1-8. That does not mean those barbs and fittings are separate from the fuel line. Rather, Dr. Morse testified that the gaseous fuel line comprises “not just the black hose, but all that bit that then goes into the carburetor.” *Id.*, 156:4-5. Similarly, Dr. Singhose acknowledges that the fuel line may comprise a set of multiple structures, such as both LPG supply hose 36 and the on-board portion of the fuel line. EX1091, 72:10-18. The “barb” in the Workshop Manual is a part of the flow path to the carburetor. The plunger (blue) is part of the valve that is positioned along the fuel path (fuel line).



EX1009, 68 (cleaned up and annotated).



EX1009, 115.

81. A POSA would have understood the gold “barb” shown in the figure above to be a portion of the gaseous fuel line, as it is a conduit that delivers gaseous

fuel from the gaseous fuel source to the carburetor. A POSA would have understood that the plunger (blue) is part of the gaseous fuel valve that is positioned along the gaseous fuel line.

82. Indeed, Tsuda, which describes the *Workshop Manual's DF972 engine* (Paper 10 at 17-18), confirms this, noting that “a gaseous fuel supply passage 39 [gold] is provided to feed a gaseous fuel from a gaseous fuel supply source 31 to the carburetor 1.” EX2062, 3:20-22. Tsuda explains that “a vaporizer 32 and a downstream gaseous fuel valve 33 [blue] ... are arranged in the ... gaseous fuel supply passage 39.” *Id.*, 3:22-27.

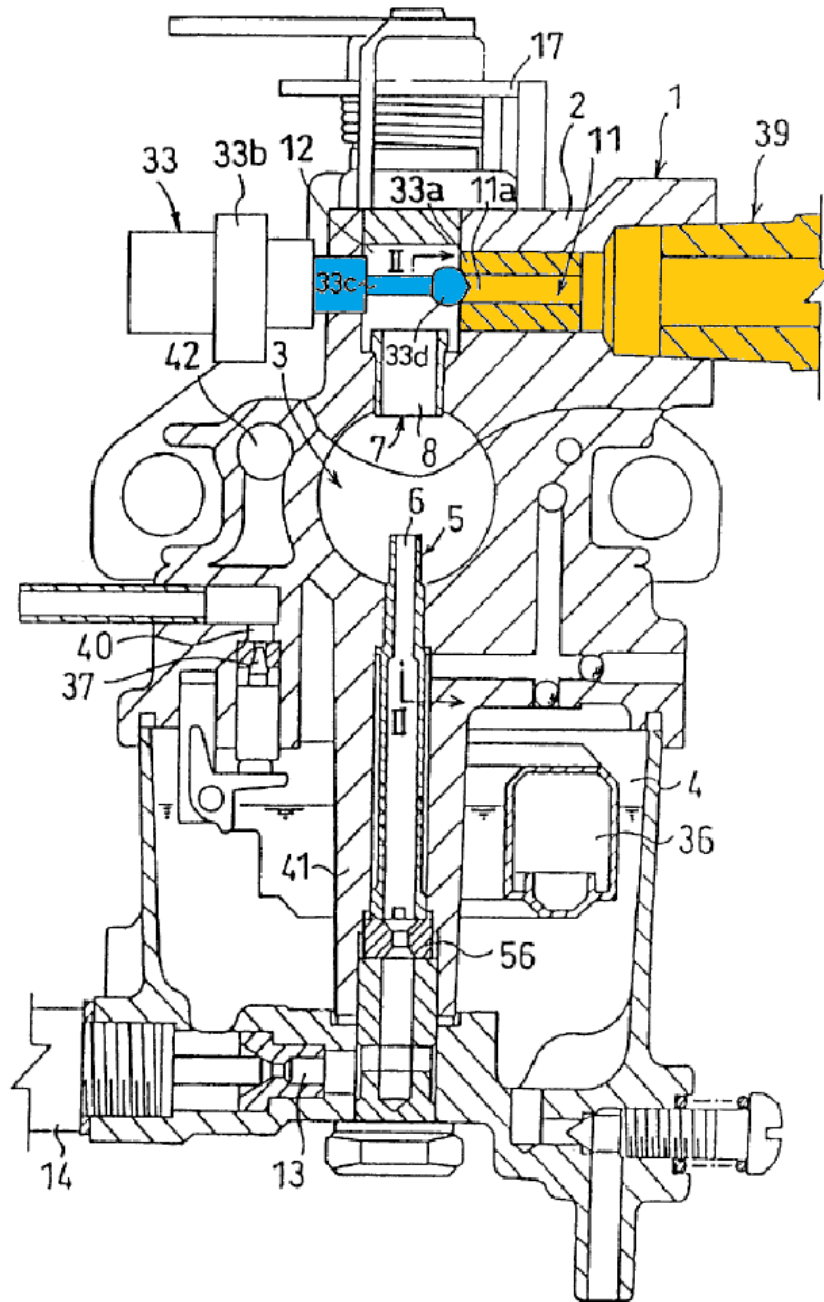
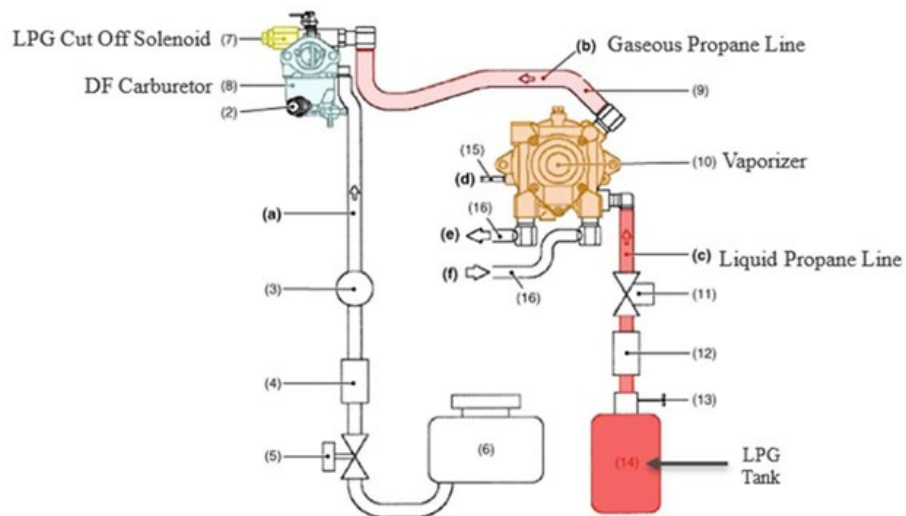


**FIG. 1**

EX2062, FIG. 1 (annotated).

83. Even accepting Champion's argument that the LPG Cut Off Solenoid (7) is not positioned along the fuel line, LPG Shut Off Solenoid (11) and LPG Manual Valve (13) are clearly positioned along the fuel line. As explained above, valves 11 and 13, and the portion of the fuel line carrying liquid phase fuel, constitute gaseous fuel valves and gaseous fuel lines regardless of fuel phase therein. Furthermore, a portion of the fuel passing through valves 11 and 13 is in gas phase, at least in part due to flash vaporization, cavitation, entrainment, and/or heat transfer. *Supra* §V. Thus, valves 11 and 13 meet this element even under Champion's construction of the fuel line and under either party's construction of "gaseous fuel."



POR, 31 (citing Pet., 31).

#### **D. Claim 3**

84. As explained in my previous declaration, the Workshop Manual discloses an LPG Cut Off Solenoid (7) that opens and closes the LPG pathway to

the carburetor. Furthermore, LPG Shut Off Solenoid Valve (11) and LPG Manual Valve (13) open and close the LPG pathway to the carburetor. Champion does not dispute that LPG Manual Valve (13) is a mechanical valve and instead only contests whether LPG Manual Valve (13) is positioned along the gaseous fuel line. As explained above, each valve is positioned along a gaseous fuel line. *Supra* §VI.C.

85. LPG Cut Off Solenoid (7) and LPG Shut Off Solenoid Valve (11) also mechanically interrupt the flow of LPG from the LPG fuel source to the carburetor and therefore constitute electrically actuated mechanical valves. As I explained in my deposition, “a mechanical system can deal with thermal, fluid, and mechanics” while an electrical system “deal[s] with electricity.” EX2136, 107:22-108:1. A mechanical system *may* have electrical components, and an electrical system *may* have mechanical components. Meanwhile an electromechanical system *must* have “an electrical component and a mechanical component.” *Id.*, 108:17-18. For example, in its infringement contentions for the Firman litigation, Champion argues that Firman’s “mechanical [gasoline] fuel valve” selectively controls the flow of LPG by actuating a “mechanical portion” of Firman’s LPG solenoid. EX1116, 5-11. Thus, according to Champion, Firman’s valves are mechanical valves even though their actuation involves the electrical portion of the LPG solenoid. Furthermore, according to Champion’s position, electrical valves essentially do not exist because

essentially all valves include some mechanical components to block and unblock the fuel line.

86. Even if solenoid valves are not mechanical valves, the type of valve used in a system is a mere design choice, and solenoid valves are readily interchangeable with purely mechanical valves. For example, Champion itself states that mechanical valves reduce complexity and are less prone to failure (POR, 69-70) while solenoid valves have faster response times and more precise control (which allows more precise air-to-fuel ratio, resulting in better control of engine-out emission). Selecting between these advantages and disadvantages is a matter of design choice.

87. Champion argues that the Petition did not identify a specific type of mechanical valve for substitution, but the type of mechanical valve is interchangeable and is immaterial. For example, the petition identifies LPG Manual Valve (13), which is also a mechanical valve, and which could be added and substituted for the solenoid valve LPG cutoff solenoid (7).

**E. Claim 6**

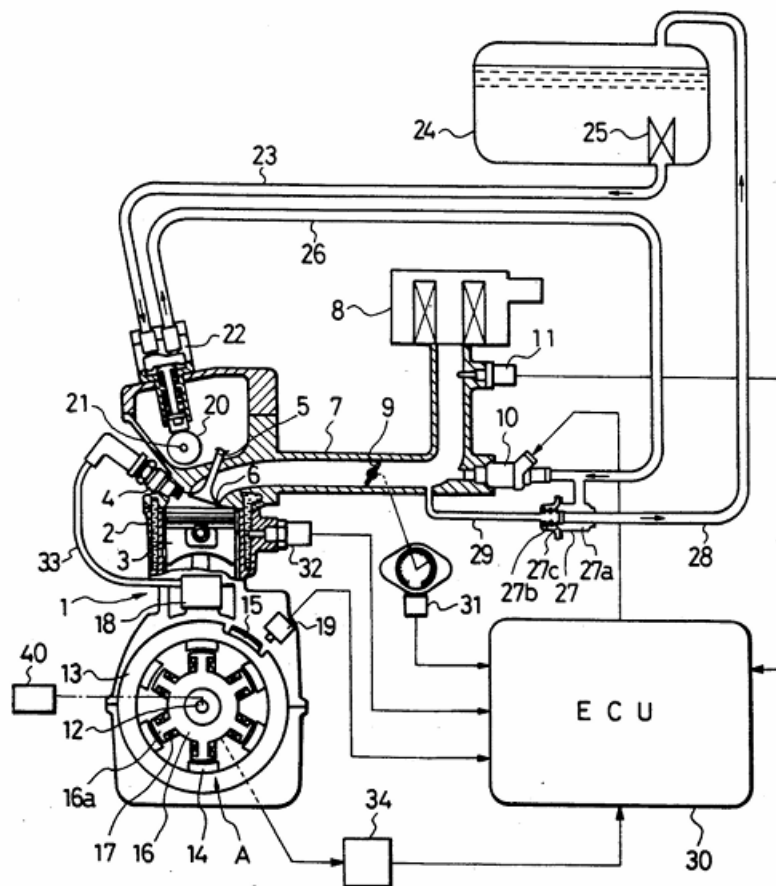
88. Champion argues that the Workshop Manual's switch is not connected to the electrical power generator. The Petition presents two alternative arguments for this limitation. First, the Workshop Manual alone teaches that its switch is connected to the electrical power generator through the battery. Second, to the extent

a connection to the generator through a battery does not meet this element, it would have been obvious to remove the battery in accordance with Matsushima's batteryless generator teaching, such that the switch is directly connected to the generator. Champion addresses only obviousness of the combination in the second argument.

89. The first argument is sufficient to teach this limitation. The Workshop Manual teaches that "battery current" flows to the solenoids through the switch. EX1009, 68. The battery is connected to the electrical power generator. *Id.*, 77. Thus, the switch is connected to the generator.

90. The claim language suggests that an indirect connection is sufficient to meet this limitation. For example, Claim 6 also states that the switch "connect[s] one fuel source to the carburetor." But Claim 6 also requires components between the fuel source and carburetor, such as the liquid fuel cut-off solenoid. Similarly, the specification demonstrates that the fuel sources are "connected" to the carburetor even though the fuel lines and fuel valves are in between the carburetor and fuel sources. Indeed, the specification states that components of the engine, such as the switch, are "operatively connected" to the alternator (generator) "by conventional means." EX1001, 4:7-9. Thus, "connected" in Claim 6 encompasses "operative" connections, such as an operative connection through a battery.

91. Champion's objection to the second argument is also wrong. Matsushima discloses that it is desirable to connect electrical components such as switches to a generator so that the electrical components can receive power without a battery or when the battery is dead. This teaching is not limited to the precise structures powered by Matsushima's batteryless generator.

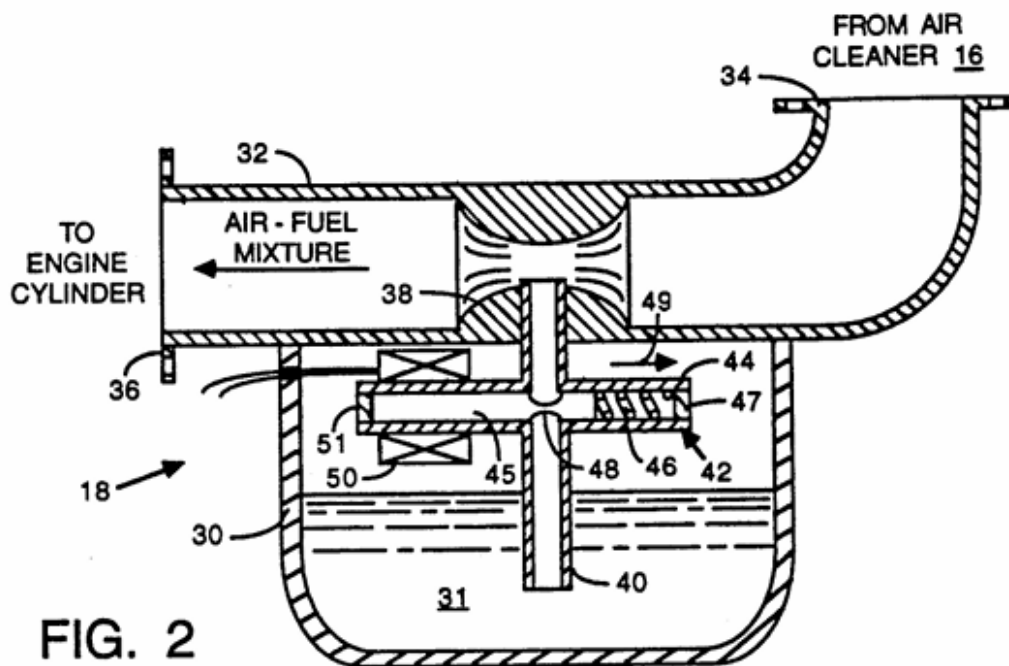


EX1012, FIG. 1 (depicting Matsushima's "AC generator A" and recoil starter 40).

**F. Claim 8**

92. Champion does not contest that Olmr teaches a normally open valve and instead disputes whether it would be obvious to combine the Workshop Manual with Olmr.

93. The Petition and my prior declaration explain the motivation to combine. Olmr teaches that it is desirable for electricity to not be required to hold the valve open. Pet., 53 (quoting EX1007, 3:43-52). A POSA would have been motivated to combine the Workshop Manual with Olmr to allow engine starting if the battery is dead or if the engine is modified to operate without a battery. It is also desirable for the valve to “fail in the normally open position.” EX1007, 3:43-52.

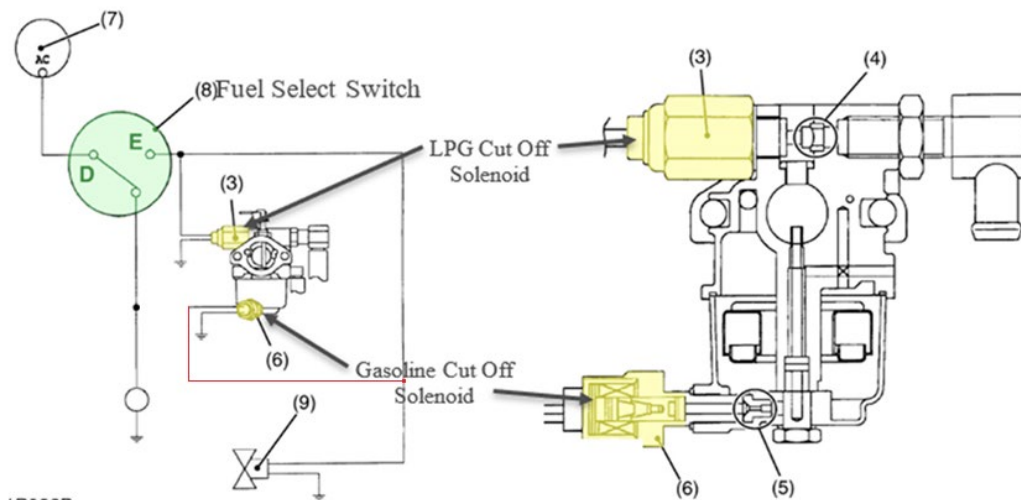


EX1007, FIG. 2 (depicting Olmr's solenoid valve 42).



96. A POSA may have chosen to make only the liquid fuel cut-off normally open, so that if the battery dies or valves fail, only one fuel is delivered to the engine. A POSA may also have chosen to make both valves normally open, so that at least one fuel is delivered to the engine during operation. Either configuration is easily wired based on when each solenoid is intended to be powered: flipping the rest condition of the solenoid simply requires connecting the solenoid to the opposite side of the switch to account for the valve substitution.

97. For example, the wiring below would apply if the liquid fuel cut-off is replaced with a normally open valve, and the gaseous fuel valve remains normally closed.

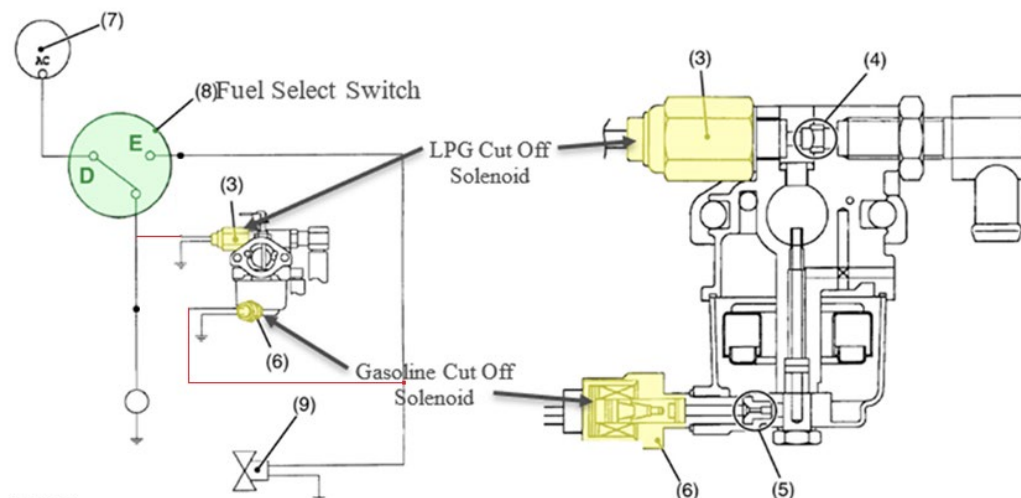


Pet., 33 (citing EX1009, 68) (rewired in red for normally open liquid fuel cut-off).

98. With this wiring, only one fuel valve is on at a time:

|                          | Powered Solenoid | Liquid Fuel Cut-Off Position (Normally Open) | Gaseous Fuel Valve Position (Normally Closed) |
|--------------------------|------------------|----------------------------------------------|-----------------------------------------------|
| <b>Switch Position D</b> | Neither Valve    | Open                                         | Closed                                        |
| <b>Switch Position E</b> | Both Valves      | Closed                                       | Open                                          |

99. The wiring diagram below would apply if both valves are replaced with normally open valves.



Pet., 33 (citing EX1009, 68) (rewired in red for both normally open valves).

100. With this wiring, only one fuel valve is on at a time:

|                          | Powered Solenoid   | Liquid Fuel Cut-Off Position (Normally Open) | Gaseous Fuel Valve Position (Normally Open) |
|--------------------------|--------------------|----------------------------------------------|---------------------------------------------|
| <b>Switch Position D</b> | Gaseous Fuel Valve | Open                                         | Closed                                      |
| <b>Switch Position E</b> | Liquid Fuel Cutoff | Closed                                       | Open                                        |

101. In either case, rewiring of “main switch (7)” is not required. “[A]llowing gasoline to flow into the carburetor” when the valve is unpowered (POR, 38) *is* the desired result of the design choice of using a normally open valve.

102. A POSA would have understood that these simple re-wirings of the Workshop Manual valve circuit would easily allow for the normally open solenoid of Olmr to be utilized in place of the normally closed Gasoline Cut Off Solenoid of the Workshop Manual.

103. Despite stating the conclusion that it is not obvious how to rewire the circuit, Dr. Singhose testified that “if [he] studied [the circuit] and worked on this [it] seems like [he] could figure out a way to [rewire] the circuit.” EX1091, 130:19-131:3. Dr. Singhose further testified that converting the valve to a normally open valve would require additional changes to prevent fuel leakage. *Id.*, 131:16-132:7; *see also* POR, 38. Olmr explains that such leakage does not occur. EX1007, 4:41-50 (disclosing that once the engine stops rotating, fuel will not be drawn out of the carburetor). Leakage is also prevented by the manual liquid fuel valve (5) (EX1009, 65) positioned along the liquid fuel line. Regardless, the purported leakage of the remaining fuel in the float bowl is inherent to Claim 8’s normally open valve disclosure. The ’145 Patent does not disclose a non-obvious solution to the purported leakage problem raised by Dr. Singhose, and the simultaneous benefits and drawbacks of using a normally open valve do not teach away from the combination.

**G. Claim 9**

104. Champion does not contest that Matsushima teaches a pull start, batteryless engine and instead only disputes whether it would have been obvious to combine the Workshop Manual with Matsushima. Specifically, Champion argues that it would not be obvious to implement Matsushima's teaching in a "large" water-cooled engine.

105. Champion incorrectly states that I "explicitly defined" small engines as having a displacement of less than 0.5L (500cc). POR, 76-77. In my declaration, I stated that I have tested small engines *such as* engines under 0.5L displacement and large engines *such as* engines with over 15L displacement. EX1003, 10. These statements were not definitional and instead were intended to describe examples of engine sizes that I have tested. "Small" and "large" are relative terms whose meanings depend on context. An engine may be "small" or "large" depending on the intended use case. If these statements were definitional, engines between 0.5L and 15L would fall between the gap as being neither nor large, and the Workshop Manual's engine would not be "large."

106. Champion does not explain why the Workshop Manual-Matsushima combination must be a large, water-cooled engine. Neither the size of the engine nor the cooling system are claimed features, nor are they inherent to the teachings of the Workshop Manual. I have been informed that obviousness combinations involve

combining the *teachings* of the references rather than bodily incorporating one reference into another.

107. Based on my review of the materials and my knowledge, it would have been obvious for a POSA to combine the Workshop Manual's dual fuel delivery system teaching with Matsushima's pull-start teaching.

108. Incorporating a pull-start in an engine with the Workshop Manual's fuel delivery system would improve reliability in cold or remote applications. Batteries are known to die in cold weather or after long periods of nonuse. For example, drivers are often unable to start car engines using the car's battery during the winter and require a jump start. Similarly, generators kept for emergency use are stored for long periods with infrequent use and therefore will often have a dead battery. Furthermore, the components for pull starting are also less expensive than a battery-based system, are easy to install, and were commonly used prior to the filing of the '145 Patent.

109. *Even if* the obviousness standard required bodily incorporation of Matsushima into the Workshop Manual, a POSA would have understood that the Workshop Manual is not prohibitively large. Champion manufactures a dual fuel 500cc engine with a recoil starter. EX1092, 1, 13, 34. Kohler also offered a family of engines between 561cc and 755cc for sale prior to 2015 that utilized recoil starting. EX1107, 11, 113. 997cc engines can also be pull-started. *See, e.g.*, EX1124.

110. A POSA would have understood that the DF972 engine of the Workshop Manual would have been able to be pull-started using a recoil starter.

111. First, a POSA would also have understood that the water pump could be removed, replaced, or scaled down with the engine in the combination. Furthermore, the work required to run a water pump compared to an engine is generally negligible. While the Workshop Manual does not describe the amount of power needed to operate its water pump, other water pumps used in vehicle engines (which a POSA would have understood can be larger than the DF972 engine) require an average of 100-400 watts of power (translating to 0.13-0.54 hp). EX1108, 30-45. A POSA would have understood that the power requirements of the water pump would have been negligible when compared to the power produced by the DF972 engine, which is rated at 32.5 hp and 31 hp for gasoline and LPG, respectively. EX1009, 8.

112. Even if the water cooler were retained in the combination, a POSA would have understood that the water cooler does not need to be powered immediately on startup via the pull start, because the engine is not hot yet. For example, a POSA would have understood that the water cooler could be started after the engine was already started using the pull start. Such sequential operation of engine powered components was well known by POSAs prior to the filing date of the '145 Patent. For example, centrifugal clutches were commonly used on engines

to keep the engine unloaded at low RPMs and automatically engage a secondary function as engine speed increases. Such centrifugal clutches were used, for example, on go-carts, lawn mowers, woodchippers, and other applications. EX1109, 1:33-41. The engine can also be started without a load for easier startup.

113. The Workshop Manual discloses the technical specifications for the engine, starting motor, and battery. EX1009, 8. To evaluate whether a human can manually pull-start the DF972 engine, I performed a conservative, worst-case torque calculation.

114. The starting motor runs with a maximum of 1.0 kW of electrical power. EX1009, 8. I assume that the motor operates at maximum capacity (1.0 kW) under worst-case startup conditions. While normal operating conditions require less power, standard engineering practice incorporates safety margins for component aging, degradation, and discrete market motor sizing. Therefore, the actual required power from the starter motor could be substantially less than 1.0 kW. To maintain a conservative approach, my calculation assumes that a human must supply the full maximum torque produced by the existing starter motor that consumes 1.0 kW electric power.

115. The starting motor is a 12 V DC starting motor. EX1009, 8. Unlike high-efficiency propulsion motors used in electric vehicles (e.g., PMSM or AC induction motors), starter motors are low-duty-cycle components optimized for cost

rather than continuous efficiency. A typical DC starting motor operates at approximately 50% efficiency. EX1129, 12. Consequently, drawing 1.0 kW of electrical power from the battery yields 500 W of mechanical output power delivered to crank the engine.

116. While automotive engines typically crank between 100 rpm and 400 rpm, a generator pull-start operates near 100 rpm due to the physical length limitation of a manual pull rope. Converting 100 rpm to angular velocity ( $\omega$ ):

$$\omega = 100 \text{ rpm} \times \frac{2\pi \text{ rad}}{60 \text{ s}} \approx 10.47 \text{ rad/s}$$

117. Using the mechanical power-torque relationship ( $P = \tau \times \omega$ ), the required cranking torque ( $\tau$ ) at 500 W mechanical output is:

$$\tau = \frac{P}{\omega} = \frac{500 \text{ W}}{10.47 \frac{\text{rad}}{\text{s}}} \approx 47.7 \text{ N m (35.2 ft lbf)}$$

118. If the 35.2 ft lbf torque is exerted over a six-inch radius recoil wheel, the required force would be 70.4 lbf. A POSA would have understood that this is comparable to the typical pull force for recoil starters. *See* EX1110, ¶[0031] (describing how the “typical pull may range from about 15-100lb”). Thus, a POSA would have had a reasonable expectation of success in starting the DF972 engine via a recoil start.

119. Furthermore, a POSA would have understood that the size of the engine can be reduced. For example, Kubota published a workshop manual for a smaller 752cc engine prior to the '145 Patent that teaches a substantially similar fuel delivery system. EX1094; *see also* EX2044. A POSA would have understood that reducing the size of the engine would have made the engine even easier to start via recoil starter.

120. A POSA would also have understood that implementing a batteryless recoil starter would have simultaneous advantages and disadvantages. The tradeoff between the advantages of a recoil starter and the difficulty of starting the engine with the recoil starter is a design choice that does not obviate the motivation to combine.

121. Dr. Morse's general testimony that "the particular characteristics of an engine are incredibly relevant" (POR, 45) does not demonstrate that the Workshop Manual teaches away from a pull start, batteryless engine. Champion assumes that engine size and water cooler are fixed characteristics that a POSA would design the engine around, but those characteristics are subject to change depending on the type and application of engine the POSA wants to develop and the required power for the contemplated application.

122. Finally, Champion argues that the Workshop Manual does not teach a system to manually prime or choke the engine with a pull start system. As an initial

matter, the Workshop Manual teaches a “choke valve (3) controlled by choke lever (1).” EX1009, 67. Similarly, Tsuda describes the DF972 engine and discloses a “choke valve 27” that is manually operated by “choke valve operating member 58.” EX2062, 8:59-60, FIG. 3. Furthermore, manual priming and choking is not required for the combination—Champion acknowledges that pull start engines merely “often” include priming and choking systems to increase fuel richness upon startup. IPR2025-01271, Paper 30 at 43. Matsushima itself teaches a pull start engine without manual priming or choking. To the extent the typical manual priming and choking configuration were desired, its implementation was well known and would naturally follow from a design choice to use a pull start system.

**H. Claims 4-5, 7, 10, and 12-16**

123. Champion does not separately address Claims 4-5, 7, 10, and 12-16. Champion’s arguments regarding Claims 1, 2, 6, and 11 are incorrect. Claims 4-5, 7, 10, and 12-16 are invalid for the reasons stated in my prior declaration.

**VII. GROUNDS 3 AND 6: CLAIMS 1-16 ARE RENDERED OBVIOUS BY THE COMBINATION OF NAKAFUSHI, MATSUSHIMA, OLMR, AND WINBERG**

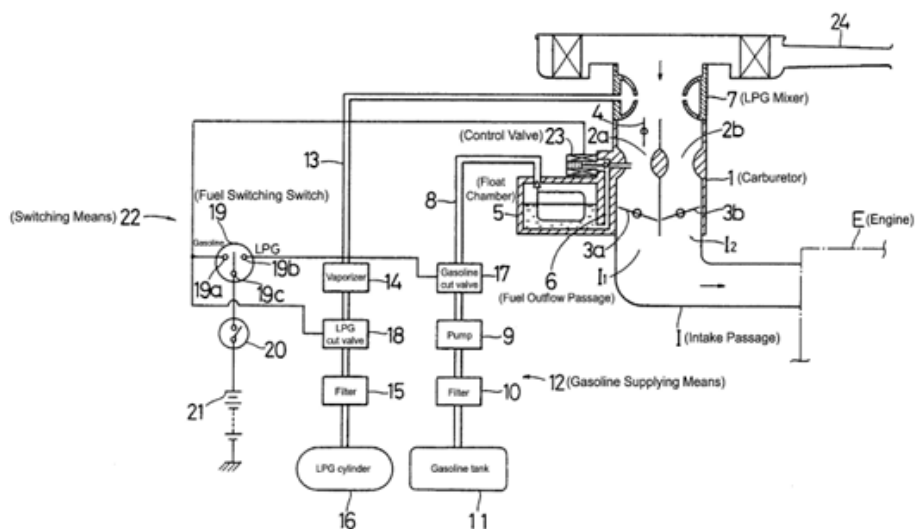
**A. Elements 1.0 and 11.0**

124. As explained above, the preambles of Claims 1 and 11 are not limiting.

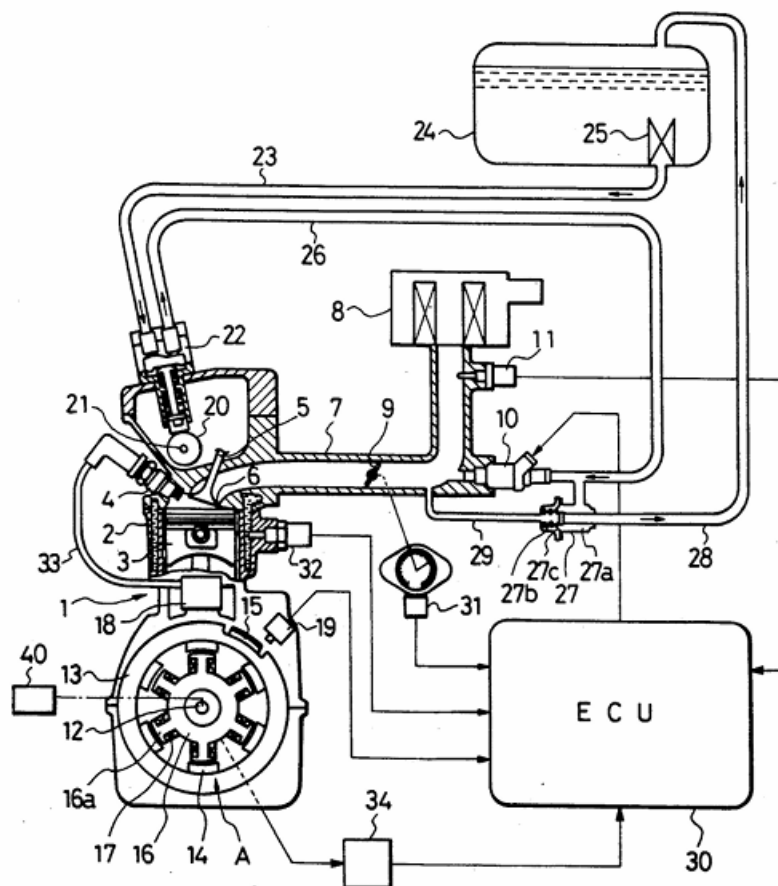
*Supra* §VI.A.

125. Even if the preambles were limiting, the Nakafushi-Matsushima combination teaches a dual fuel generator. As explained in Element 1.1, Nakafushi teaches a dual fuel delivery system for an engine. Champion has previously admitted that Nakafushi's teaching is not limited to any particular use case. IPR2025-01271, Paper 30 at 64-65. As explained in Element 1.2, Matsushima teaches a generator driven by an engine. The use of internal combustion engines, including dual fuel engines, to drive a generator was well known and is within the range of uses a POSA would have considered for Nakafushi's fuel delivery system.

126. Champion complains that the Petition does not specify "which engine" is being implemented in a dual fuel generator. POR, 47. That is because the engine choice is irrelevant. Nakafushi teaches a dual fuel delivery system for an engine and Matsushima teaches using an engine to drive a generator. I have been informed that obviousness combinations involve combining the *teachings* of the references rather than bodily incorporating one reference into another. Thus, there is no need to bodily incorporate Nakafushi's teaching into Matsushima's engine or vice versa.



EX1005, FIG. 1 (depicting Nakafushi's dual fuel delivery system).



EX1012, FIG. 1 (depicting Matsushima's "AC generator A" and recoil starter 40).

**B. Elements 1.4 and 11.2**

127. Champion argues that Nakafushi fails to disclose a gaseous fuel source because LPG leaves the LPG Cylinder 16 in liquid phase. Champion is wrong. First, its arguments are based on its incorrect "gaseous fuel" claim construction positions. Second, it misunderstands what the state of the LPG fuel is in the various sections of the fuel delivery system, and third, it narrowly confines the "gaseous fuel source" as being just the LPG Cylinder or the exit point therein.

128. First, as explained above, the "gaseous fuel" terms are properly understood to refer to components that interact with fuel that is in the gaseous state at standard temperature and pressure. *Supra* §V. Nakafushi discloses that the engine is configured to run on LPG, which is a gaseous fuel. The LPG Cylinder stores LPG and is the source of this gaseous fuel. Therefore, the LPG Cylinder is properly considered a "gaseous fuel source" regardless of the phase of the LPG inside the LPG Cylinder or when it exits the cylinder.

129. Second, even accepting Champion's argument that the LPG Cylinder can only be considered a "gaseous fuel source" if LPG exits the LPG Cylinder in gas phase, Nakafushi does *not* state that LPG exits the cylinder in liquid phase. Champion assumes that because pressure regulator 14 is a vaporizer, it must receive LPG in liquid phase. But Champion itself pointed out in prosecution that a vaporizer

can receive a gaseous fuel in either liquid or gaseous phase. POR, 6-7 (quoting EX2137, 373). Vapor service does not eliminate the function of the vaporizer. Heating the fuel with a vaporizer is desirable not just to increase vaporization rate, but also to maintain the phase of preexisting vapor and prevent that vapor from recondensing. Vaporizers can also have the additional function of providing vaporized fuel at the appropriately regulated pressure for operation of the engine, for example as shown in the prior art references discussed herein (e.g., EX1009, EX1005). Champion itself explained that Sugimoto teaches a vaporizer that receives a first fuel gas in liquid phase and a second fuel gas in gas phase. POR, 6-7 (quoting EX2137, 373). Nakafushi teaches an LPG Cylinder, and the scope of that disclosure includes an LPG Cylinder in which the LPG exits in gas phase or as a mixture of gas and liquid.

130. Even if Nakafushi is limited to liquid service, at least a portion of the LPG would be in gas phase upon exiting the LPG Cylinder, at least in part due to entrainment, flash vaporization, and cavitation, heat transfer, and similar effects due to localized pressure or temperature changes. *Supra* §V. Thus, even under Champion’s incorrect claim construction arguments, because the LPG Cylinder supplies LPG in gas phase, it is properly understood to be a “gaseous fuel source.”

131. Third, if the “gaseous fuel source” must *only* provide gaseous fuel in a gas phase, the Board found in the ’034 Patent IPR that the LPG tank and vaporizer,

taken together, supply a “gaseous fuel” in the form of gas phase LPG. IPR2025-00805, Paper 24 at 30-32. The carburetor (8) is connected to the output of the vaporizer (10) and thereby receives the gas phase LPG from the vaporizer.

**C. Claim 2**

132. Champion argues that Nakafushi fails to disclose a gaseous fuel valve positioned along a gaseous fuel line because LPG is in liquid phase in that portion of the fuel line. Champion is wrong. First, its arguments are based on its incorrect “gaseous fuel” claim construction positions. Second, it misunderstands what the state of the LPG fuel is in the various sections of the fuel delivery system.

133. First, as explained above, the “gaseous fuel” terms are properly understood to refer to components that interact with fuel that is in the gaseous state at standard temperature and pressure. Nakafushi discloses that the engine is configured to run on LPG, which is a gaseous fuel. The LPG cut valve 18 and the portion of LPG supplying passage 13 between the LPG Cylinder and the vaporizer both carry LPG. Therefore, LPG cut valve 18 is a gaseous fuel valve and LPG supplying passage 13 is a gaseous fuel line, regardless of the fuel’s phase inside those structures. Tsuda describes a similarly located valve (located upstream from a vaporizer) as an “upstream gaseous fuel valve.” EX2062, 3:22-27, FIG. 3.

134. Second, even accepting Champion’s argument that the LPG must exit the LPG Cylinder in gas phase, Nakafushi does *not* state that LPG exits the cylinder

in liquid phase. Champion assumes that because pressure regulator 14 is a vaporizer, it must receive LPG in liquid phase. But Champion itself pointed out in prosecution that a vaporizer can receive a gaseous fuel in either liquid or gaseous phase. POR, 6-7 (quoting EX2137, 373). Champion explained that Sugimoto teaches a vaporizer that receives a first fuel gas in liquid phase and a second fuel gas in gas phase. POR, 6-8 (quoting EX2137, 399). Vapor service does not eliminate the function of the vaporizer. Heating the fuel with a vaporizer is desirable not just to increase vaporization rate, but also to maintain the phase of preexisting vapor and prevent that vapor from recondensing. Vaporizers can also have the additional function of providing vaporized fuel at the appropriately regulated pressure for operation of the engine. Nakafushi teaches an LPG cut valve positioned along LPG supplying passage 13, and the scope of that disclosure includes an LPG cut valve and fuel line through which LPG travels in gas phase.

135. Even if Nakafushi is limited to liquid service, at least a portion of the LPG in the fuel line and fuel valve would be in gas phase, at least in part due to flash vaporization, cavitation and entrainment, heat transfer, and similar effects due to localized pressure or temperature changes. Thus, even under Champion's incorrect claim construction arguments, because the LPG line and LPG cut valve contain LPG in gas phase, these components are properly understood to be a "gaseous fuel line" and "gaseous fuel valve."

**D. Claim 3**

136. As explained above (*supra* §VI.D), a POSA would have understood that Nakafushi and the Workshop Manual's gaseous fuel valves mechanically interrupt the flow of LPG from the LPG fuel source to the carburetor and therefore constitute electrically actuated mechanical valves.

137. Even if Nakafushi's valves are not mechanical valves, it would have been obvious to substitute the valves with purely mechanical valves, which would have been a simple design choice with known benefits and drawbacks. *Supra* §VI.D.

138. Nakafushi and the Workshop Manual teach similar fuel delivery systems such that a POSA would combine their teachings in similar ways. For example, Nakafushi, like the Workshop Manual, teaches a fuel delivery system comprising a liquid fuel valve, gaseous fuel valve, liquid fuel cut-off, and switch. Champion does not explain why any of the differences between the Workshop Manual and Nakafushi are material to whether there is motivation to use mechanical valves instead of both references' electrical/solenoid valves.

**E. Claim 6**

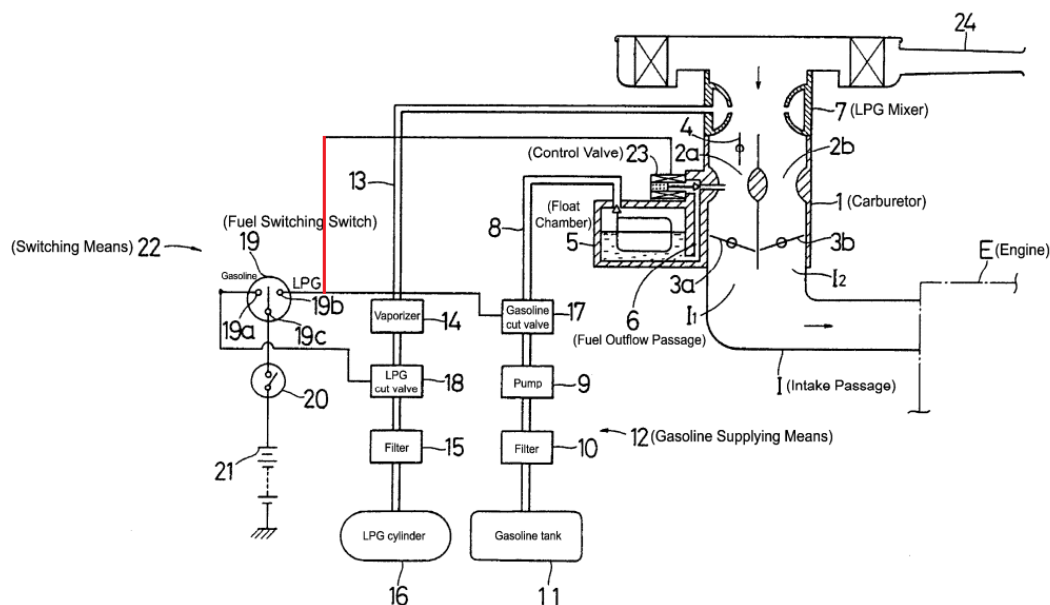
139. Nakafushi teaches that the switch is connected to a battery. Nakafushi does not specify how the battery is charged. As explained above (*supra* §VI.E), Matsushima teaches that it is desirable to power electrical devices in the engine such as the battery and electrical switch using a generator.

140. Furthermore, it is desirable to be able to start the engine without a battery or when the battery is dead. *See supra* §VI.G. Matsushima teaches that it is desirable to connect electrical devices in the engine such as the electrical switch to a generator so that they can be powered without a battery.

**F. Claim 8**

141. Champion does not contest that Olmr teaches a normally open solenoid valve and instead disputes whether the Petition establishes a motivation to combine the Nakafushi with Olmr.

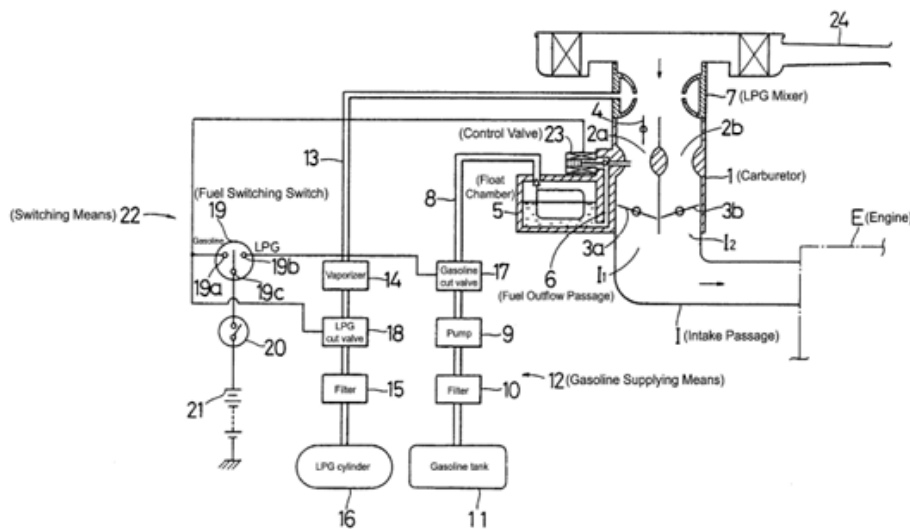
142. As explained in my prior declaration, the decision to configure a solenoid as normally open or normally closed is mere design choice, with known advantages and disadvantages to each choice regarding power consumption and preferred failure states. Champion also faults Generac for purportedly failing to describe every minute detail of how to rewire the circuitry to work with a normally open valve instead of a normally closed valve. Champion then deploys a strawman argument assuming the rest condition of the solenoid is flipped without any rewiring. POR, 59-60. Rewiring Nakafushi to account for the substitution of a normally open liquid fuel cutoff valve 23 have been straightforward to a POSA, as shown below.



EX1005, FIG. 1 (rewired for a normally open liquid fuel cutoff valve 23).

143. Furthermore, Nakafushi and the Workshop Manual teach similar fuel delivery systems such that a POSA would combine their teachings in similar ways. *Supra* Section VII.D. Champion does not explain why any of the differences between the Workshop Manual and Nakafushi are material to how they are combined with Olmr. The fact that Nakafushi's cut valves are normally open while the Workshop Manual's analogous valves are normally closed bears no relation to whether it would be obvious to make a different valve normally open in either system. If anything, Nakafushi's normally open cut valves further supports making the liquid fuel cutoff valve 23 normally open as well.

144. Meanwhile, because gasoline cut valve 17 already is normally open, replacing gasoline cut valve 17 with a normally open solenoid would not require any rewiring. Champion argues that valve 17 does not provide fuel “to the engine” because of intervening valve 23. But the ’145 Patent’s specification describes valves other than the final valve as controlling fuel flow “to the engine.” *See, e.g.*, EX1001, 6:13-20 (mechanical fuel valve 54 controls liquid fuel flow “to the engine” despite downstream liquid fuel cutoff). Furthermore, under Champion’s position, the disclosed liquid fuel cutoff does not provide liquid fuel to the engine either because of the downstream choke valve in the carburetor. Valve 17 provides fuel to the engine at least when valve 17 is unpowered and valve 23 is powered so that both valves are open (i.e. when power is flowing through the switch 19 positioned in 19a for gasoline) and therefore provides fuel to the engine when unpowered.



EX1005, FIG. 1 (depicting Nakafushi's dual fuel delivery system with normally open gasoline cut valve 17 and normally closed control valve 23).

**G. Claims 4-5, 7, 9-10, and 12-16**

145. Champion does not separately address Claims 4-5, 7, 9-10, and 12-16.

Champion's arguments regarding Claims 1, 2, 6, and 11 are incorrect. Claims 4-5, 7, 9-10, and 12-16 are invalid for the reasons stated in my prior declaration.

**VIII. GROUNDS 4, 7, AND 8: CLAIMS 1-16 ARE RENDERED OBVIOUS BY HOLZAPFEL, ALONE OR IN COMBINATION WITH MATSUSHIMA, OLMR, AND WINBERG**

**A. Elements 1.0 and 11.0**

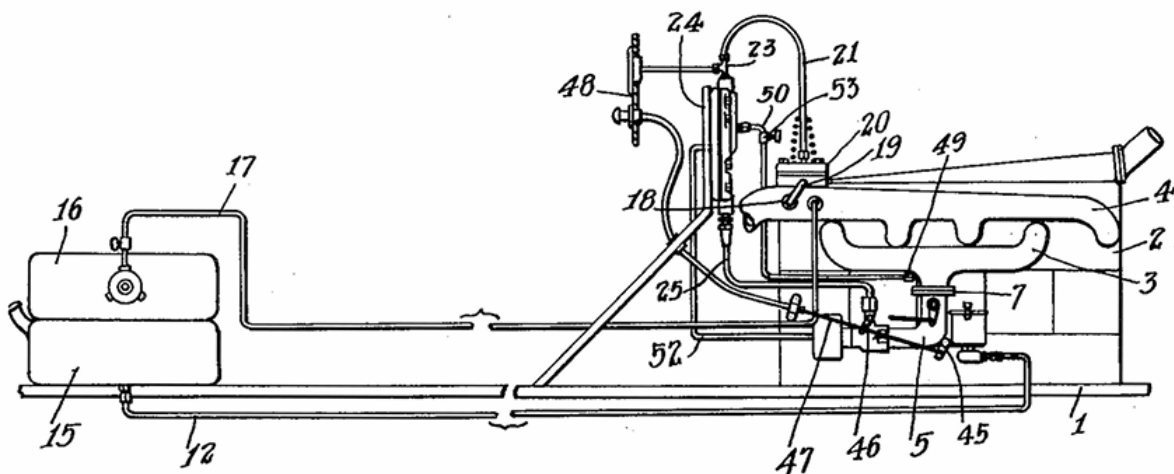
146. As explained above, the preambles of Claims 1 and 11 are not limiting.

*Supra* §VI.A.

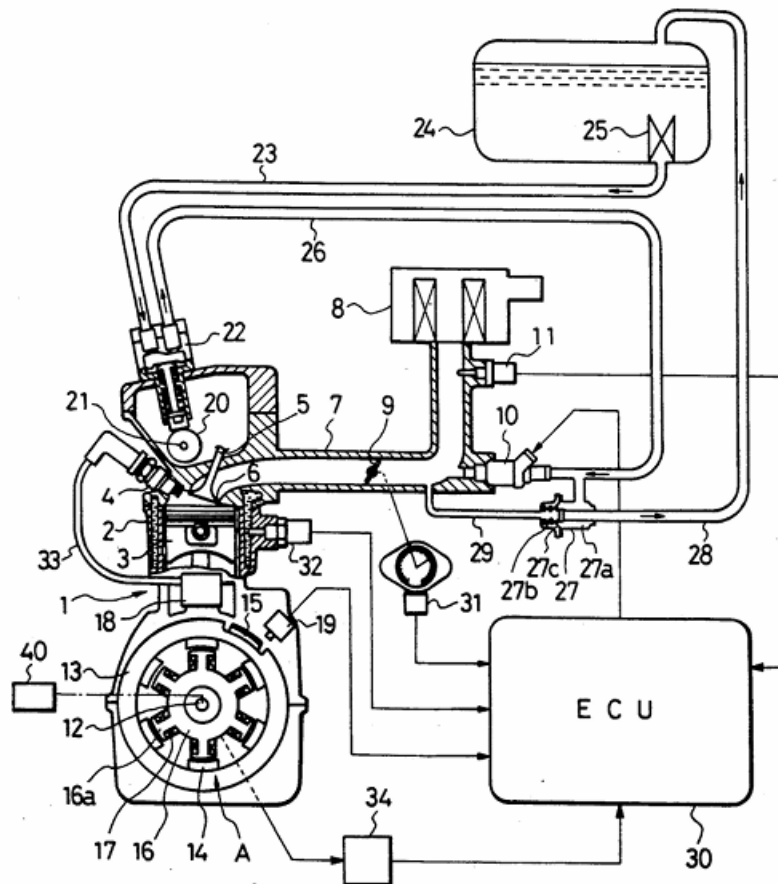
147. Even if the preambles were limiting, the Holzapfel-Matsushima combination teaches a dual fuel generator. As explained in Element 1.1, Holzapfel teaches a dual fuel delivery system for an engine. As explained in Element 1.2, Matsushima teaches a generator driven by an engine. The use of internal combustion engines, including dual fuel engines, to drive a generator was well known and is within the range of uses a POSA would have considered for Holzapfel's fuel delivery system.

148. Champion complains that the Petition does not specify "which engine" is being implemented in a dual fuel generator. POR, 61. That is because the engine

choice is irrelevant. Holzapfel teaches a dual fuel delivery system for an engine and Matsushima teaches using an engine to drive a generator. I have been informed that obviousness combinations involve combining the *teachings* of the references rather than bodily incorporating one reference into another. Thus, there is no need to bodily incorporate Holzapfel's teaching into Matsushima's engine or vice versa.



EX1008, FIG. 1 (depicting Holzapfel's dual fuel delivery system).



EX1012, FIG. 1 (depicting Matsushima's "AC generator A" and recoil starter 40).

## B. Element 1.2

149. Champion does not dispute that Matsushima discloses an electrical power generator and instead contests whether it would have been obvious to combine Holzapfel with Matsushima.

150. Champion incorrectly requires the combination to involve incorporating Matsushima's teachings into a "1930s" automobile engine. POR, 67. But 1930s automobiles typically included a generator (such as an alternator,

magneto, or charging coil) to power electrical systems for the engine. Engines circa 1930 relied on either spark ignition (e.g. gasoline) or compression ignition (diesel). Holzapfel's liquid fuel may be gasoline. EX1008, 2:124-147. Gasoline engines use spark ignition; they cannot function with compression ignition. Holzapfel therefore inherently requires an electrical system for spark ignition. The spark ignition system typically used a generator (such as an alternator, magneto, or charging coil) for power while the engine was running. For example, the Model T Ford included a magneto. EX1125. A POSA would have understood that Matsushima's generator (magneto) would have been suitable for this purpose.

151. Regardless, a POSA considering Holzapfel and Matsushima would have understood how to use their teachings in a modern engine, including the typical electrical equipment in a modern engine. This is especially so because the combination already requires the implementation of Matsushima's electrical system for Elements 1.5 and 1.6. A POSA would have understood that those electrical systems would be powered by Matsushima's generator.

**C. Elements 1.4 and 11.2**

152. Champion argues that Holzapfel fails to disclose a gaseous fuel source because the normally gaseous fuel leaves tank 16 in liquid phase. Champion is wrong. First, its arguments are based on its incorrect "gaseous fuel" claim construction positions. Second, it misunderstands what the state of the normally

gaseous fuel is in the various sections of the fuel delivery system, and third, it narrowly confines the “gaseous fuel source” as being just the tank.

153. First, as explained above, the “gaseous fuel” terms are properly understood to refer to components that interact with fuel that is in the gaseous state at standard temperature and pressure. Holzapfel discloses that the engine is configured to run on a normally gaseous fuel. *See* EX1008, 2:8-12 (describing the additional fuel supply as “a normally gaseous fuel” that “is compressed and thereby maintained in liquefied condition.”). Therefore, tank 16 is properly considered a “gaseous fuel source” regardless of the phase of the normally gaseous fuel inside the tank or when it exits the tank. Holzapfel itself describes the fuel as a “gaseous fuel” when it is in the tank. Holzapfel’s claim 2 discloses a “source of gaseous fuel” distinct from the gaseous fuel line (“means for introducing said gaseous fuel into said carbureter comprising a tube”). EX1008, Claim 2. Champion’s claim construction position therefore requires Holzapfel’s structure described as a “source of gaseous fuel” to not comprise a “gaseous fuel source.”

154. Second, even accepting Champion’s argument that tank 16 can only be considered a “gaseous fuel source” if the normally gaseous fuel exits the tank in gas phase, at least a portion of the fuel would be in gas phase upon exiting the tank, at least in part due to entrainment, flash vaporization, cavitation, heat transfer, and similar effects due to localized pressure or temperature changes. *Supra* §V.

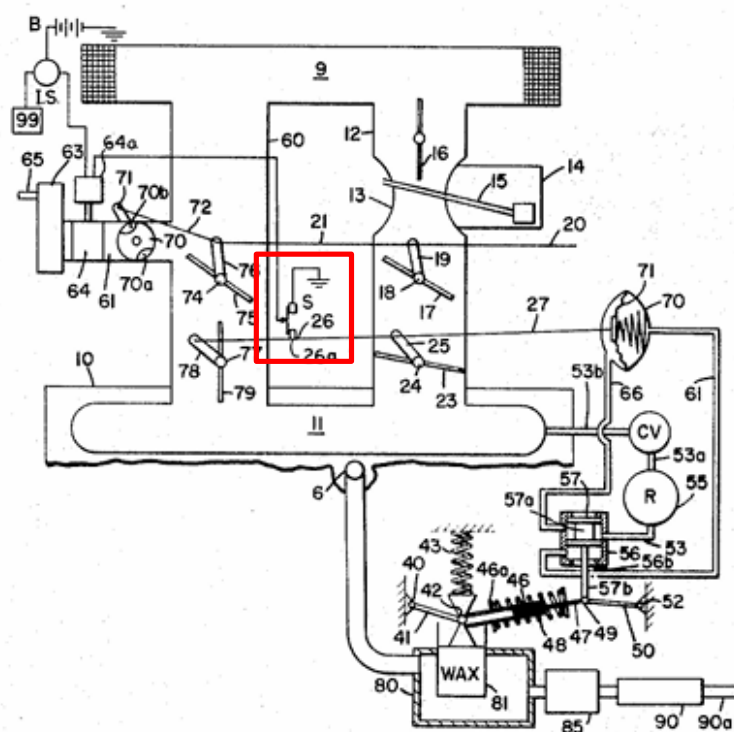
Regardless of where the fuel is drawn from the tank, it will flow into “gaseous fuel supply tube 17” as a mixture of gas phase and liquid phase fuel. Thus, even under Champion’s incorrect claim construction arguments, because tank 16 supplies fuel in gas phase, it is properly understood to be a “gaseous fuel source.”

155. Third, if, as Champion seems to incorrectly suggest in its claim construction arguments, the “gaseous fuel source” must *only* provide gaseous fuel in a gaseous state, the Board found in the ’034 Patent IPR that the tank combined with the heat exchanger 20 (vaporizer) would then constitute a “gaseous fuel source.” IPR2025-00805, Paper 24 at 30-32; *see also* POR, 65-66 (describing the vaporization of gaseous fuel into a gaseous state by these structures). The carburetor is connected to the output of the heat exchanger 20 (vaporizer) and thereby receives fuel in gas phase.

**D. Element 1.5**

156. Champion disputes whether it would have been obvious to combine Holzapfel’s dual fuel delivery teaching with Olmr’s solenoid valve teaching. Although Holzapfel’s valves are mechanically actuated, a POSA would have understood that the choice between mechanical and electrical actuation is a design choice with known benefits and drawbacks. For example, one benefit of electrical actuation is fast response times and precise control (which allows more precise air-to-fuel ratio, resulting in better control of engine-out emission).

157. A POSA would have had a reasonable expectation of success implementing a manual actuation system for Olmr's solenoid valve. For example, a POSA would have understood how to implement a power system, such as a battery or generator, to power an electrical actuation system and electrical valve. Automobiles contemporary to Holzapfel typically included a generator. A POSA would also have understood that Holzapfel's rod/wire could be coupled to an actuation system for a solenoid. For example, Walker discloses a system to actuate a solenoid switch S (controlling solenoid valve 64a) using a rod 27 similar to Holzapfel's rod/wire 47. EX1015, 2:13-32, FIG. 1.



EX1015, FIG. 1 (annotated).

158. Champion suggests that using electrical actuation might not be *net* beneficial given the “increased complexity and potential failures.” POR, 69-70. But simultaneous benefits and drawbacks of using a normally open valve do not teach away from the combination.

**E. Element 1.6**

159. Once again, Champion disputes whether a POSA would have been motivated to combine Holzapfel with Matsushima. Incorporating the generator of Matsushima to power electrical devices in the generator and/or external electrical devices would entail incorporating the voltage regulator of Matsushima so that the devices powered by the generator receive a consistent voltage.

**F. Claim 2**

160. As explained in my prior declaration, Holzapfel discloses a liquid fuel valve 9 positioned along the liquid fuel line.

161. Champion restrictively reads the “liquid fuel line” as referring to reference number 12 of Holzapfel and nothing else. But Champion’s position is undermined by the ’145 Patent. Specifically, the claim language indicates that the liquid fuel line “coupl[es] the liquid fuel source to the carburetor.”

162. Likewise, the written description states that liquid fuel line “provide[s] a flow path for first [liquid] fuel source 28 to carburetor 62.” EX1001, 11:13-16. A

POSA would have understood from these disclosures that the claimed fuel line includes the entire flow path from the fuel source to the carburetor, which is not limited to tubing. For example, a valve positioned in the middle of the liquid fuel line, as depicted in Figures 4A and 4B, does not bisect the flow path into two separate liquid fuel lines. The valve, along with the pipes/tubes on either side of the valve comprise a single fuel line.

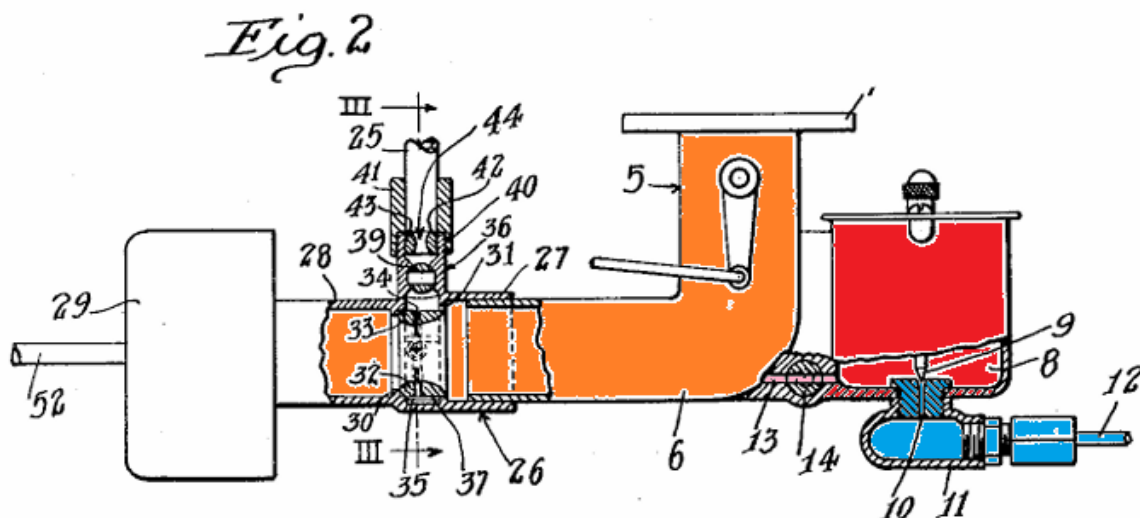
163. For example, the '145 Patent describes fuel inlet 59 as part of the gaseous fuel line 70. EX1001, 8:21-22, 8:5-7. Fuel inlet 59 includes the first end 50a of the quick-connect hose coupling, and the first end 50a includes a valve. *Id.*, 7:23-24, 10:54-56. Thus, the claimed “gaseous fuel line” refers not only to the conduit forming the second fuel line 70 but includes other structures such as valves and inlets along the way.

164. The coupling 50 comprises an inlet structure and is a distinct component from the LPG supply hose 30 and on-board tubing of the gaseous fuel line. Furthermore, coupling 50 is positioned at the end of the second fuel line 70.



comprises “not just the black hose, but all that bit that then goes into the carburetor.” EX2127, 156:4-5. Similarly, Dr. Singhose acknowledges that the fuel line may comprise a set of multiple structures, such as both LPG supply hose 36 and the on-board portion of the fuel line. EX1091, 72:10-18. The inlet connection and passage in Holzapfel comprise a part of the flow path to the carburetor.

168. Specifically, the '145 Patent discloses that the carburetor comprises a throat, float bowl, and fuel passage extending from the float bowl to the throat. *See* EX1001, Claim 15. Holzapfel describes the carburetor as comprising the float bowl 8 (red) and bent tube 6 (with a throat, orange). EX1008, 2:86-107. The carburetor also includes fuel passage 13 (pink) controlled by valve 14. Inlet connection 11 and passage 10 are components of the flow path/fuel line (blue) leading into carburetor 5. Needle valve 9 is positioned along (at the end of) that fuel line.



EX1008, FIG. 2 (annotated).

**G. Claim 6**

169. Once again, Champion disputes whether a POSA would have been motivated to combine Holzapfel with Matsushima. Using a liquid fuel cut-off solenoid would require incorporating an electrical actuation mechanism with an electrical switch, such as Olmr's switch. A POSA would have understood that the electrical switch could be coupled to Holzapfel's rod/wire, for example in an arrangement similar to Walker's switch. *Supra* §VIII.D. Incorporating the generator of Matsushima to power electrical devices in the generator such as the liquid fuel cut-off solenoid and corresponding switch would entail connecting the switch to Matsushima's generator so that it can receive power.

**H. Claim 8**

170. Champion disputes whether it would have been obvious to combine Holzapfel's dual fuel delivery teaching with Olmr's solenoid valve teaching. This argument is wrong. *Supra* §VIII.D.

171. The only argument Champion raises relating to whether the combination would result in a normally open valve is that "in the event the valve loses power ... gasoline [will] to flow to the engine" while operating on gaseous fuel. POR, 73-74. The normally open valve has the opposite benefit of allowing gasoline to flow to the engine as intended if the valve loses power while operating

on gasoline. Meanwhile, the leakage of liquid fuel in gaseous fuel operation is inherent to Claim 8's normally open valve disclosure. The '145 Patent does not disclose a non-obvious solution to the leakage problem, and the simultaneous benefits and drawbacks of using a normally open solenoid valve do not teach away from the combination.

**I. Claim 9**

172. Champion states that “Holzapfel’s engine does not actually need electrical power.” POR, 74. Internal combustion engines of the 1900s relied on either spark ignition (SI) or compression ignition (diesel). Because gasoline causes severe knocking under the high compression ratios of a compression ignition engine, it requires spark ignition to run properly. Since Holzapfel’s engine operates on gasoline from tank 15 (EX1008, 2:124-147), it must be a spark-ignition engine and therefore requires electrical power to produce the necessary spark. The electrical power may either come from a battery or mechanically driven generator (alternator or magneto) action (e.g. via a pull start). Either option would have had associated benefits and drawbacks, and choosing between the two options (or using both options in the same engine) would have been a matter of design choice for a POSA.

173. Furthermore, as explained with the Workshop Manual (*supra* §VI.G), Holzapfel’s dual fuel delivery system teaching is not limited to automobiles or large engines. Holzapfel’s teaching can be used with a “small” engine such as

Matsushima's engine. Some automobile engines in the 1900s were relatively small. For example, the Citroën 2CV featured engine displacements of just 375 cc and 435 cc throughout its production run from 1948 to 1990. EX1127. At least under those circumstances, it would be obvious to use a pull starter for improved reliability in cold and remote applications, and a POSA would have a reasonable expectation of success.

174. Even if bodily incorporation were required, automobile engines may be started using a recoil starter. Engines comparable in size to automobile engines can be pull-started. *See, e.g.*, EX1124. Historically, automobile engines were often started manually using a hand crank. EX1128.

**J. Claims 3-5, 7, 10, and 12-16**

175. Champion does not separately address Claims 3-5, 7, 10, and 12-16. Champion's arguments regarding Claims 1, 2, 6, and 11 are incorrect. Claims 3-5, 7, 10, and 12-16 are invalid for the reasons stated in my prior declaration.

**IX. CONCLUSION**

176. For at least the foregoing reasons, in my opinion, Claims 1-16 are invalid.

I hereby declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct, and that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I understand that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. § 1001).

Date: September 1, 2026

Respectfully submitted,



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Prof. Mahdi Shahbakhti