

U.S. Patent No. 10,393,034

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

Petitioners

v.

CHAMPION POWER EQUIPMENT INC.,

Patent Owner.

Patent No. 10,393,034

Issued: August 27, 2019

Title: FUEL SYSTEM FOR A MULTI-FUEL INTERNAL COMBUSTION
ENGINE

Inter Partes Review No. IPR2025-00805

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 10,393,034**

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EXHIBIT LIST

Exhibit No.	Description
1001	U.S Patent No. 10,393,034 to Collie et al. (“the ’034 Patent”)
1002	File History for U.S. Patent No. 10,393,034 (“the ’034 File History”)
1003	Declaration of Dr. Timothy Morse
1004	JPS61283734A (Original) (“Nakafushi”)
1005	Certified Translation of JPS61283734A (“Nakafushi”)
1006	Small Engine Technology, Second Edition, Schuster, William A, (1999) (“Schuster”)
1007	U.S. Patent No. 5,301,644 (“Olmr”)
1008	U.S. Patent No. 4,372,276 (“Bernhardsson”)
1009	U.S. Patent No 1,931,698 (“Holzapfel”)
1010	U.S. Patent Pub. No. 2011/0100335A1 (“Parlatore”)
1011	U.S. Patent Pub. No. 2014/0239645 (“Jungmann”)
1012	Kubota DF972-E2 Workshop Manual (“Workshop Manual”)
1013	Kubota DF972-E2 Operator’s Manual (“Operator’s Manual”)
1014	Declaration from Mr. James Strepek re Kubota Manuals
1015	Declaration from Mr. Scott Schlabach re Kubota Manuals

1016	<i>Auto Fuel Systems</i> . The Goodheart-Wilcox Company. James Duffy and Howard Smith. 1987. (“Duffy”)
1017	DuroMax Manual Next Generation Power Systems
1018	U.S. Patent No. 5,809,979 (“Tsuda”)
1019	Oxford Dictionary of Mechanical Engineering, Tony Atkins & Marcel Escudier, 2013.
1020	U.S. Patent No. 9,175,601 (“Markoski”)
1021	Tri-Fuel YouTube Video (https://www.youtube.com/watch?v=DpknaAPTQ9U) (“Tri-Fuel Video”)
1022	Declaration from Mr. John Ley re Tri-Fuel Video

CLAIM LISTING

Element	Claim Language
[1.0]	1. A multi-fuel engine comprising:
[1.1]	an engine operable on a liquid fuel and a gaseous fuel;
[1.2]	a carburetor attached to an intake of the engine to mix air and fuel and connect a liquid fuel source to the intake, the carburetor comprising a float bowl;
[1.3]	a liquid cutoff solenoid coupled to the carburetor to open and close a liquid fuel path to the engine downstream from the float bowl;
[1.4]	a gaseous cutoff coupled to open and close a gaseous fuel source to the engine; and
[1.5]	a switch selectively coupling a power source to the liquid cutoff solenoid to open and close the liquid fuel path.
[2.0]	The multi-fuel engine of claim 1; and
[2.1]	wherein the liquid cutoff solenoid is positioned on the liquid fuel path, which extends from the float bowl to a throat of the carburetor, to open and close the liquid fuel path; and
[2.2]	further wherein the gaseous cutoff solenoid ¹ couples the gaseous fuel source to the intake to control flow of the gaseous fuel to the engine.
3	The multi-fuel engine of claim 1 wherein the switch actuates the liquid cutoff solenoid to enable changing engine operation between the liquid fuel and the gaseous fuel, so as to prevent fuel flow from the liquid fuel source and the gaseous fuel source simultaneously and allow switching between fuel sources on-the-fly during engine operation.
4	The multi-fuel engine of claim 1 wherein the switch actuates the liquid cutoff solenoid to provide fuel overlap when

¹ Per the Certificate of Correction dated August 27, 2019. Ex. 1002, 1-3.

Element	Claim Language
	changing engine operation between the liquid fuel and the gaseous fuel.
5	The multi-fuel engine of claim 1 wherein the engine is a dual fuel engine that operates on gasoline from the liquid fuel source and LPG from the gaseous fuel source.
6	The multi-fuel engine of claim 1 wherein activating the gaseous cutoff simultaneously activates the liquid cutoff solenoid.
7	The multi-fuel engine of claim 1 wherein the liquid cutoff solenoid is selectively operable to cut off fuel flow from the float bowl to a nozzle in a venturi of the carburetor upstream from a throttle for the engine.
8	The multi-fuel engine of claim 1 wherein the carburetor connects the gaseous fuel source to the intake.
9	The multi-fuel engine of claim 1 further comprising a liquid fuel valve positioned on a liquid fuel line coupling the liquid fuel source to the carburetor to open and close the liquid fuel source to the engine.
10	The multi-fuel engine of claim 9 wherein the switch opens the liquid fuel valve to fill the float bowl with liquid fuel prior to actuating the liquid cutoff solenoid to open the liquid fuel path.
[11.0]	A multi-fuel generator and fuel delivery system comprising:
[11.1]	a multi-fuel internal combustion engine configured to operate on a liquid fuel supplied from a liquid fuel source through a liquid fuel line and a gaseous fuel supplied from a pressurized fuel source through a gaseous fuel line;
[11.2]	an alternator driven by the multi-fuel internal combustion engine;
[11.3]	a fuel regulator system comprising:
[11.4]	a primary pressure regulator coupled to a service valve of the pressurized fuel source to regulate fuel supplied from the pressurized fuel source to a reduced pressure, and

Element	Claim Language
[11.5]	a secondary pressure regulator coupled to the primary pressure regulator to regulate fuel supplied from the primary pressure regulator to a desired pressure for delivery through the gaseous fuel line to operate the engine; and
[11.6]	an electro-mechanical valve system coupled to the engine and operated by an electrical switch powered by one of the alternator, a battery, and a magneto that controls fuel flow to the engine from the liquid fuel source and the pressurized fuel source.
12	The multi-fuel generator and fuel delivery system of claim 11 wherein the electro-mechanical valve system is configured to switch operation of the generator from multiple fuel sources while the generator is running.
13	The multi-fuel generator and fuel delivery system of claim 11 wherein the electro-mechanical valve system is configured to prevent simultaneous delivery of the liquid fuel and the gaseous fuel to the engine.
[14.0]	The multi-fuel generator and fuel delivery system of claim 11 wherein the electro-mechanical valve system comprises:
[14.1]	a carburetor cutoff solenoid coupled to a carburetor to control liquid fuel flow to the engine, and
[14.2]	a gaseous fuel cutoff solenoid coupled to the gaseous fuel line to control flow of the gaseous fuel to the engine.
15	The multi-fuel generator and fuel delivery system of claim 14 further comprising a liquid fuel cutoff solenoid coupled to the liquid fuel line to control flow of the liquid fuel to the carburetor.
16	The multi-fuel generator and fuel delivery system of claim 11 wherein the pressurized fuel source comprises a pressurized fuel container located off-board the generator having a regulator mounting device to secure at least the secondary pressure regulator thereto. –

Element	Claim Language
17	The multi-fuel generator and fuel delivery system of claim 11 wherein a dual stage pressure regulator comprises the primary pressure regulator and the secondary pressure regulator.
[18.0]	A multi-fuel internal combustion engine comprising:
[18.1]	an engine operable on liquid fuel supplied through a liquid fuel line from a liquid fuel source and gaseous fuel supplied through a gaseous fuel line from a pressurized fuel source;
[18.2]	a carburetor coupled to an intake of the engine to mix air and fuel and connect to the liquid fuel line and the gaseous fuel line;
[18.3]	a carburetor cutoff solenoid coupled to control fuel flow within the carburetor from the liquid fuel line and selectively engage engine operation on liquid fuel; and
[18.4]	a gaseous fuel valve coupled to control fuel flow through the gaseous fuel line and selectively engage engine operation on gaseous fuel.
19	The multi-fuel internal combustion engine of claim 18 wherein the gaseous fuel valve comprises a gaseous fuel cutoff solenoid.
20	The multi-fuel internal combustion engine of claim 19 further comprising a switch to change operation of the engine from liquid fuel to gaseous fuel and from gaseous fuel to liquid fuel while the engine is running.
21	The multi-fuel internal combustion engine of claim 20 wherein the switch institutes a predefined delay between actuating the carburetor cutoff solenoid and the gaseous fuel cutoff solenoid.
22	The multi-fuel internal combustion engine of claim 20 wherein the switch operates the carburetor cutoff solenoid and the gaseous fuel cutoff solenoid to substantially prevent simultaneous fuel delivery of the liquid fuel and the gaseous fuel to the engine.

Element	Claim Language
23	The multi-fuel internal combustion engine of claim 20 wherein the gaseous fuel cutoff solenoid and the carburetor cutoff solenoid operate as normally closed solenoid valves.
[24.0]	The multi-fuel internal combustion engine of claim 18 further comprising:
[24.1]	an alternator driven by the engine to form a generator; and
[24.2]	a fuel regulator system located off-board the generator and comprising:
[24.3]	a primary pressure regulator coupled to a service valve of the pressurized fuel source to regulate the fuel supplied from the pressurized fuel source to a reduced pressure, and
[24.4]	a secondary pressure regulator coupled to the primary pressure regulator to regulate the gaseous fuel supplied from the primary pressure regulator to a desired pressure for delivery through the gaseous fuel line to operate the engine.

Harbor Freight Tools USA, Inc., Generac Power Systems, Inc., and MWE Investments, LLC, (“Petitioners”) petition for *Inter Partes* Review (“IPR”) under 35 U.S.C. §§311-319 and 37 C.F.R. §42 of Claims 1-24 (“the Challenged Claims”) of U.S. Patent No. 10,393,034 (“the ’034 Patent”). This Petition establishes a reasonable likelihood that Petitioners will prevail in showing at least one of the Challenged Claims is unpatentable. Petitioners respectfully request that this IPR be instituted, and that the Challenged Claims be canceled as unpatentable.

I. STANDING AND RELIEF REQUESTED

Petitioners certify that the ’034 Patent is available for IPR. Petitioners are not barred or estopped from requesting this review, and request IPR of the Challenged Claims on the grounds set forth below.

Ground	’034 Patent Claims	Basis for Rejection
Ground 1	1-3, 5-9, and 18	§103 over Nakafushi in view of Olmr
Ground 2	4 and 10	§103 over Nakafushi in view of Olmr and Duffy
Ground 3	19-23	§103 over Nakafushi in view of Olmr and Bernhardsson and/or Duffy
Ground 4	11-13 and 16-17	§103 over Nakafushi in view of Jungmann and Parlatore
Ground 5	14-15 and 24	§103 over Nakafushi in view of Jungmann and Parlatore, with Olmr and/or Bernhardsson

Ground	'034 Patent Claims	Basis for Rejection
Ground 6	1-3, 5-9, 11-14, 17-20, and 22-23	§102 over the Kubota DF972 Workshop Manual
Ground 7	4	§103 over the Kubota DF972 Workshop Manual in view of Duffy
Ground 8	16 and 24	§103 over the Kubota DF972 Workshop Manual in view of Parlatore and/or the Tri-Fuel Video

This Petition explains how the claims are unpatentable under the statutory grounds identified, identifying where each element can be found in the cited prior art and how the prior art renders the Challenged Claims unpatentable. The Petition is further supported by the declaration of Dr. Timothy Morse, an expert in the field of dual-fuel engines and fuel delivery systems. Ex. 1003, ¶¶1-32.

II. STATE OF THE ART

A. Carburetors

A carburetor is a device that supplies an air-fuel mixture to a spark-ignition engine. The diagram below shows a carburetor's basic elements.

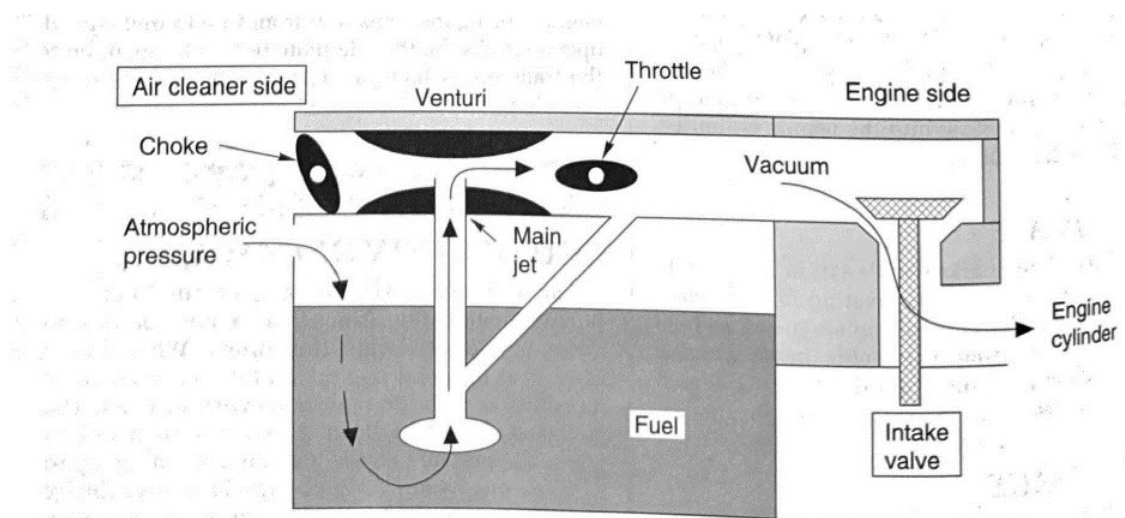


Fig. 4-7 Choke system. (Courtesy of William A. Schuster)

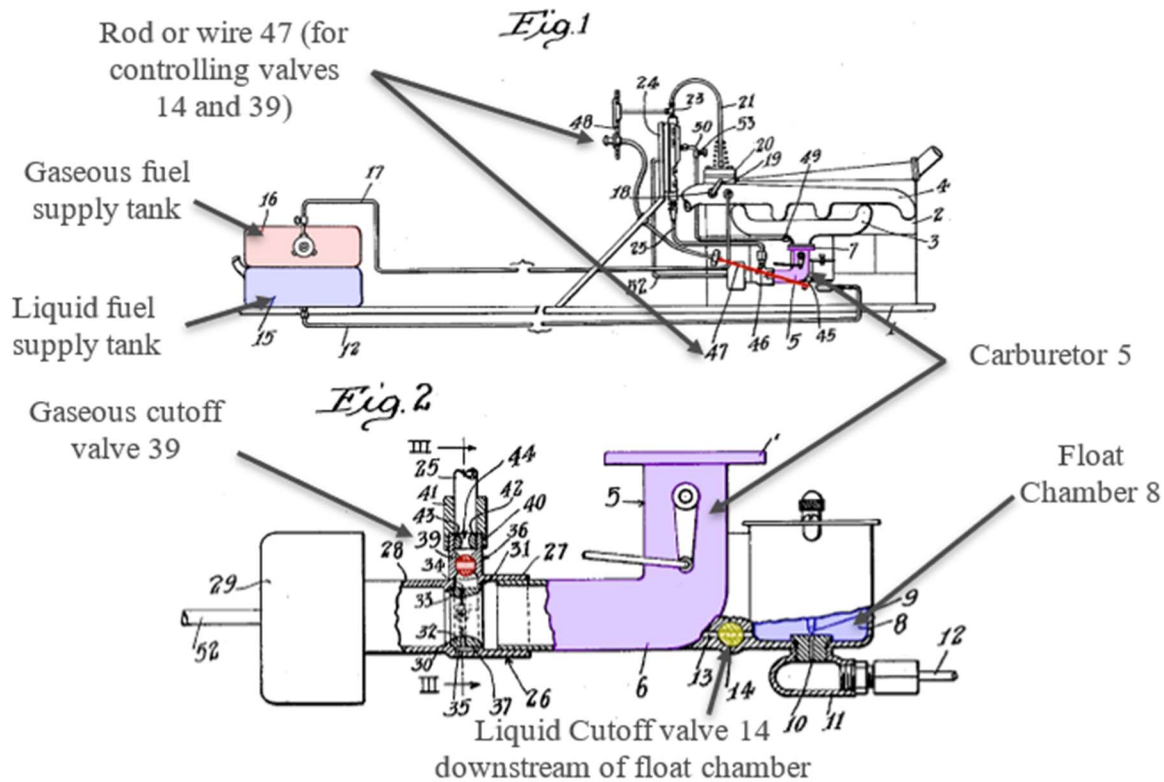
Ex. 1006, 8.

A carburetor induces air flow through a venturi, a shape that is wider at the ends and narrower in the middle. When air flows through the venturi, the velocity increases and pressure decreases through the narrow portion (the “Venturi effect”), which pulls fuel from the float bowl/chamber through the main jet and mixes it with air. The choke controls air in-flow, while the throttle controls the outflow of the air/fuel mixture to the engine. Ex. 1003, ¶¶33-34.

B. Multi-Fuel Combustion Engines

Dual-fuel engines running alternatively on liquid or gaseous fuels have been known for nearly 100 years. For example, U.S. Patent No. 1,931,698 (“Holzapfel”) was filed in 1931 and discloses “a fuel system embodying the supplying of liquid fuel and gaseous fuel to an engine in alternation at will.” Ex.

1009, 1:1-42. A “rod or wire 47” controls both the liquid and gaseous valves, as seen in Holzapfel’s Figures 1 and 2 below (annotated):



Ex. 1003, ¶¶35-36.

Notably, Holzapfel’s liquid cutoff 14 is located downstream from the carburetor float chamber 8. Ex. 1009, 1:100-107, Fig. 2.

C. Switches and Solenoids

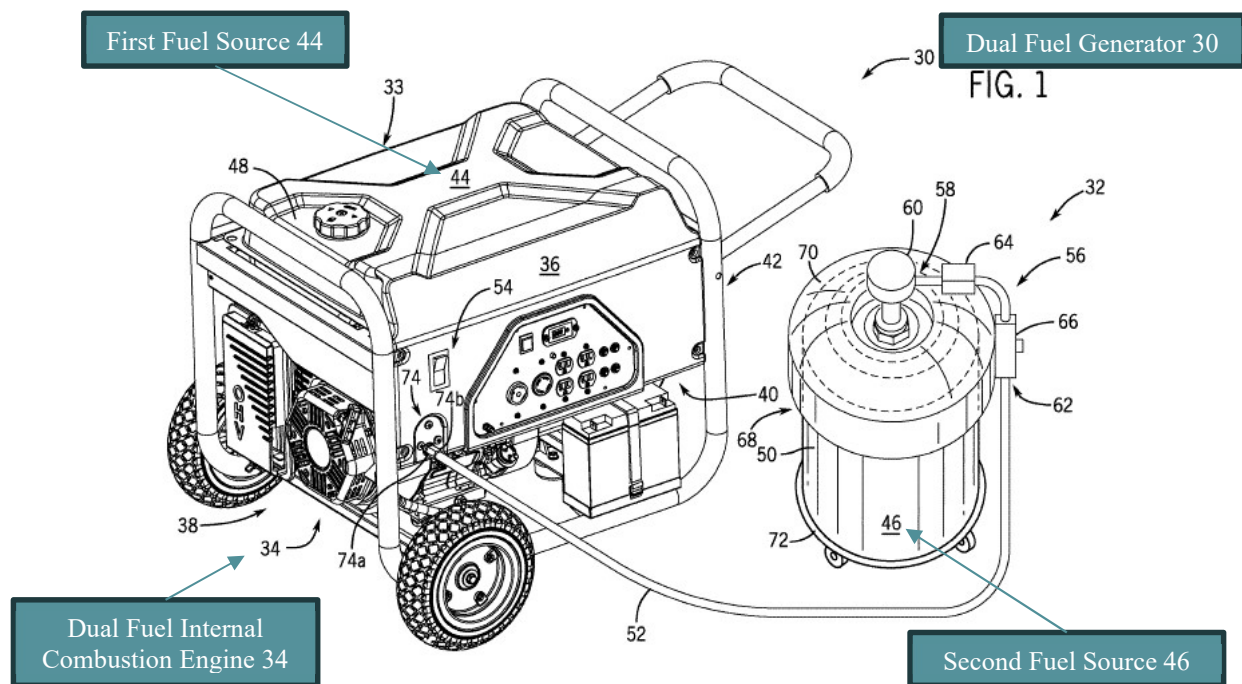
A solenoid valve is a type of electro-mechanical valve. It uses a wire coil to generate a magnetic field when energized, which can be controlled by an electrical switch. The magnetic field moves a piston to open or close the valve. Solenoid valves are widely used in a range of fluid control applications, including the

control of fuel flow in an engine. In carbureted engines, solenoid valves are commonly used downstream of the float chamber to control/cut off the flow of fuel, and have been known for decades. Ex. 1003, ¶37.

III. SUMMARY OF THE '034 PATENT

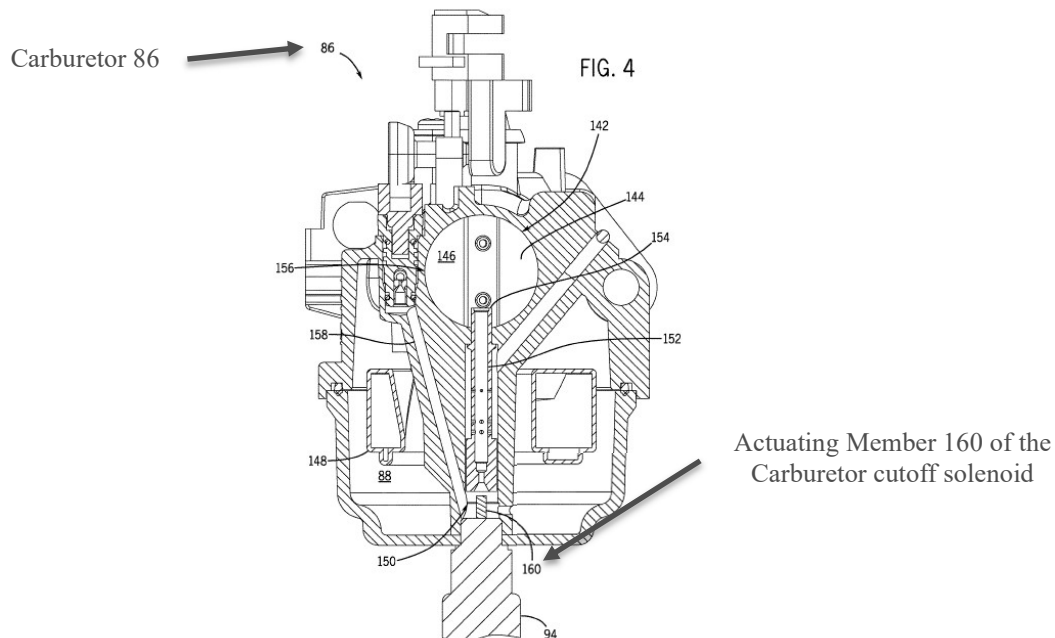
A. The '034 Patent

The '034 Patent discloses multi-fuel internal combustion engines/generators operable on liquid or gaseous fuels. Ex. 1001, 1:16-20. Figure 1 discloses a generator with such an engine:



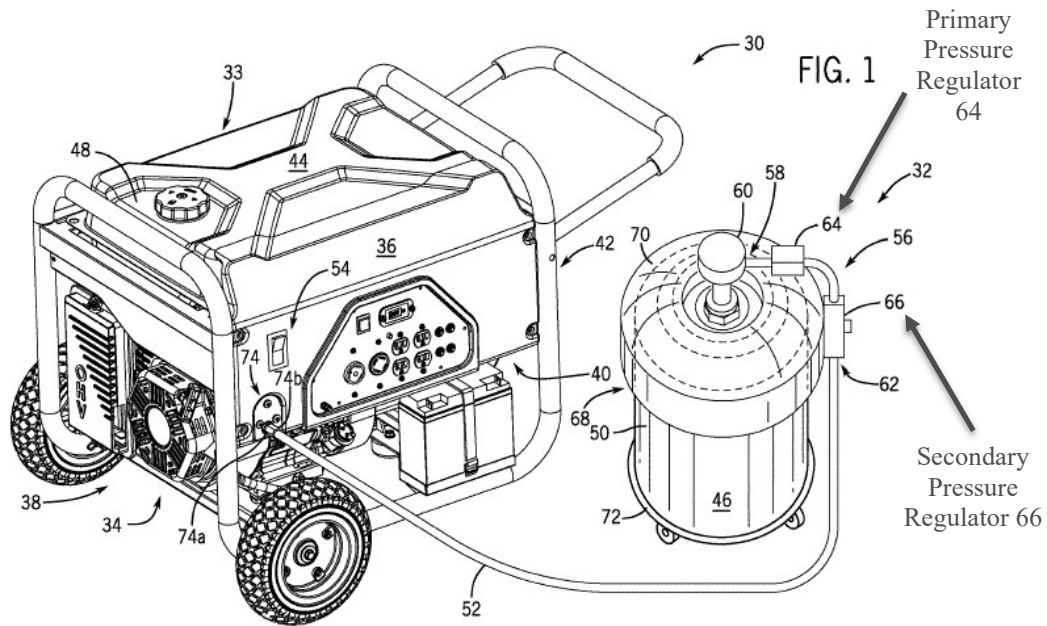
The '034 Patent states that switching fuel sources in conventional multi-fuel engines can cause overly rich air-fuel ratios and unstable operating conditions when both liquid and gaseous fuels are fed to the engine. *Id.*, 1:56-2:6. The '034

Patent purports to solve this problem by implementing a switch that powers cutoff solenoids for controlling liquid and gaseous fuel flow. *Id.*, 2:15-23. The '034 Patent also locates a gasoline cutoff downstream of the float bowl to prevent excess gasoline from passing to the engine, as depicted in Figure 4:



Id., 11:55-59.

The '034 Patent further discloses two pressure regulators in the gaseous fuel line to regulate the gaseous fuel pressure for delivery to the engine, shown in Figure 1:



Id., 4:7-45 (annotated).

B. Prosecution History

The '034 Patent is part of a family that includes at least twelve U.S. patents and/or pending applications.² The '034 Patent issued from U.S. Application No. 15/285,215 (“the '215 Application”), filed on October 4, 2016, claiming priority to two prior applications: U.S. Application No. 14/925,441 (“the '441 Application”), filed on October 28, 2015, and U.S. Application No. 14/738,060 (“the '060 Application”), filed on June 12, 2015. The '215 Application was a continuation-in-part of the '441 Application, which was, in turn, a continuation-in-part of the '060

² Other family members include U.S. Patent App. Nos. 14/738,060, 14/925,441, 15/332,264, 16/946,438, 15/285,215, 16/358,822, 16/946,439, 16/783,455, 17/937,046, 18/183,734, and 18/443,487.

Application. For purposes of this Petition only, Petitioners will treat the effective priority date of the '034 Patent as June 12, 2015.

The '034 Patent's prosecution history includes multiple rejections and amendments. The Examiner primarily relied on U.S. Patent No. 4,489,669 ("Poehlman"), U.S. Publication No. 2004/0139943 ("Kern") and U.S. Patent No. 5,450,832 ("Graf") to reject the pending claims, prior to allowing the '215 Application after the Applicant made several amendments. Ex. 1002, 25-32, 35-40, 68-105, 119-135, 221-237.

1. Distinguishing Poehlman's Liquid and Gaseous Cutoff Solenoids

The Examiner asserted that, *inter alia*, Poehlman disclosed liquid and gaseous cutoffs (Ex. 1002, 142-145), but Applicant argued Poehlman did not disclose valves that are *solenoids* (*id.*, 73-74). The Examiner subsequently argued that using solenoids in Poehlman would have been obvious in view of Walker (U.S. Patent No. 4,489,699). *Id.*, 47. The Examiner concluded it would have been obvious to combine Poehlman with Walker to "minimize the connective elements of an electromechanical control for each fuel cutoff...." *Id.*, 48.

In a final amendment, the Applicant added limitations requiring the liquid cutoff solenoid be located "downstream from the float bowl" and/or "within the carburetor":

1. (Currently Amended) A multi-fuel engine comprising:
an engine operable on a liquid fuel and a gaseous fuel;
a carburetor attached to an intake of the engine to mix air and fuel and connect a liquid fuel source to the intake, the carburetor comprising a float bowl;
a liquid cutoff solenoid coupled to the carburetor to open and close a liquid fuel path to the engine downstream from the float bowl;
a gaseous cutoff ~~solenoid~~ coupled to open and close a gaseous fuel source to the engine; and
a switch selectively coupling a power source to the liquid cutoff solenoid to open and close the liquid fuel path ~~and the gaseous cutoff solenoid to switch between fuel sources on the fly during engine operation.~~

20. (Currently Amended) A multi-fuel internal combustion engine comprising:
an engine operable on liquid fuel supplied through a liquid fuel line from a liquid fuel source and gaseous fuel supplied through a gaseous fuel line from a pressurized fuel source;
a carburetor coupled to an intake of the engine to mix air and fuel and connect to the liquid fuel line and the gaseous fuel line;
~~a switch to change operation of the engine from liquid fuel to gaseous fuel and from gaseous fuel to liquid fuel while the engine is running;~~

a ~~liquid fuel~~carburetor cutoff solenoid coupled to control fuel flow within the carburetor from through the liquid fuel line and selectively engage engine operation on liquid fuel; ~~upon actuation of the switch from gaseous fuel to liquid fuel;~~ and
a gaseous fuel ~~cutoff solenoid~~valve coupled to control fuel flow through the gaseous fuel line and selectively engage engine operation on gaseous fuel ~~upon actuation of the switch from liquid fuel to gaseous fuel.~~

Id., 28, 30-31. The Examiner allowed these amended claims (which issued as Claims 1 and 18), reasoning:

The Amendment overcomes the prior art rejection because neither Poehlman nor Walker teaches a liquid cutoff solenoid ***coupled to the carburetor downstream from the float bowl***, as well as a switch to selectively couple a power source to the liquid cutoff solenoid to open and close the liquid fuel path.

Id., 16 (emphasis added).

2. Distinguishing Kern and Graff's Pressure Regulators

The Examiner asserted that Kern taught the claimed engine/generator arrangement and relied on Graf as teaching the remaining elements of pending claim 13, which included “primary” and “secondary” pressure regulators:

13. A multi-fuel generator and fuel delivery system comprising:
a multi-fuel internal combustion engine configured to operate on a liquid fuel supplied from a liquid fuel source through a liquid fuel line and a gaseous fuel supplied from a pressurized fuel source through a gaseous fuel line;
an alternator driven by the multi-fuel internal combustion engine;
a fuel regulator system comprising:
a primary pressure regulator coupled to a service valve of the pressurized fuel source to regulate fuel supplied from the pressurized fuel source to a reduced pressure, and
a secondary pressure regulator coupled to the primary pressure regulator to regulate fuel supplied from the primary pressure regulator to a desired pressure for delivery through the gaseous fuel line to operate the engine; and
an electro-mechanical valve system coupled to the engine and operated by an electrical switch powered by one of the alternator, a battery, and a magneto that controls fuel flow to the engine from the liquid fuel source and the pressurized fuel source.

Id., 373.

The Applicant distinguished Graf as not disclosing (1) a primary pressure regulator and (2) an electro-mechanical valve system... that controls fuel flow to the engine *from the liquid fuel source* and the pressurized fuel source.” *Id.*, 91. The Examiner ultimately allowed this claim, which issued as Claim 11.

IV. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art (hereinafter “POSA”) would “be aware of all the pertinent prior art” at the time of the alleged invention (*Custom Accessories, Inc. v. Jeffrey-Allan Indus.*, 807 F.2d 955, 963 (Fed. Cir. 1986)), including specialized knowledge applicable to various aspects of the claimed invention. *See, e.g., AVX Corp. v. Greatbatch, Ltd.*, IPR2014-00697, Paper 60 at 3 (P.T.A.B. Jan. 11, 2016). A POSA is also a person of ordinary creativity, not an automaton, and thus is able to make inferences from the art. *KSR Int’l Co. v. Teleflex*, 550 U.S. 398, 420-21 (2007).

For purposes of this IPR, a POSA would have a college degree in mechanical engineering, physics, or related fields, and three years of work experience in combustion engines operating on various fuel sources. Ex. 1003, ¶¶31, 49-50. Additional higher graduate education could substitute for work experience, and additional work experience/training could substitute for formal education. *Id.* For example, a person having significant experience servicing or

operating dual-fuel combustion engines, or incorporating such engines into their finished products, would qualify as a POSA. *Id.*

V. CLAIM CONSTRUCTION

The Board construes claims under the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (*en banc*). 37 C.F.R. §42.100(b). Under this standard, claim terms should be given their plain and ordinary meaning as understood by a POSA and the prosecution history. Petitioners have not identified any claim terms that need construction in order to address the issues raised by this Petition, but Petitioners reserve the right to respond to any constructions offered by Patent Owner or the Board.

VI. OVERVIEW OF ASSERTED PRIOR ART

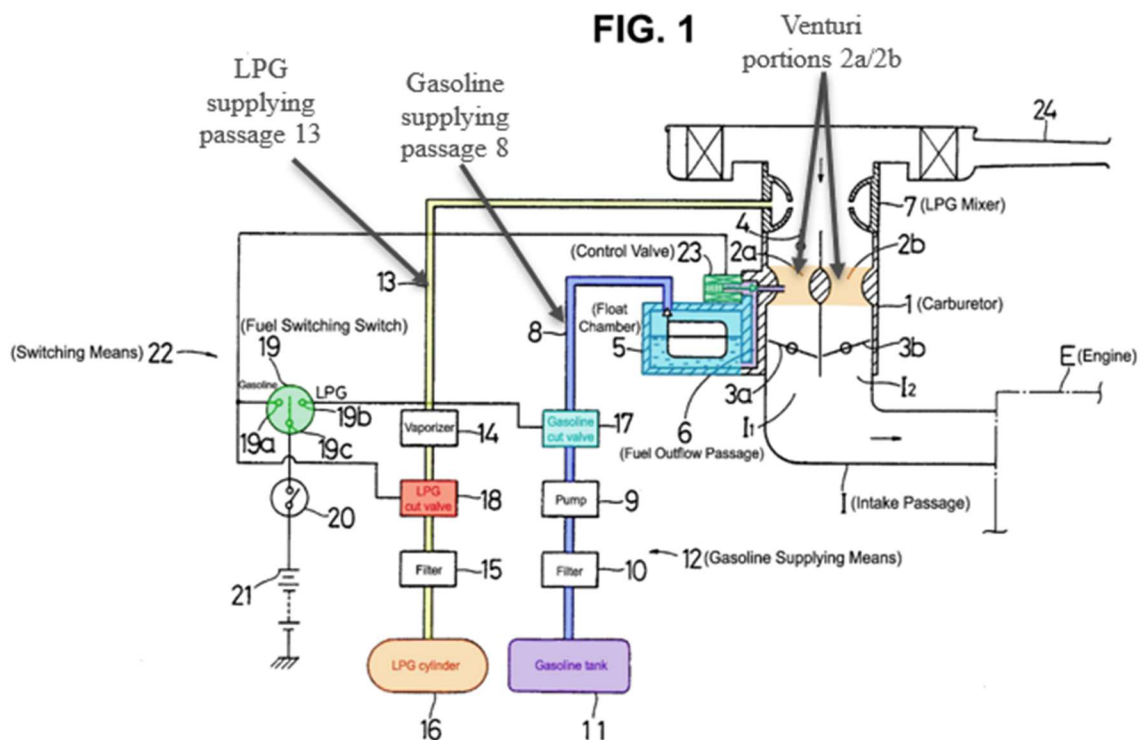
A. JPS61283734A (“Nakafushi”) (Ex. 1004/1005)

Nakafushi (Ex. 1004 (original); Ex. 1005 (certified translation)) was filed on June 7, 1985, and published on December 13, 1986. Nakafushi is thus prior art to the '034 Patent under 35 U.S.C. §102(a).

Nakafushi is directed to an engine configured to selectively use gasoline or liquid petroleum gas (“LPG”) as fuel. Ex. 1005, ¶[0001]. Nakafushi notes that when engine operation is switched from gasoline to LPG, a residual amount of gasoline remains in the float chamber (i.e., float bowl) and gets mixed with the LPG, resulting in over-rich air-to-fuel ratio. *Id.*, ¶¶[0003]-[0004]. Also, because

the residual gasoline is drained from the float chamber, when the engine is switched back to gasoline, gasoline delivery is delayed until the level of gasoline in the float chamber recovers. *Id.*, ¶[0004]. During this delay, the air-to-fuel ratio becomes over-lean. *Id.* Nakafushi solves these problems by including a control valve 23 **downstream of the float chamber** to prevent it from being emptied of gasoline when switching to LPG operation. *Id.*, ¶¶[0006]-[0007].

Nakafushi discloses a carburetor 1 having venturi portions 2a and 2b and an intake passage I, as seen below:



Id., ¶[0010], Fig. 1 (annotated); Ex. 1003, ¶53. Gasoline is stored in tank 11 and pumped to float chamber 5 through gasoline supply passage 8, which is opened

and closed by gasoline cut valve 17. Ex. 1005, ¶¶[0012]-[0013]. Gasoline in the float chamber 5 is sucked into the venturi portions 2a and 2b through a fuel outflow passage 6. *Id.*, ¶[0010]. Control valve 23 opens and closes the fuel outflow passage 6, thus controlling gasoline flow from the float chamber 5 to the intake I. *Id.*, ¶[0014].

Separately, LPG is stored in cylinder 16, and travels to LPG mixer 7 in the carburetor through LPG supply passage 13, which is opened and closed with LPG cut valve 18. *Id.*, ¶¶[0011]-[0013].

Nakafushi discloses a fuel switching switch 19 that controls which fuel is fed to the engine. *Id.*, ¶¶[0013]-[0014]. When switch 19 is set to the gasoline side contact 19a: (1) LPG cut valve 18 closes to block the LPG supply; (2) gasoline cut valve 17 opens to allow gasoline flow through passage 8 to the carburetor float chamber; and (3) control valve 23 opens to allow gasoline flow from the float chamber to the intake. *Id.*

Conversely, when the switch 19 is set to the LPG side contact 19b: (1) gasoline cut valve 17 and control valve 23 are closed to block the flow of gasoline; and (2) LPG cut valve 18 is opened, allowing LPG to flow through passage 13 to the carburetor mixer 7. *Id.*

Closing control valve 23, which is downstream of the float chamber, prevents residual gasoline from exiting the float chamber when switching to LPG

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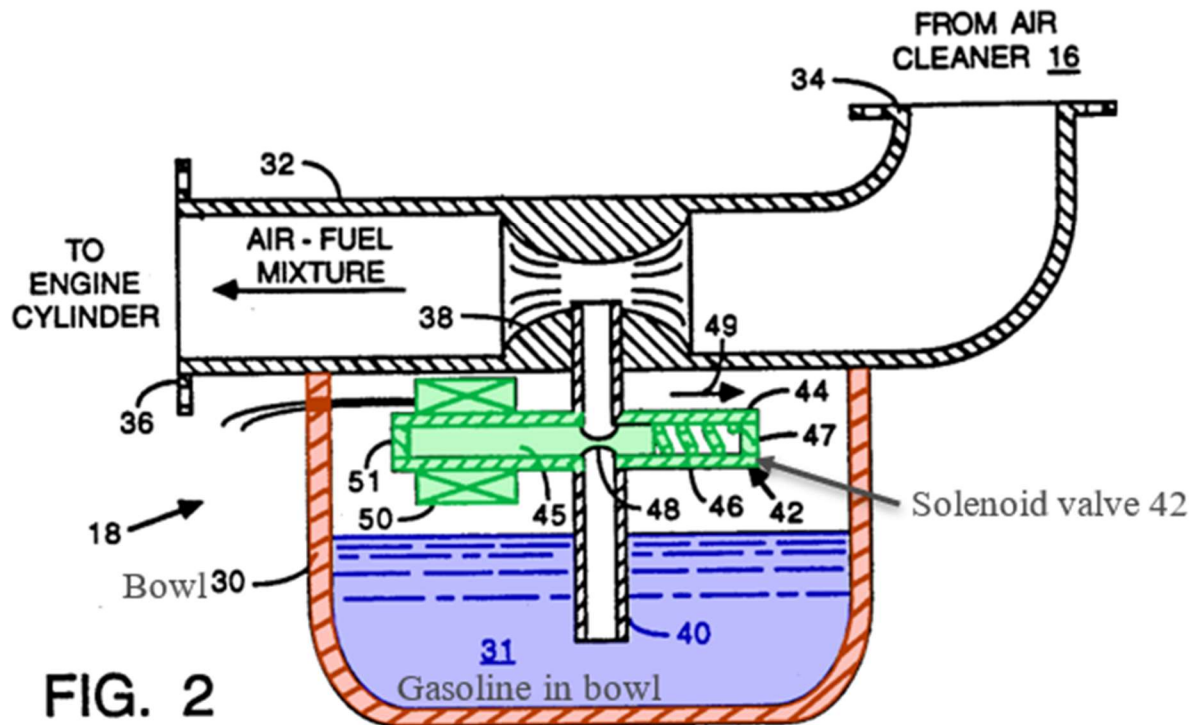
operation. *Id.*, ¶[0014], Fig. 1. Because gasoline is not drained from the float chamber, that gasoline is more readily available to fuel the engine upon switching back to gasoline operation. *Id.*

Nakafushi thus addresses the alleged “problems” identified by the ’034 Patent, and discloses the same solution claimed in the ’034 Patent some 30 years earlier. Ex. 1003, ¶¶52-59.

B. U.S. Patent No. 5,301,644 (“Olmr”)

Olmr (Ex. 1007) was filed on June 16, 1993, and issued on April 12, 1994. Olmr is thus prior art to the ’034 Patent under 35 U.S.C. §102(a).

Olmr teaches locating a solenoid valve within the float bowl 30 of the carburetor. Ex. 1007, 1:33-48, 2:30-42, Fig. 2. Specifically, solenoid valve 42 “provide[s] a mechanism for cutting off the supply of fuel to an internal combustion engine when the engine is being stopped,” as seen in Olmr’s Figure 2:

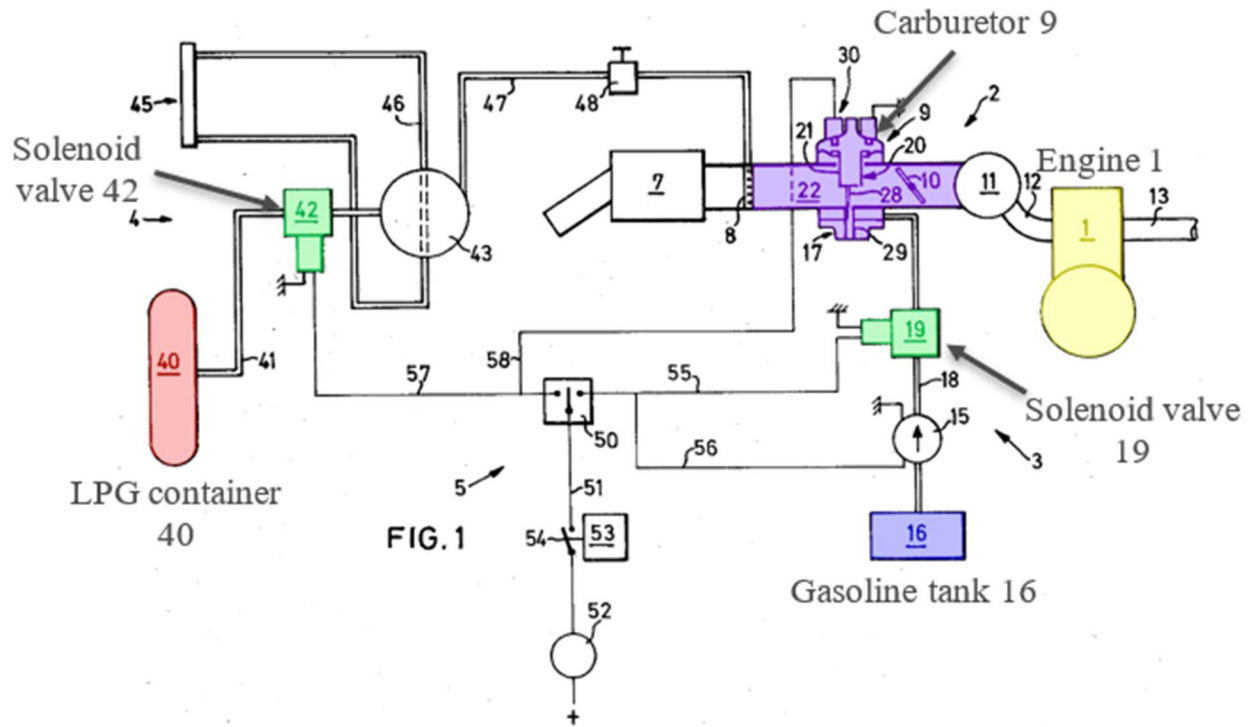


Id., 1:33-37 (annotated); Ex. 1003, ¶60.

C. U.S. Patent No. 4,372,276 (“Bernhardsson”)

Bernhardsson (Ex. 1008) was filed on June 13, 1980, and issued on February 8, 1983. Bernhardsson is thus prior art to the '034 Patent under 35 U.S.C. §102(a).

Bernhardsson is directed to an arrangement for switching engine operation between liquid fuel (e.g., gasoline) and gaseous fuel (e.g., LPG). *Id.*, 1:6-21 (referring to gasoline as “petrol” and LPG as “LP gas”). Bernhardsson discloses solenoid valves 19 and 42 for regulating the flow of gasoline and LPG to the carburetor, as seen in Bernhardsson’s Figure 1:



Id., Fig. 1 (annotated). Bernhardsson thus discloses the use of liquid and gaseous cutoff *solenoids* for cutting liquid and gas fuel flow, as claimed more than 30 years later in the '034 Patent. Ex. 1003, ¶¶61-62.

D. U.S. Patent Pub. No. 2011/0100335A1 (“Parlatore”)

Parlatore (Ex. 1010) was filed on November 5, 2009, and published on May 5, 2011. Parlatore is thus prior art to the '034 Patent under 35 U.S.C. §102(a).

Parlatore discloses various fuel delivery system embodiments, including one with a propane tank, a first regulator coupled to the tank, and a second regulator connected to the first regulator, all located remote/off-board from the engine/generator, as depicted in Parlatore’s Figures 1 and 3:



Fig. 1

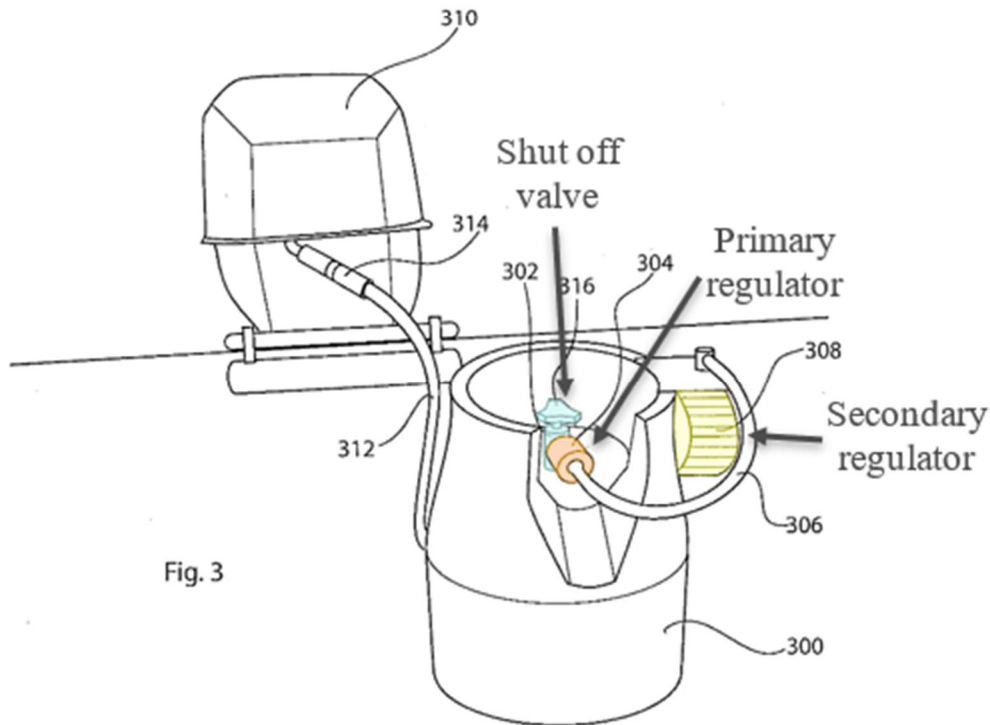


Fig. 3

Id., ¶¶[0005]-[0006], Figs. 1, 3 (annotated). Parlatore thus discloses the use of off-board primary and secondary pressure regulators delivering gaseous fuel to an engine/generator. Ex. 1003, ¶¶63-64.

E. U.S. Patent Pub. No. 2014/0239645 (“Jungmann”)

Jungmann (Ex. 1011) was filed on February 28, 2013, and published on August 28, 2014, before the earliest priority date (i.e., June 15, 2015). Jungmann is prior art to the '034 Patent under 35 U.S.C. §102(a).

Jungmann discloses a generator comprising an alternator driven by an internal combustion engine, with the engine operable on gaseous fuels (propane, natural gas) or liquid fuels (gasoline, diesel), shown in Figure 3:

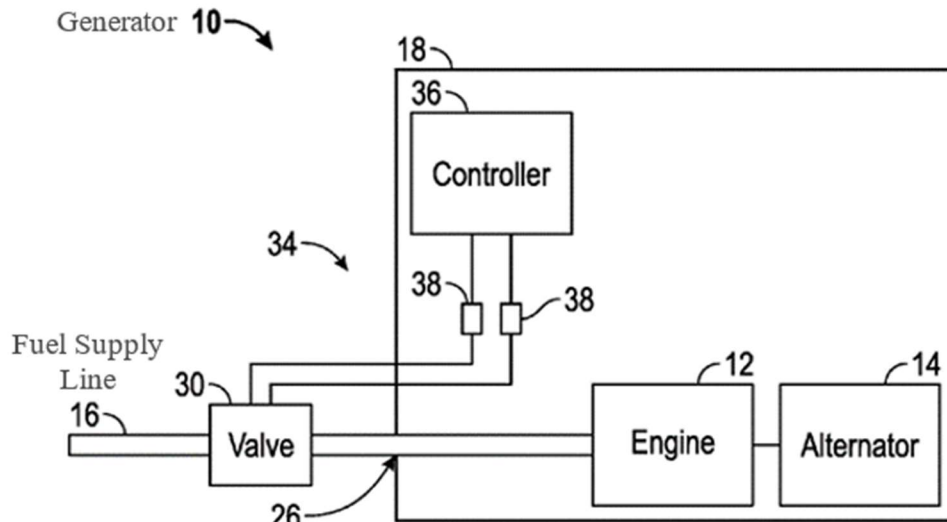


FIG. 3

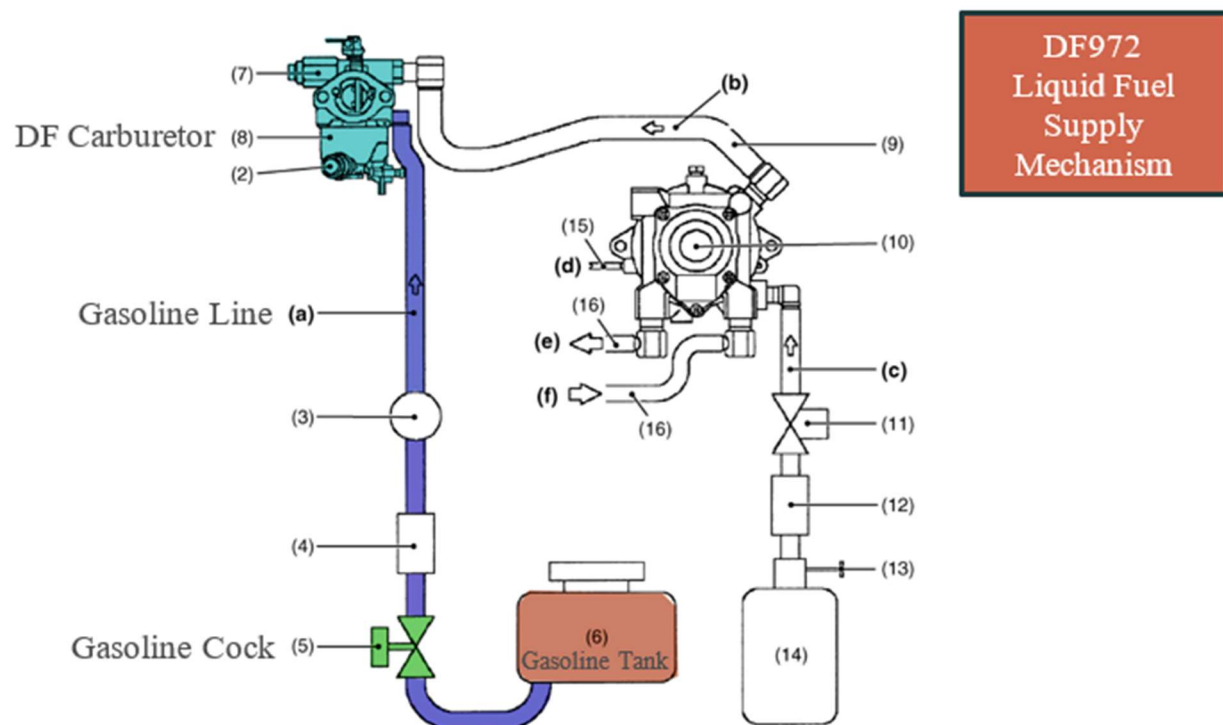
Id., Abstract, ¶¶[0002], [0015]. Jungmann thus discloses an engine that uses liquid or gaseous fuels in a generator. Ex. 1003, ¶65.

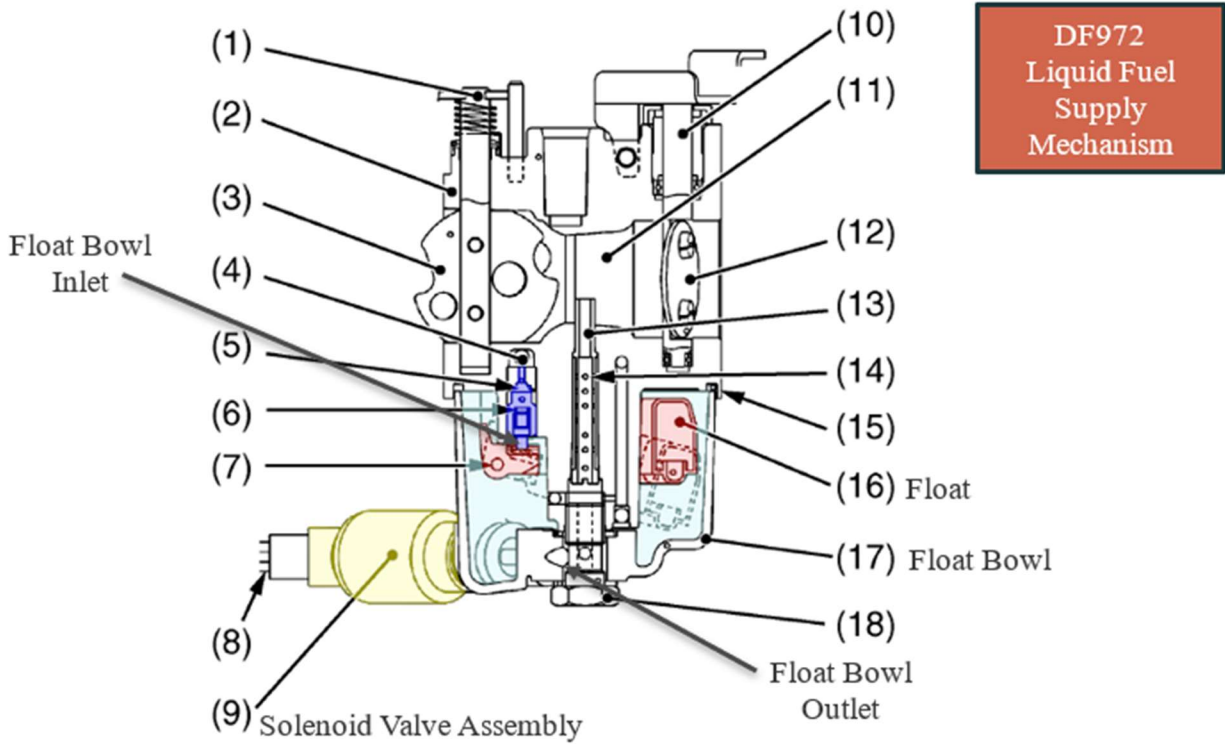
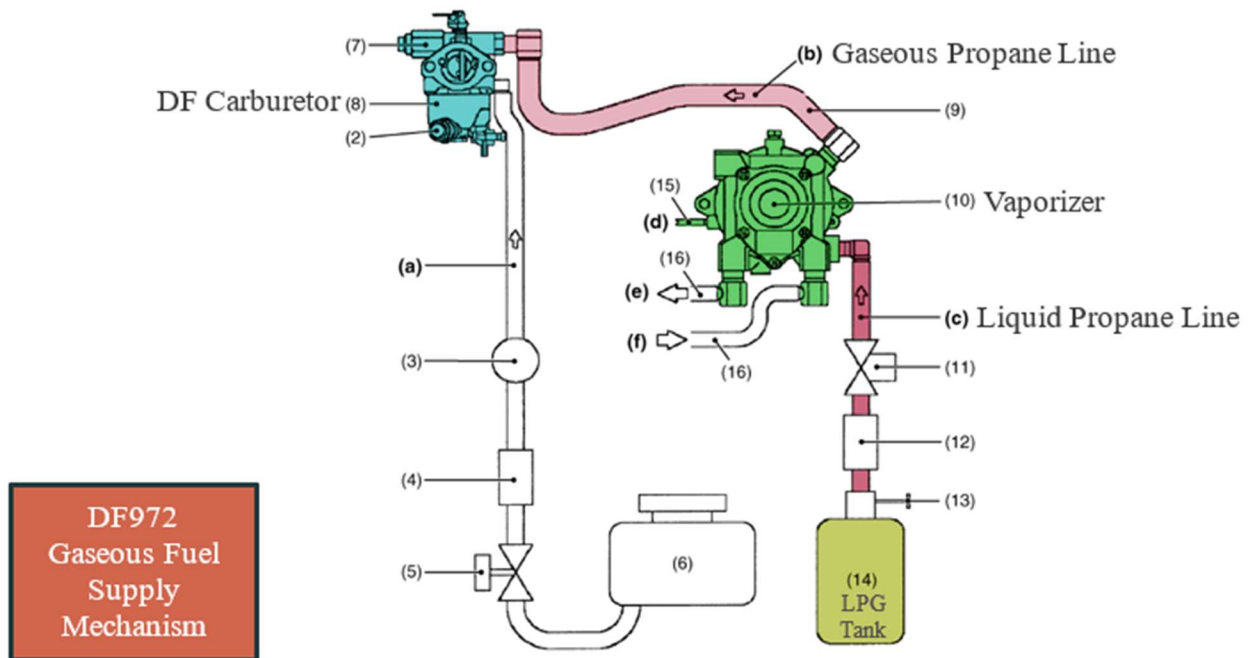
F. Kubota DF972-E2 Workshop Manual (“Workshop Manual”)

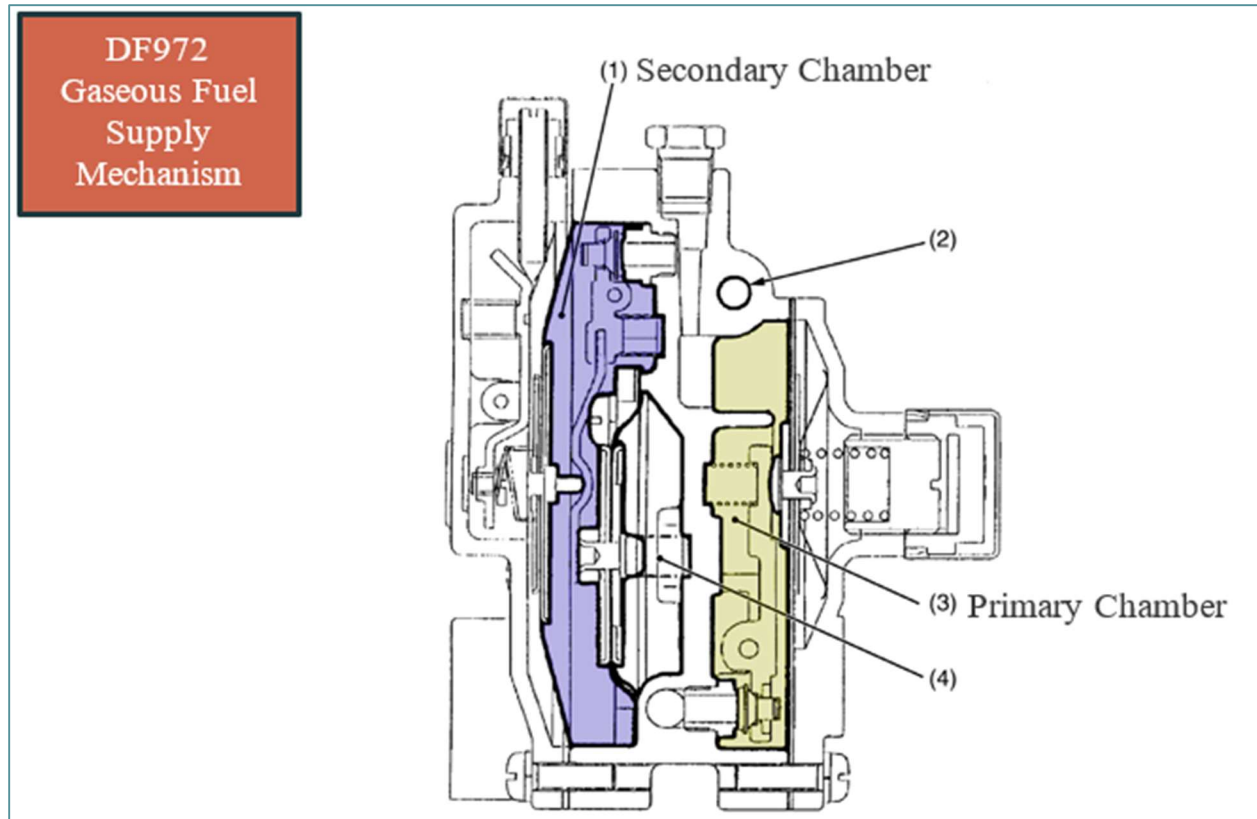
The Workshop Manual (Ex. 1012) was published/publicly available at least by June 2009 (Ex. 1014, ¶¶4-10; Ex. 1015, ¶¶4-14), before the earliest priority date (i.e. June 12, 2015). Specifically, the Workshop Manual is a public, non-confidential document that was publicly accessible to purchasers, end-users, and service personnel working on Kubota DF-972 engines, through their exercise of reasonable diligence (e.g., requesting a copy directly from Kubota, obtaining a

copy from a Kubota service center, etc.). *Id.* The Workshop Manual was created for dissemination to the interested public to provide instructions about how to safely assemble/disassemble, maintain, and service the DF-972 engine, and is prior art to the '034 Patent under 35 U.S.C. §102(a). *Weber, Inc. v. Provisur Technologies, Inc.*, 92 F.4th 1059, 1067-69 (Fed. Cir. 2024).

The Workshop Manual describes the Kubota DF972-E2 engine—a dual-fuel engine with an alternator to function as a generator that runs alternatively off of gasoline or LPG. Ex. 1012, 65. The Workshop Manual discloses a carburetor through which gasoline and LPG are routed, as shown below:

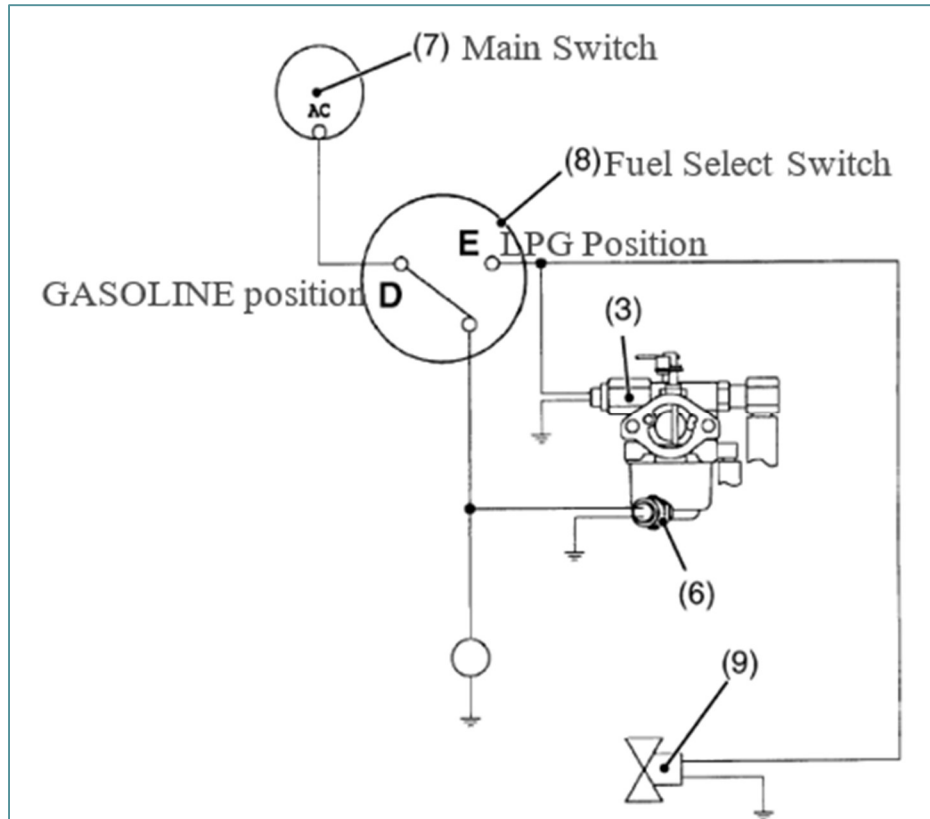






Id., 65, 67, 69 (annotated); Ex. 1003, ¶¶66-72.

The Workshop Manual further teaches a fuel select switch that controls whether a gasoline cut off solenoid (located downstream of the float bowl) allows gasoline to pass through the carburetor, or whether an LPG cut off solenoid allows LPG to pass through the carburetor, to power the engine/generator, shown below:



Ex. 1012, 68 (annotated); Ex. 1003, ¶¶73-74.

G. Kubota DF972-E2 Operator's Manual ("Operator's Manual")

The Operator's Manual was published and publicly available at least by the end of 2014 (Ex. 1014, ¶¶4-10; Ex. 1015, ¶¶4-14), before the filing date of the earliest application to which the '034 Patent claims priority (i.e. June 12, 2015). Specifically, the Workshop Manual was a public, non-confidential document that was publicly accessible to purchasers, end-users, and service personnel working on Kubota DF-972 engines, and which was shipped to the customer with every sold engine. *Id.* The Operator's Manual was created for dissemination to the interested public to provide instructions about how to operate, maintain, and service the DF-

U.S. Patent No. 10,393,034

972 engine, and is thus prior art to the '034 Patent under 35 U.S.C. §102(a).

Weber, Inc. v. Provisur Technologies, Inc., 92 F.4th 1059, 1067-69 (Fed. Cir. 2024).

The Operator's Manual discusses the same Kubota DF972-E2 engine as the Workshop Manual (Ex. 1003, ¶75 n.3), and teaches how to operate the DF972 engine. *Id.*, ¶75.

H. Tri-Fuel Video

The Tri-Fuel Video (Ex. 1021) was posted on YouTube on October 2, 2011, and viewed (and commented on) at least 13 years ago (*see* Ex. 1022), i.e., before June 12, 2015, and is thus prior art under 35 U.S.C. §102(a).

The Tri-Fuel Video discloses a multi-fuel generator having a remote propane tank with two regulators and a supply hose, as shown below:







Ex. 1003, ¶¶76-81.

I. *Auto Fuel Systems*, by Duffy/Smith (“Duffy”)

Duffy (Ex. 1016) is a textbook published in 1987 “designed to help prepare you to properly diagnose and repair all types of automotive fuel systems.” Ex. 1016, 3. Duffy explains, *inter alia*, that computer-controlled “mixture control solenoids” are timed to open and close to control the fuel/air mixture. Ex. 1003, ¶¶82-85.

VII. THE CHALLENGED CLAIMS ARE UNPATENTABLE

This Petition shows how the cited prior art references, alone or in combination, disclose the limitations of the Challenged Claims, thereby invalidating Claims 1-24 of the '034 Patent. As detailed below, this Petition

establishes a reasonable likelihood that Petitioners will prevail with respect to one or more of the Challenged Claims. *See* Ex. 1003, ¶¶86-451.

A. Ground 1: Claims 1-3, 5-9, and 18 are obvious over Nakafushi in view of Olmr

Claims 1-3, 5-9, and 18 of the '034 Patent are obvious under 35 U.S.C. §103, as detailed below and in the declaration of Dr. Timothy Morse (*see* Ex. 1003, ¶¶87-185).

1. Claim 1

a. Element [1.0]

Element [1.0] recites a “multi-fuel engine.” Whether or not limiting, Nakafushi discloses a “multi-fuel engine.” Specifically, Nakafushi discloses a “gasoline/LPG combined engine configured to selectively use gasoline or LPG as a fuel.” Ex. 1005, ¶[0001].

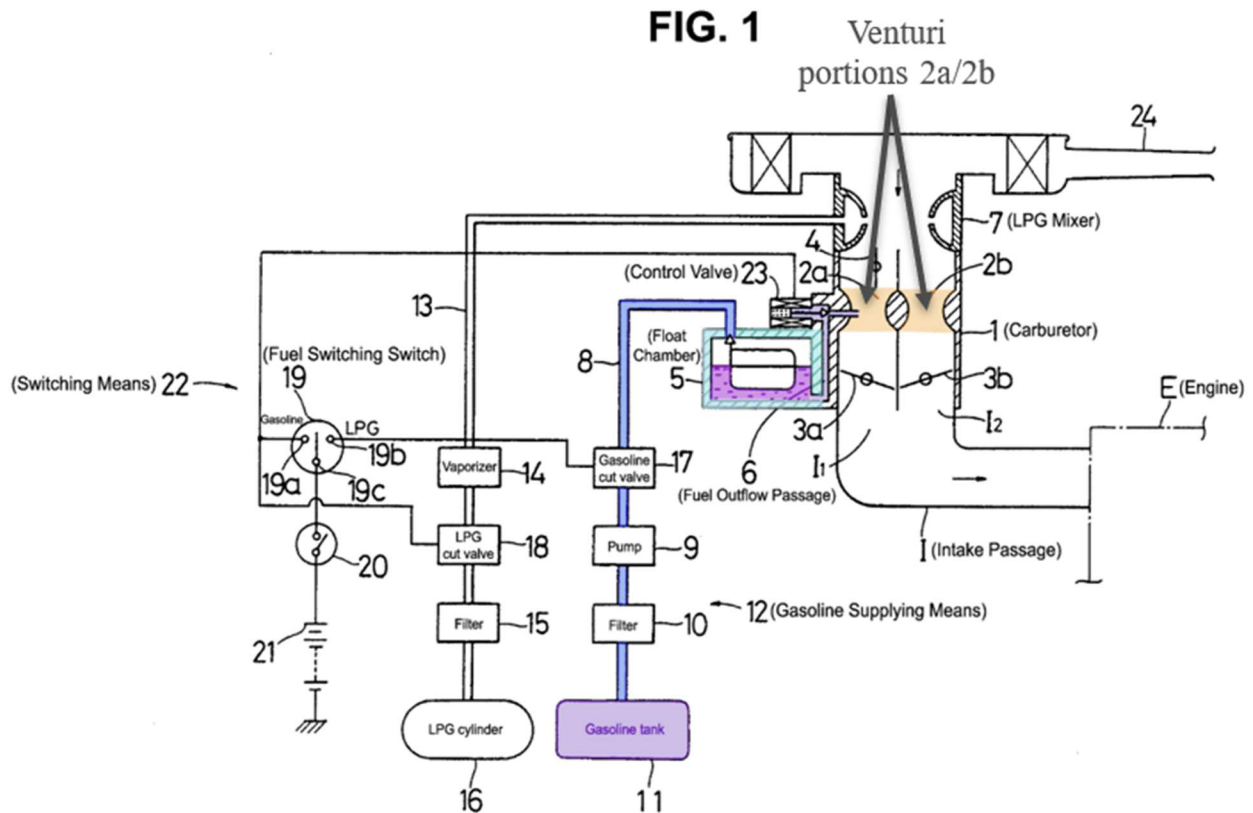
b. Element [1.1]

Element [1.1] recites “an engine operable on a liquid fuel and a gaseous fuel.” Nakafushi’s engine selectively uses gasoline or LPG as fuel. *Id.* As confirmed by the '034 Patent (Ex. 1001, 3:45-47), gasoline is liquid fuel and LPG is a gaseous fuel. Ex. 1003, ¶90.

c. Element [1.2]

Element [1.2] recites “a carburetor attached to an intake of the engine to mix air and fuel and connect a liquid fuel source to the intake, the carburetor comprising a float bowl.”

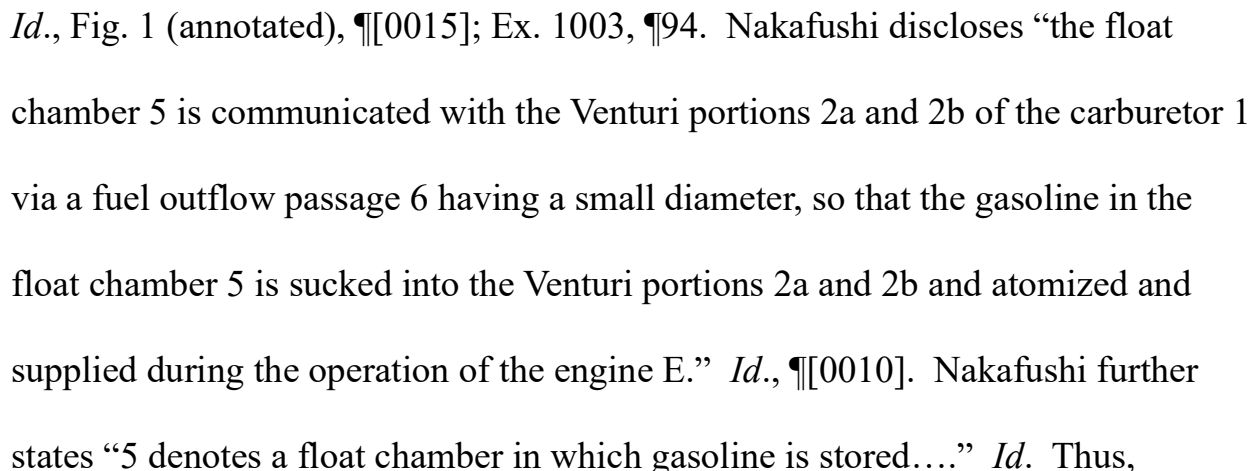
Nakafushi discloses a carburetor 1 attached to the intake of the engine E, shown in Figure 1 below:



Ex. 1005, Fig. 1 (annotated), Fig. 1; Ex. 1003, ¶93.

Nakafushi states “E denotes an engine with a specification of an existing carburetor, I denotes an intake passage connected to the engine E, and a two-barrel

FIG. 1



Nakafushi's float chamber 5 is a "float bowl" for purposes of Element [1.2]. Ex. 1003, ¶¶95-99.

A POSA would have understood that engines such as Nakafushi's operated by mixing fuel (either gasoline or LPG in Nakafushi's case) with air prior to combustion in the engine, as confirmed by Nakafushi's numerous references to the "air-fuel ratio" in regard to gasoline (and/or LPG) being mixed with air. *Id.*, ¶¶[0004]-[0005], [0008], [0016]; Ex. 1003, ¶96. A POSA thus would have recognized Nakafushi's disclosure of a dual-fuel engine as one that mixes air with the liquid fuel (i.e., gasoline) in carburetor 1, which is attached to the intake I for delivery to the engine. Ex. 1003, ¶¶97.

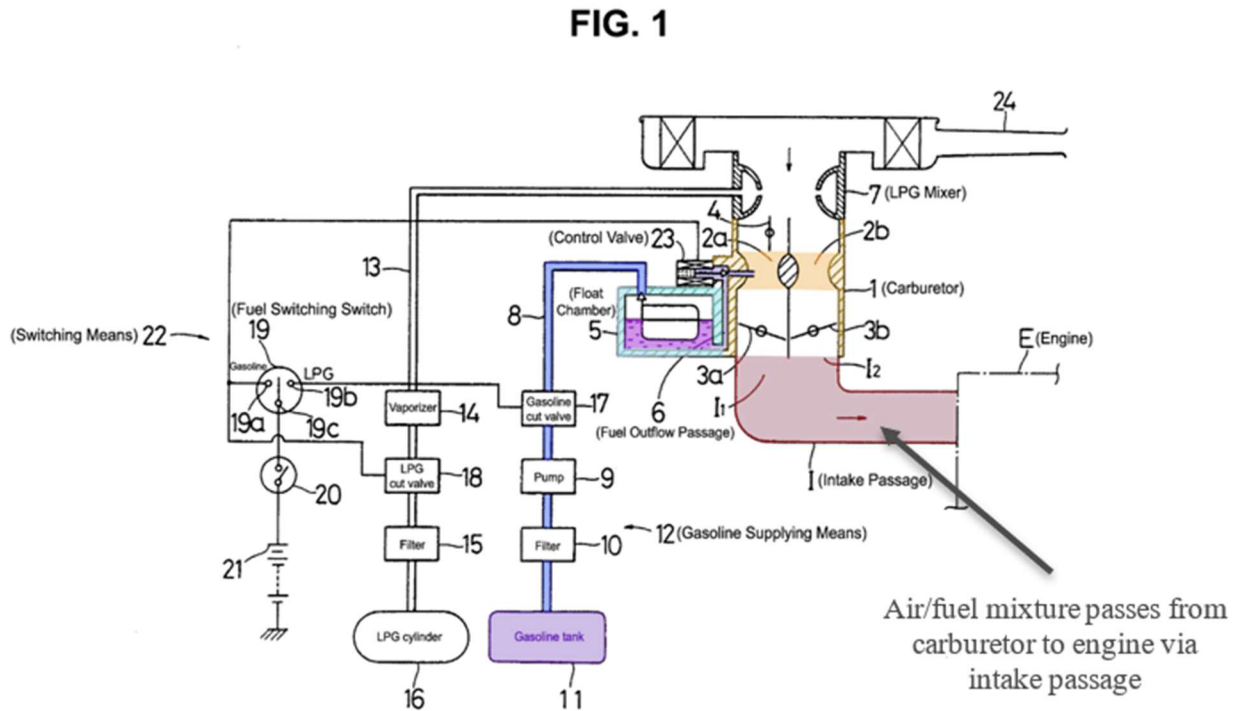
Accordingly, Nakafushi teaches carburetor 1, attached to the engine intake, that mixes air and gasoline and thereby connects the gasoline fuel source to the intake, as recited in Element [1.2]. *Id.*

d. Element [1.3]

Element [1.3] recites "a liquid cutoff solenoid coupled to the carburetor to open and close a liquid fuel path to the engine downstream from the float bowl."

Nakafushi discloses control valve 23 (Ex. 1005, ¶[0014], Fig. 1), which is a "liquid cutoff" for purposes of Element [1.3]. Ex. 1003, ¶101. Specifically, Nakafushi explains that "a control valve 23 configured to open and close the fuel outflow passage 6 is disposed so as to intervene in the fuel outflow passage 6."

Ex. 1005, ¶[0014]. Nakafushi's fuel outflow passage 6 connects the float chamber 5 to the carburetor's venturi portions 2a and 2b, with the fuel outflow passage 6 downstream of the float chamber 5. *Id.*, ¶[0010]. This arrangement is shown in Figure 1:

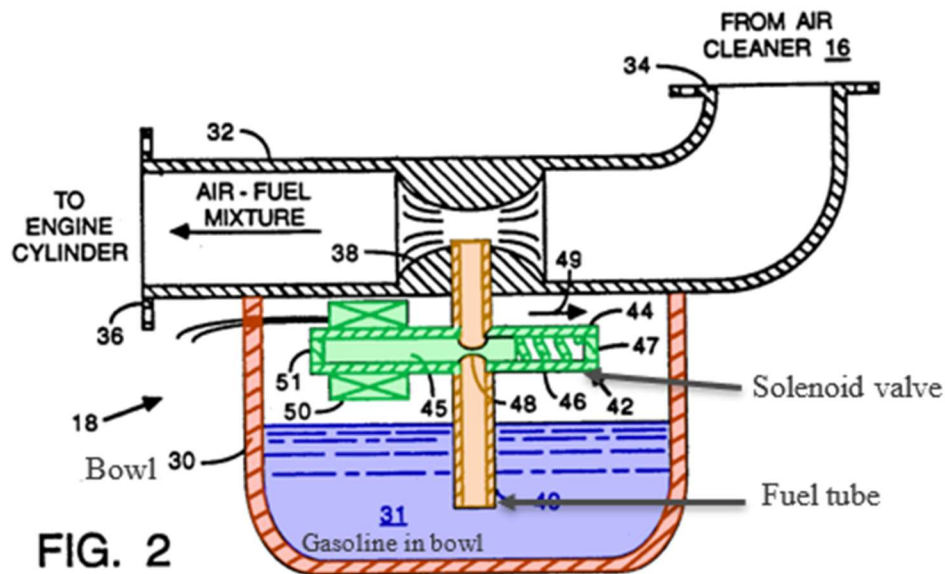


Id., Fig. 1 (annotated); Ex. 1003, ¶102.

Figure 1 thus shows that control valve 23 is “coupled to the carburetor” and is “downstream from the float bowl,” and a POSA would have recognized that fuel outflow passage 6 is a “liquid fuel path to the engine,” thus meeting these portions of Element [1.3]. Ex. 1003, ¶103. While Nakafushi does not use the word “solenoid” to describe its control valve 23, a POSA would have understood valve

23 to be a solenoid valve, such that Nakafushi alone satisfies this element. Ex. 1003, ¶104.

To the extent Nakafushi does not disclose a “solenoid,” it would have been obvious to a POSA to use a solenoid in view of Olmr. Olmr discloses a gasoline engine having solenoid valve 42 in a float bowl 30 that cuts off the flow of gasoline to the venturi 38 when the operator closes the kill switch. Ex. 1007, 2:30-68, 4:11-27. Olmr’s Figure 2 shows:



Id., Fig. 2 (annotated); Ex. 1003, ¶¶110-113. Thus, Olmr’s valve 42 is a liquid cutoff solenoid coupled to the float bowl 30 in the carburetor that opens and closes a liquid fuel path to the engine via venturi 38. Ex. 1003, ¶¶110-113.

A POSA would have found it obvious to utilize a solenoid such as that disclosed by Olmr for Nakafushi's control valve 23, as discussed below.

i. Motivation to Combine

Nakafushi and Olmr both relate to gasoline engines and both seek to prevent the flow of gasoline from the float bowl to the engine intake upon cessation of gasoline operation of the engine. Ex. 1003, ¶¶114-120. In Nakafushi, control valve 23 cuts the gasoline flow from float chamber 5 when the operation of the engine is switched from gasoline to LPG. Ex. 1003, ¶121. Nakafushi does not expressly label the type of valve is used, but Olmr expressly teaches using a solenoid (valve 42) for this same purpose. Ex. 1007, 2:30-56; *see also id.*, 1:33-36, Fig. 2. Olmr thus teaches an express example—a solenoid valve—for accomplishing the same function taught by Nakafushi, i.e., cutting gasoline flow to the carburetor when needed. It would have thus been a simple substitution to incorporate Olmr's expressly-identified solenoid valve to accomplish the same function in Nakafushi. Ex. 1003, ¶¶121-124.

ii. Reasonable Expectation of Success

A POSA would have reasonably expected success in using Olmr's solenoid valve 42 as Nakafushi's control valve 23. At the time of the invention, the use of solenoid valves to cut off/control the flow of fuel was ubiquitous, with Olmr being just one example. Ex. 1003, ¶¶125-126.

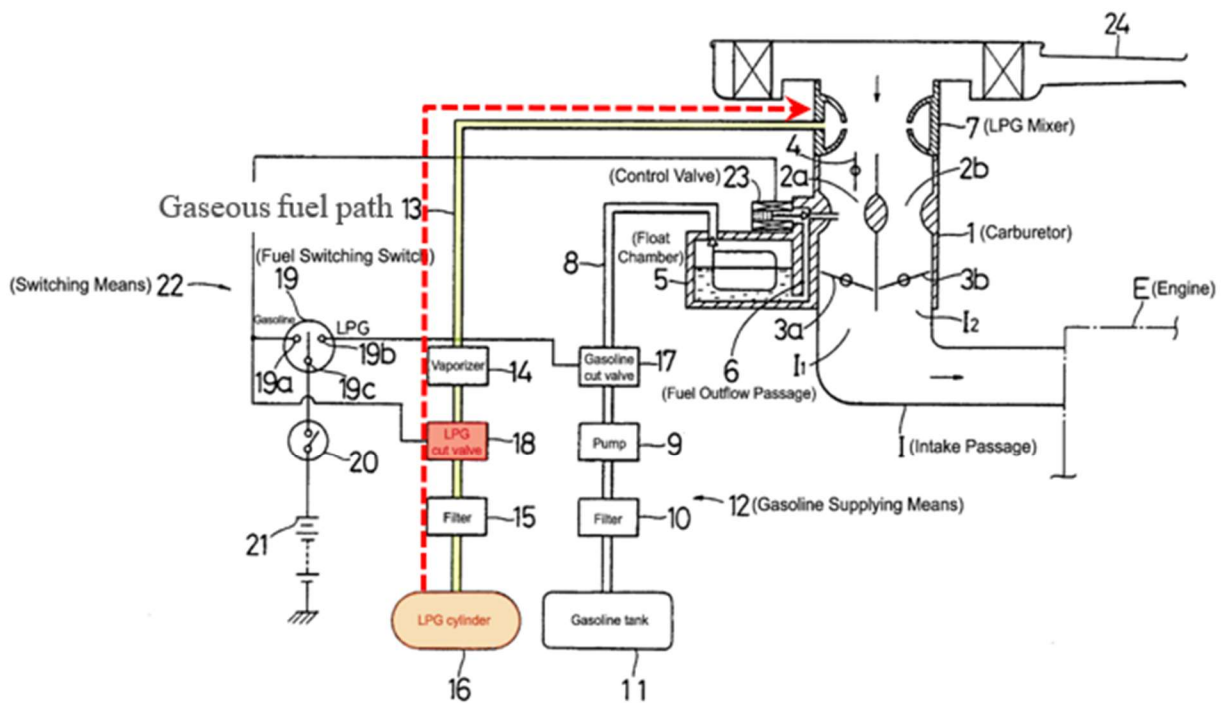
Furthermore, Nakafushi discloses a simple electrical circuit to open and close its control valve 23 (Ex. 1005, ¶¶[0013]-[0014], Fig. 1), which a POSA would have recognized as being suitable to energize a solenoid valve, such as Olmr's solenoid valve 43, to open and close the fuel pathway. Ex. 1003, ¶¶127-131. Indeed, Olmr teaches an essentially identical electrical circuit for operating its solenoid valve. Ex. 1007, 2:57-4:27, Figs. 2-3. A POSA would have therefore reasonably expected that Olmr's solenoid valve could be successfully implemented to serve as Nakafushi's control valve 23 to accomplish the desired function of cutting off the supply of gasoline from Nakafushi's float chamber 5 to the intake of the engine.

e. Element [1.4]

Element [1.4] recites “a gaseous cutoff coupled to open and close a gaseous fuel source to the engine.”

Nakafushi discloses “LPG cut valve 18 configured to close the LPG supplying passage 13 in response to a cut signal (described later) provided in the LPG supplying passage 13 so as to intervene between the vaporizer 14 and the filter 15.” Ex. 1005, ¶[0013]. Cut valve 18's function in opening and closing the gaseous fuel source to the engine is highlighted in Figure 1 below:

FIG. 1



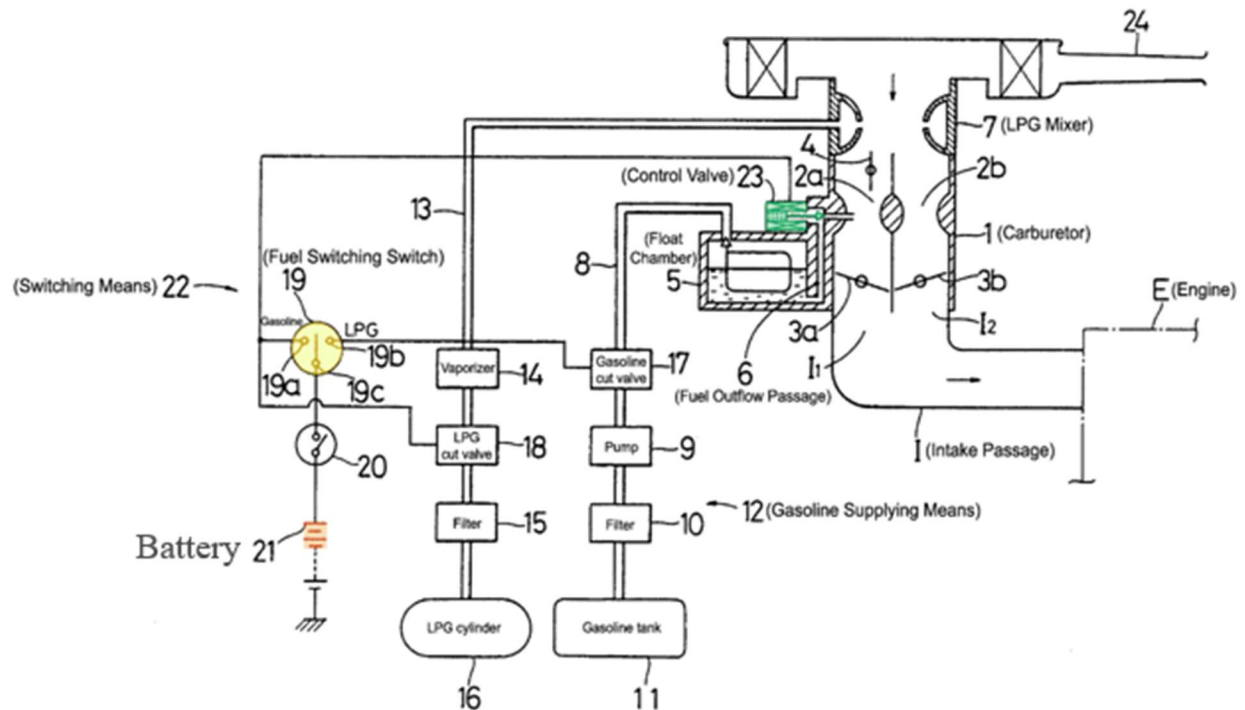
Id., Fig. 1 (annotated); Ex. 1003, ¶¶133-134.

Nakafushi thus discloses a “gaseous cutoff.” Ex. 1003, ¶135.

f. Element [1.5]

Element [1.5] recites “a switch selectively coupling a power source to the liquid cutoff solenoid to open and close the liquid fuel path.”

Nakafushi discloses a “fuel switching switch 19” that is “connected to a battery 21 via an ignition switch 20.” Ex. 1005, ¶[0013]. These elements are highlighted in Figure 1 below:

FIG. 1

Id., Fig. 1 (annotated); Ex. 1003, ¶137.

Nakafushi's battery 21 is a “power source,” and is coupled to switch 19 for “selectively coupling a power source to the liquid cutoff solenoid to open and close the liquid fuel path.” Specifically, the fuel switch 19 has a “gasoline-side contact point 19a and an LPG side contact point 19b,” and Nakafushi teaches that the “selective coupling” between fuel switch 19 and control valve 23 whereby “the control valve 23 is connected to the gasoline contact point 19a of the fuel switching switch 19.” *Id.*, ¶¶[0013]-[0014].

This selective coupling causes the liquid solenoid to open and close the liquid fuel path. Nakafushi discloses that during gasoline operation, “the control

valve 23 is turned ON..., thereby allowing the gasoline to be sucked from the float chamber 5 to the Venturi portions 2a and 2b,” and during LPG operation, “the control valve is turned OFF..., thereby blocking the suction of the gasoline from the float chamber 5 to the Venturi portions 2a and 2b.” *Id.*, ¶[0014]. Control valve 23 opens and closes the liquid fuel path, i.e. fuel outflow passage 6. *Id.*

When using a solenoid for Nakafushi’s liquid cutoff as taught by Olmr (*see supra*, §VII.A.1.d), Nakafushi’s switch 19 would operate the solenoid in the same way that Olmr teaches the opening and closing of its solenoid valve 42 via a similar switch and power source. Ex. 1007, 2:57-4:27, Fig. 2-3; Ex. 1003, ¶140.

Figure 1 above teaches switch 19 as part of a circuit connected to battery 21 and control valve 23, showing that when switch 19 is switched to the gasoline-side contact 19a, an electrical connection forms between battery 21 and control valve 23.

Nakafushi (as modified by Olmr to utilize a solenoid as the liquid cutoff) thus discloses this element.

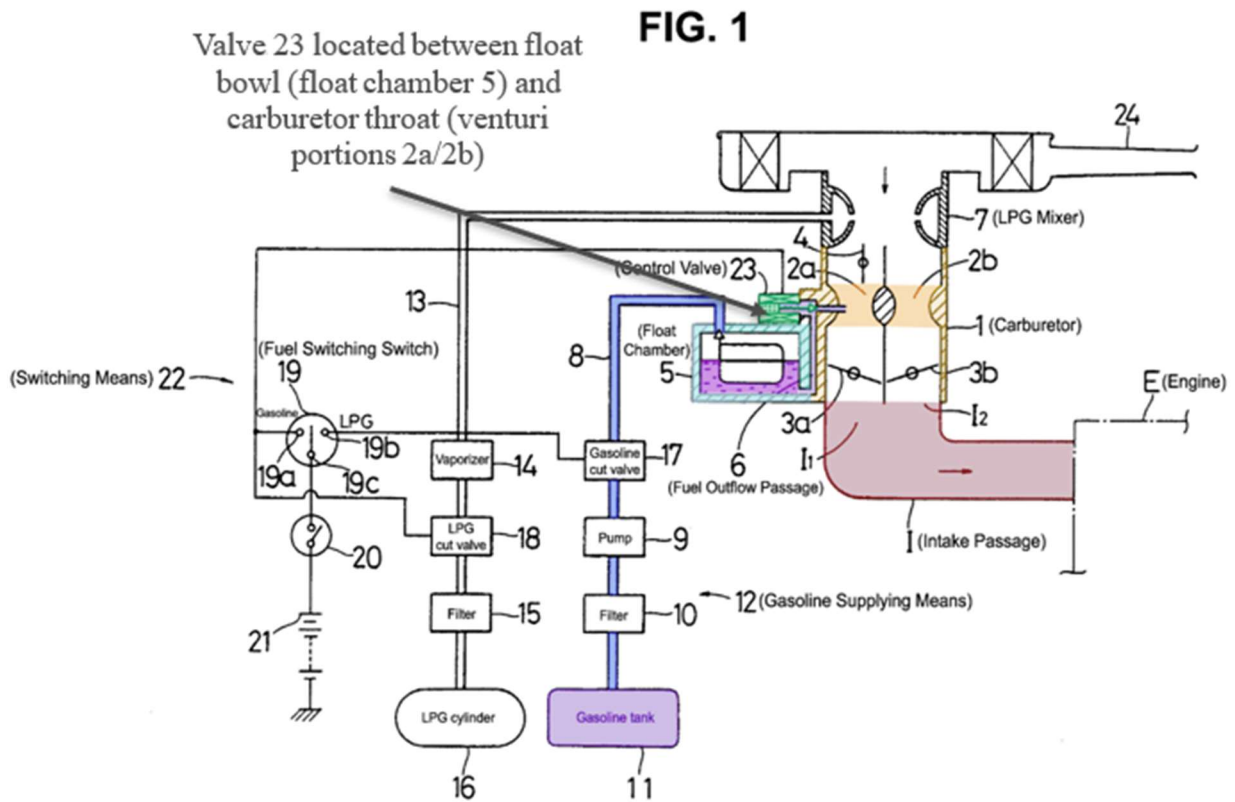
2. Claim 2

Claim 2 depends from Claim 1, and adds two elements.

a. Element [2.1]

Element [2.1] recites “wherein the liquid cutoff solenoid is positioned on the liquid fuel path, which extends from the float bowl to a throat of the carburetor, to open and close the liquid fuel path.”

As explained for Element [1.3], Nakafushi’s control valve 23 is a “liquid cutoff” that opens/closes the liquid fuel path and is located downstream of the float bowl. *Supra*, §VII.A.1.d. Being downstream of the float bowl, Nakafushi’s control valve 23 is necessarily positioned on the liquid fuel path extending from the float bowl to a throat of the carburetor, as seen in annotated Figure 1:



Ex. 1005, Fig. 1 (annotated); Ex. 1003, ¶145. Furthermore, as explained for Element [1.3] (*supra*, §VII.A.1.d), it was obvious to use a solenoid for Nakafushi's control valve 23.

b. Element [2.2]

Element [2.2] recites “further wherein the gaseous cutoff couples the gaseous fuel source to the intake to control flow of the gaseous fuel to the engine.”

As noted for Element [1.4] (*supra*, §VII.A.1.e), Nakafushi discloses a “gaseous cutoff” that “couples the gaseous fuel source” (Nakafushi's LPG cylinder 16) “to the intake to control the flow of the gaseous fuel to the engine.” Ex. 1005, ¶[0013]; Ex. 1003, ¶¶148-149.

3. Claim 3

Claim 3 depends from Claim 1, and further requires “wherein the switch actuates the liquid cutoff solenoid to enable changing engine operation between the liquid fuel and the gaseous fuel, so as to prevent fuel flow from the liquid fuel source and the gaseous fuel source simultaneously and allow switching between fuel sources on-the-fly during engine operation.”

As noted for Element [1.5] (*supra*, §VII.A.1.f), Nakafushi discloses fuel switch 19 that controls valve 23 (i.e., the liquid cutoff solenoid when Nakafushi is combined with Olmr for this element (*supra*, §VII.A.1.d)), the LPG cut valve 18 and gasoline cut valve 17 to prevent fuel flow from the liquid fuel source and the

gaseous fuel source simultaneously. Specifically, the switch simultaneously opens control valve 23 and gasoline cut valve 17, and closes the LPG valve 18 during gasoline operation, and vice versa for LPG operation. Ex. 1005, [0013]-[0014]; Ex. 1003, ¶151. This simultaneous operation of control valves 17, 18 and 23 prevents both fuels from entering the carburetor simultaneously, but allows for switching between the fuel sources while the engine is running (i.e., “on the fly” switching). Ex. 1003, ¶152.

Specifically, when Nakafushi’s switch 19 is switched to the gasoline contact point 19a side, a cut signal is sent to the LPG cut valve 18 (the “gaseous cutoff”) and simultaneously, control valve 23 receives a signal to open. Ex. 1005, ¶¶[0013]-[0014]. In contrast, when fuel switch 19 is switched to the LPG contact point 19b side, the reverse occurs where a cut signal is sent to the gasoline cut valve 17 to stop gasoline flow while the LPG valve 18 is opened. *Id.* Figure 1 shows the LPG cut valve 18 and the control valve 23 are on the same circuit, such that the switching of switch 19 will “simultaneously” actuate both valves to their respective open or closed positions. Ex. 1005, Fig. 1; Ex. 1003, ¶154.

Nakafushi also discloses the claimed “allow[ing] switching between fuel sources on-the fly during engine operation,” teaching that:

[A]n object of the present invention is, in a gasoline-LPG combined engine comprising a carburetor equipped with a float chamber, to

enable *switching between a gasoline engine operation and an LPG engine operation during the operation of the engine.*

Id., ¶[0005] (emphasis added); *see also id.*, ¶¶[0008], [0016].

4. Claim 5

Claim 5 depends from Claim 1 and further requires that “the engine is a dual fuel engine that operates on gasoline from the liquid fuel source and LPG from the gaseous fuel source.”

Nakafushi discloses “[t]he present invention relates to a gasoline-LPG combined engine configured to selectively use gasoline or LPG as a fuel.” Ex. 1005, ¶[0001].

5. Claim 6

Claim 6 depends from Claim 1, and further requires that “activating the gaseous cutoff simultaneously activates the liquid cutoff solenoid.”

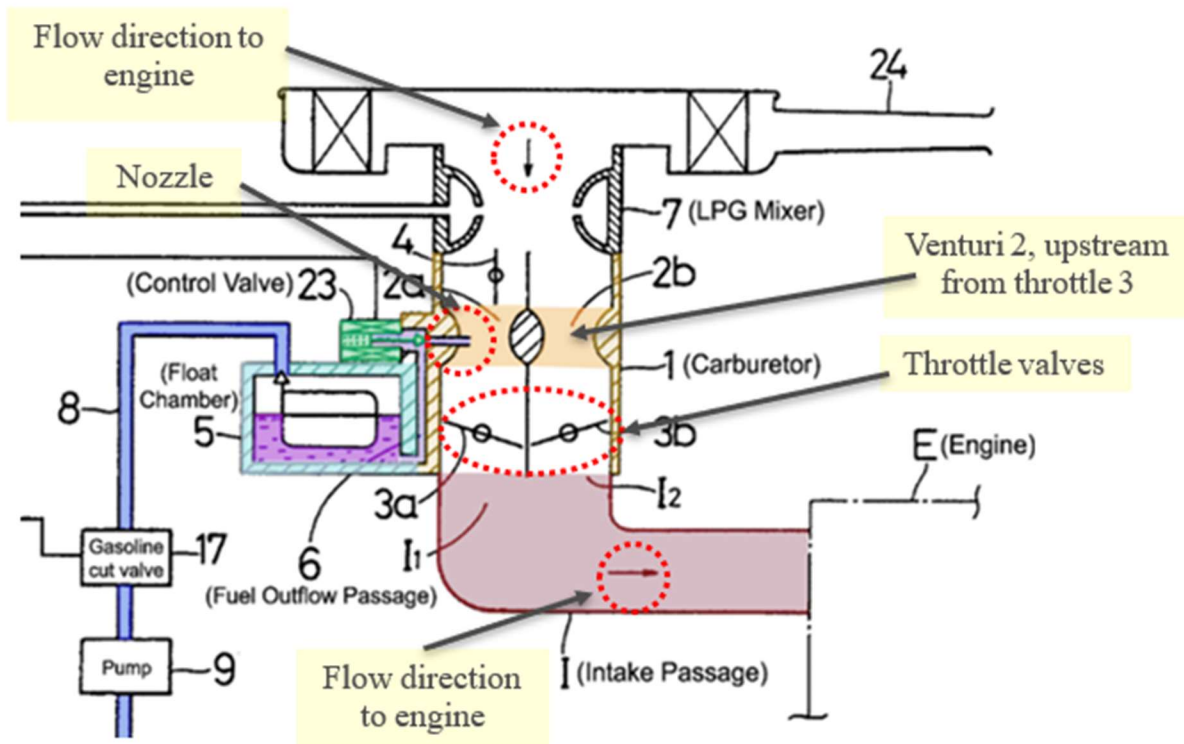
As discussed (*supra*, §§VII.A.1.f, VII.A.I.A.3)), Nakafushi explains that fuel switch 19 “simultaneously” activates the gaseous cutoff and the liquid cutoff solenoid. Ex. 1005, ¶¶[0013]-[0014], Fig. 1 (showing the valves on the same circuit such that the activation is “simultaneous”); Ex. 1003, ¶¶159-161.

6. Claim 7

Claim 7 depends from Claim 1, and further requires “the liquid cutoff solenoid is selectively operable to cut off fuel flow from the float bowl to a nozzle in a venturi of the carburetor upstream from a throttle for the engine.”

Nakafushi discloses that control valve 23 (which is the claimed “liquid cutoff solenoid” when modified with Olmr (*supra*, §VII.A.1.d)), is “selectively operable to cut off fuel flow from the float bowl to a nozzle in a venturi of the carburetor.” *Id.* Specifically, control valve 23 cuts fuel flow in the fuel outflow passage 6, which culminates with a “nozzle in a venturi of the carburetor.” Ex. 1005, ¶[0014], Fig. 1; Ex. 1003, ¶¶163-165.

Nakafushi expressly states “throttle valves 3a and 3b are disposed downstream of the Venturi portions 2a and 2b” (Ex. 1005, ¶[0010]), and Figure 1 confirms this relative positioning:



Ex. 1003, ¶¶165-166.

7. Claim 8

Claim 8 depends from Claim 1, and requires that “the carburetor connects the gaseous fuel source to the intake.”

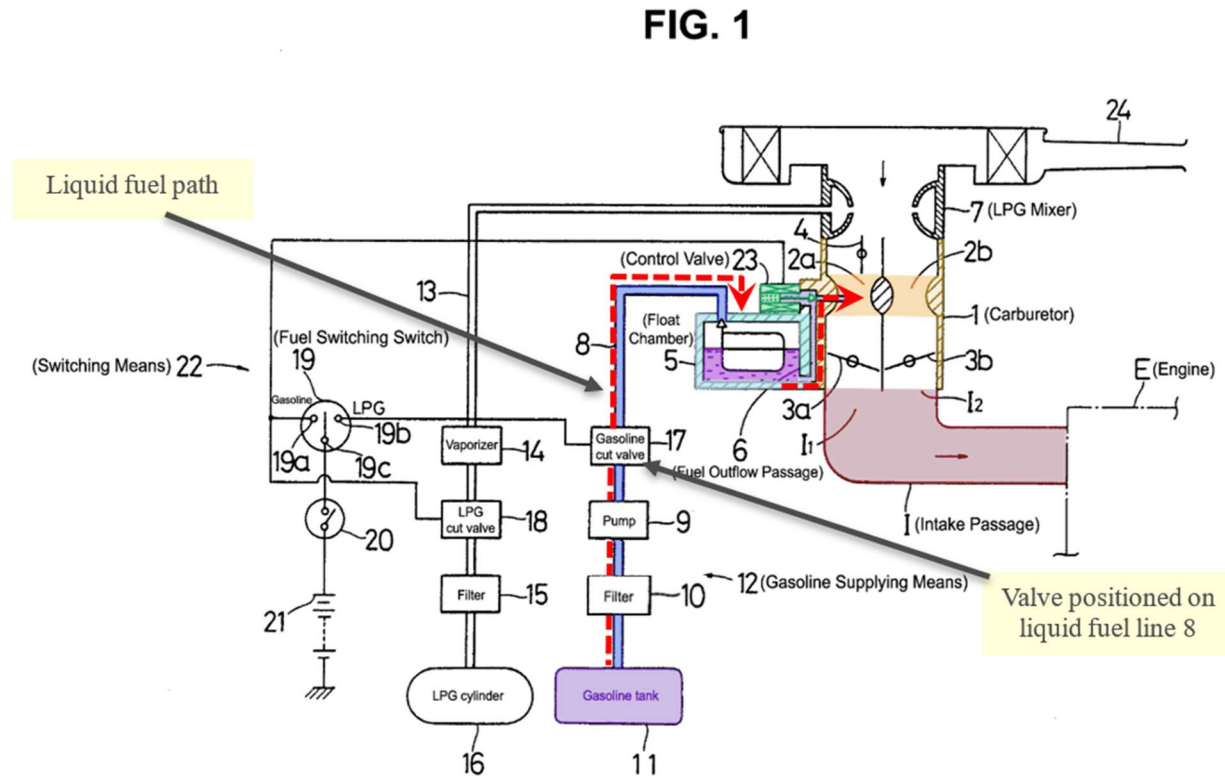
Nakafushi teaches that “an LPG mixer 7 for vaporizing LPG and supplying the vaporized LPG to the intake passage I is mounted on the upper portion of the carburetor 1 in the intake passage I.” Ex. 1005, ¶[0011]. Further, “the LPG mixer 7 is communicated with an LPG cylinder 16 as an LPG supplying means by an LPG supplying passage 13 via a vaporizer 14 for vaporizing LPG and a filter 15.” *Id.*, ¶[0012]. Thus, Nakafushi discloses that carburetor 1 connects the gaseous fuel source (the LPG cylinder 16) to the intake (intake passage I₁ and intake passage I₂). Ex. 1003, ¶¶168-170.

8. Claim 9

Claim 9 depends from Claim 1, and further requires a “liquid fuel valve positioned on a liquid fuel line coupling the liquid fuel source to the carburetor to open and close the liquid fuel source to the engine.”

Nakafushi discloses “gasoline cut valve 17 [i.e., a “liquid fuel valve”] configured to close the gasoline supplying passage 8 in response to a cut signal... to intervene between the float chamber 5 and the pump 9.” Ex. 1005, ¶[0013]. Figure 1 shows gasoline cut valve 17 positioned on the gasoline supply passage 8

leading to float chamber 5, which in turn is connected to carburetor 1 through fuel outflow passage 6, as illustrated below:



Id., Fig. 1 (annotated); Ex. 1003, ¶¶172-173.

9. Claim 18

a. Element [18.0]

Nakafushi discloses “a multi-fuel internal combustion engine.” *Supra*, §VII.A.1.a.

b. Element [18.1]

Element [18.1] recites “an engine operable on liquid fuel supplied through a liquid fuel line from a liquid fuel source and gaseous fuel supplied through a gaseous fuel line from a pressurized fuel source.”

Nakafushi's engine selects between gasoline and LPG fuels. Ex. 1005, ¶[0001]. As the '034 specification recognizes, gasoline is liquid fuel and LPG is gaseous fuel. Ex. 1001, 3:45-47.

Nakafushi's "liquid fuel source" is gasoline tank 11, which supplies gasoline through supply passage 8 to carburetor 1, and on to the engine through fuel outflow passage 6 and intake I. Ex. 1005, ¶¶[0010], [0012], Fig. 1; Ex. 1003, ¶177.

Nakafushi's "pressurized fuel source" is LPG cylinder 16, which supplies gaseous fuel through supply passage 13 to the carburetor 1, and from there to the engine through intake I. Ex. 1005, ¶[0012], Fig. 1; Ex. 1003, ¶178. A POSA would have appreciated that LPG tanks such as Nakafushi's cylinder 16 store LPG under pressure, which is necessary given LPG's boiling point of approximately minus 40°C. Ex. 1003, ¶178; *see also* Ex. 1001, 1:48-49 (acknowledging that LPG "can be conveniently stored under pressure in a liquid state").

c. Element [18.2]

Element [18.2] recites "a carburetor coupled to an intake of the engine to mix air and fuel and connect to the liquid fuel line and the gaseous fuel line."

Nakafushi's carburetor 1 is coupled to the intake I and mixes air and fuel. Ex. 1005, ¶[0010], Figs. 1-2; *supra*, §VII.A.1.c. Carburetor 1 connects to both the liquid and gaseous fuel lines through fuel passages 8 and 13, respectively. *Id.*; Ex. 1003, ¶180.

d. Element [18.3]

Element [18.3] recites “a carburetor cutoff solenoid coupled to control fuel flow within the carburetor from the liquid fuel line and selectively engage engine operation on liquid fuel.”

As discussed, Nakafushi’s control valve 23 is a “carburetor cutoff” coupled to control liquid fuel flow within the carburetor through fuel passage 6; when valve 23 is open, the engine operates on liquid fuel. *Supra*, §VII.A.1.d. As discussed, to the extent that Nakafushi does not disclose a solenoid for valve 23, it would have been obvious to use Olmr’s solenoid for Nakafushi’s control valve 23. *Id.*

e. Element [18.4]

Element [18.4] recites “a gaseous fuel valve coupled to control fuel flow through the gaseous fuel line and selectively engage engine operation on gaseous fuel.”

Nakafushi’s LPG cut valve 18 is a “gaseous fuel valve” coupled to gaseous fuel passageway 13 to selectively operate the engine on gaseous fuel when desired. *See supra* §§VII.A.1.e, A.2.b; Ex. 1003, ¶¶184-185.

B. Ground 2: Claims 4 and 10 are obvious over Nakafushi in view of Olmr and Duffy

Claims 4 and 10 of the ’034 Patent are obvious under 35 U.S.C. §103, as detailed below and in the declaration of Dr. Timothy Morse (*see* Ex. 1003, ¶¶186-200).

1. Claim 4

Claim 4 depends from Claim 1, and further requires “the switch actuates the liquid cutoff solenoid to provide fuel overlap when changing engine operation between the liquid fuel and the gaseous fuel.”

While Nakafushi does not expressly disclose a “fuel overlap,” it would have been obvious to use an electrically-controlled solenoid (such as a computer-controlled solenoid) to control the timing of the liquid cutoff, with such solenoid controls well-known to a POSA before the date of the invention, as shown by Duffy. Ex. 1016, 11-15; Ex. 1003, ¶¶188-191. A POSA would have been motivated to do so to ensure an appropriate “fuel overlap” when switching from gasoline to LPG to prevent the engine from stalling. Ex. 1003, ¶192-193.

Because Nakafushi’s valve 23 is so close to the carburetor (especially as compared to LPG valve 18), a POSA would have been motivated to slightly delay shutting valve 23 upon opening LPG valve 18 to continue providing gasoline fuel for the short period of time required for LPG fuel to approach the carburetor, and only thereafter cutting off the gasoline flow. *Id.* Fine control of the needed timing would allow the engine to operate better while providing a more uniform power output (e.g., for generating electricity). *Id.*

A POSA appreciated the benefits of achieving a balanced fuel-air ratio, including when switching between fuels on the fly. *Id.* Control circuitry for

providing short delays of this nature were well-known, and were easily incorporated into Nakafushi's switch 19 and valves; a POSA would have would have had a reasonable expectation of success in using routine optimization to achieve the desired valve timing and fuel overlap for optimal engine operation. *Id.*, ¶193.

2. Claim 10

Claim 10 depends from Claim 1, and further requires “the switch opens the liquid fuel valve to fill the float bowl with liquid fuel prior to actuating the liquid cutoff solenoid to open the liquid fuel path.”

It would have been obvious to a POSA to utilize a switch to electrically control the opening of the liquid fuel valve to occur prior to actuating the liquid cutoff solenoid. Ex. 1003, ¶195. As noted for Claim 4 above, electrically controlled solenoids were well known.

A POSA would have been motivated to delay opening the liquid cutoff solenoid until after the liquid fuel valve is opened for a sufficient period to fill the float bowl with gasoline—especially where the float bowl has been previously drained pursuant to the manufacturer's instructions. *See* Ex. 1017, 24 (Instruction 7.b); Ex. 1003, ¶¶196-199. The float bowl must have sufficient gasoline to operate the engine smoothly, as insufficient gasoline in the float bowl risks inadequate fuel supply to the engine upon start-up or when switching from LPG operation back to

gasoline. *Id.* A POSA would have been further motivated to adopt the claimed sequencing because repeated operation of the engine with insufficient fuel in the bowl would cause degradation and wear on the engine. *Id.*

As discussed, a POSA would have had a reasonable expectation of success in incorporating electrically-controlled solenoids to institute a predefined delay of this nature. *Supra*, §VII.B.1.

C. Ground 3: Claims 19-23 are obvious over Nakafushi in view of Olmr and Bernhardsson and/or Duffy

Claims 19-23 of the '034 Patent are obvious under 35 U.S.C. §103, as detailed below and in Dr. Morse's declaration (Ex. 1003, ¶¶201-229).

1. Claim 19

Claim 19 depends on claim 18, and further requires "wherein the gaseous fuel valve comprises a gaseous fuel cutoff solenoid."

Nakafushi's LPG cut valve 18 is a "gaseous fuel valve." *Supra*, §VII.A.9.e.

Bernhardsson discloses a dual-fuel engine with a solenoid valve 42 that cuts off gaseous fuel flow from LPG container 40 to the carburetor, as seen in Figure 1:

Nakafushi does not expressly describe the mechanism that serves as its cut valve 18; a POSA would have found it obvious to use a solenoid, e.g., Bernhardsson's solenoid, for Nakafushi's LPG cut valve 18 (Ex. 1003, ¶206), as explained below.

A POSA would have been motivated to combine Bernhardsson with Nakafushi because both relate to dual-fuel engines alternatively operating on liquid or gaseous fuel, and both disclose cut-off valves downstream of the gaseous fuel containers. While Nakafushi does not describe the exact mechanism used for its gaseous fuel cut valve 18, Bernhardsson discloses using a solenoid valve (i.e. valve

42) for cutting fuel flow from LPG container 40 to carburetor 9. Ex. 1008, 2:58-68, Fig. 1. Thus, Bernhardsson discloses an exemplary valve type, a solenoid, for carrying out the same function in Nakafushi, and a POSA would have found it obvious to implement Bernhardsson's solenoid valve for this purpose. Ex. 1003, ¶¶207-210.

b. Reasonable Expectation of Success

A POSA would have reasonably expected success in using Bernhardsson's solenoid for Nakafushi's LPG cut valve 18. Ex. 1003, ¶211. At the time of the invention, the use of solenoid valves to cut fuel flow to an engine was ubiquitous. *Id.*, ¶212. Nakafushi discloses a simple electrical circuit to open and close valve 18 (Ex. 1005, ¶¶[0013]-[0014], Fig. 1.), as does Bernhardsson (Ex. 1008, 3:5-10). Because the control mechanisms are the same, a POSA would have found it easy to implement Bernhardsson's solenoid in Nakafushi. Ex. 1003, ¶¶213-216.

2. Claim 20

Claim 20 depends from Claim 19, and further requires "a switch to change operation of the engine from liquid fuel to gaseous fuel and from gaseous fuel to liquid fuel while the engine is running."

As discussed, the operation of Nakafushi's fuel switch 19 changes engine operation between LPG and gasoline "while the engine is running." *Supra*, §§VII.A.1.f, VII.A.3.

3. Claim 21

Claim 21 depends from Claim 1, and further requires that “the switch institutes a predefined delay between actuating the carburetor cutoff solenoid and the gaseous fuel cutoff solenoid.”

As discussed, it would have been obvious to use electrically-controlled solenoids to implement the claimed predefined delay for the same reasons discussed. *Supra*, §VII.B.1.

4. Claim 22

Claim 22 depends from Claim 20, and further requires “wherein the switch operates the carburetor cutoff solenoid and the gaseous fuel cutoff solenoid to substantially prevent simultaneous fuel delivery of the liquid fuel and the gaseous fuel to the engine.”

As discussed, Nakafushi’s switch 19 “substantially prevent[s] simultaneous fuel delivery of the liquid fuel and the gaseous fuel to the engine.” *Supra*, §VII.A.3. This would remain true when using solenoids for the liquid and gas cutoffs, as disclosed by Olmr and Bernhardsson. *Supra*, §§VII.A.1.d, VII.B.1; Ex. 1003, ¶¶224-225.

5. Claim 23

Claim 23 depends from Claim 20, and further requires that “the gaseous fuel cutoff solenoid and the carburetor cutoff solenoid operate as normally closed solenoid valves.”

The carburetor cutoff of Nakafushi is “normally closed.” Ex. 1005, ¶[0014]. As discussed, it would have been obvious in view of Olmr to use a solenoid for this valve. *Supra*, §VII.A.3. While Nakafushi teaches a “normally open” gaseous fuel cutoff, it would have been obvious to a POSA to configure it as normally closed. Ex. 1003, ¶227. Bernhardsson’s gaseous fuel cutoff solenoid is normally closed (Ex. 1008, 3:65-4:17), and the decision to configure a solenoid as normally open or normally closed is mere design choice. Ex. 1003, ¶227.

A POSA would have been further motivated to utilize a normally-closed LPG solenoid for safety reasons, such that if power is lost, the fuel valve reverts to its closed position. *Id.* Replacing Nakafushi’s normally-open LPG valve with the normally-closed solenoid of Bernhardsson would have been a simple substitution that would merely involve rewiring Nakafushi’s switch to account for the normally closed valve. *Id.*

D. Ground 4: Claims 11-13 and 16-17 are obvious over Nakafushi in view of Jungmann and Parlato

Claims 11-13 and 16-17 of the ’034 Patent are obvious under 35 U.S.C. §103, as detailed below and in Dr. Morse’s declaration (*see* Ex. 1003, ¶¶230-288).

1. Claim 11

a. Element [11.0]

Whether or not limiting, Nakafushi discloses a multi-fuel engine and fuel delivery system. *Supra*, §VII.A.1.a.

Jungmann discloses an engine with a gasoline or propane fuel-delivery system in a generator. Ex. 1011, ¶[0002]. In view of Jungmann, a POSA would have found it obvious to use Nakafushi's engine in a generator. Ex. 1003, ¶¶232-234.

i. Motivation to Combine/Expectation of Success

A POSA would have been motivated to use Nakafushi's engine in a generator to provide the user with the option of alternatively using gasoline or LPG to generate electricity. *Id.* Jungmann discloses the use of various types of fuels for an engine used in a generator, including propane (LPG) and gasoline. Ex. 1011, ¶[0015]. Jungmann thus demonstrates that using such engines in a generator was well-known. Ex. 1003, ¶¶235-243; *see also* Ex. 1017.

Multi-fuel engines such as Nakafushi's were recognized as especially useful for generators because, for example, in certain power outages (such as major storms), the user may not have access to gasoline if the gasoline stations are out of service. *Id.* Alternatively, the user may not have LPG on hand, but may have gasoline on hand for other uses, making it a readily available fuel source. *Id.* Enabling the option of using gasoline or LPG makes the generator more versatile. *Id.* Purposing Nakafushi's engine for use in/as a generator would have involved nothing more than a simple substitution, whereby Nakafushi's engine is used in place of Jungmann's engine. *Id.*

A POSA would have reasonably expected success in using Nakafushi's multi-fuel engine in a generator given that this implementation was already demonstrated by Jungmann. *Id.*, ¶¶244-245. Moreover, Nakafushi's engine could be used in a generator simply by adding an alternator to the engine, as was already common and well known by that time (for example, alternators are commonly combined with car engines to generate electricity, and generators driven by multi-fuel engines were already commonly available (*see, e.g.*, Ex. 1017)). Ex. 1003, ¶246.

b. Element [11.1]

Element [11.1] recites “a multi-fuel internal combustion engine configured to operate on a liquid fuel supplied from a liquid fuel source through a liquid fuel line and a gaseous fuel supplied from a pressurized fuel source through a gaseous fuel line.” As discussed, Nakafushi discloses this limitation. *Supra*, §VII.A.1.9.b.

c. Element [11.2]

Element [11.2] recites “an alternator driven by the multi-fuel internal combustion engine.” Jungmann discloses an alternator driven by an internal combustion engine:

On embodiment of the invention relates to a generator including an enclosure, an internal combustion engine provided within the enclosure, ***an alternator provided within the enclosure and driven by the internal***

combustion engine, [and] a fuel supply line for providing fuel to the internal combustion engine....

Ex. 1011, ¶[0002] (emphasis added).

Indeed, alternators are common components in generators. Ex. 1003, ¶248. As discussed, a POSA would have found it obvious to combine the alternator from Jungmann with the dual-fuel engine in Nakafushi to create a generator. *Supra*, §VII.C.1.a.

d. Element [11.3]

Element [11.3] recites “a fuel regulator system.” According to the ’034 Patent, the “fuel regulator system”:

includes one or more pressure regulators that reduce and control the pressure of the fuel from pressurized fuel container [] and delivers fuel at a desired pressure for operation of the engine.

Ex. 1001, 4:8-13.

Nakafushi discloses vaporizer 14 for vaporizing the LPG prior to delivery to the carburetor. Ex. 1005, ¶¶[0012]-[0013]. Such vaporizers convert LPG from liquid to gas and regulate the pressure of the gas being delivered to the engine. Ex. 1003, ¶¶251-252. Thus, Nakafushi’s vaporizer 15 constitutes the claimed “fuel regulator system.” *Id.*

Moreover, even though Nakafushi's vaporizer is not expressly described as such, LPG vaporizers were well-known in the art to comprise dual-stage pressure regulators. *Id.* For example, Parlatore teaches providing fuel to an engine by vaporizing LPG in a first regulator 304, followed by flow through a second regulator 308 for "metering the flow of the propane vapor from the second regulator to an engine." Ex. 1010, ¶¶[0005]-[0006], [0014], [0016], [0018], [0020]-[0022], Figs. 1-3. In this way, the first regulator acts as the main step-down pressure regulator, while the second acts as the flow meter to the engine. *Id.*, ¶¶[0016]-[0017].

Parlatore further discloses that the primary and secondary regulators may be combined as a single, two-stage, regulator to feed the vaporized propane into the carburetor. *Id.*, ¶[0018]; Fig. 2 (two-stage regulator 202). Parlatore teaches that its fuel regulator system advantageously avoids freezing of traditional (single-stage) regulators/vaporizers without relying on a heat-control circuit from the engine. *Id.*, ¶¶[[0004], [0022]; Ex. 1003, ¶¶254-257.

Jungmann also teaches a fuel regulator system, comprising fuel regulator 28. Ex. 1011, ¶[0017]. A POSA would have understood Jungmann's fuel regulator 28 to constitute the claimed "fuel regulator system" since it reduces pressure and controls the fuel flow from the pressurized fuel container, delivering it to the engine at the pressure desired for operation. Ex. 1003, ¶258.

To the extent not sufficiently disclosed by Nakafushi or Jungmann, it would have been obvious to a POSA to incorporate Parlatore's two-stage fuel regulator system (either as two separate regulators, or as a combined dual-stage regulator) into the engine of Nakafushi to regulate the LPG gas pressure supplied to Nakafushi's engine when operating on LPG.

i. Motivation to Combine / Expectation of Success

A POSA would have been motivated to utilize Parlatore's fuel regulator system with Nakafushi's engine for several reasons. First, Nakafushi discloses vaporizer 14 along the LPG supply line. According to Parlatore (Ex. 1010, ¶[0004], if Nakafushi's vaporizer had only a single stage, it could freeze due to the endothermic nature of vaporizing a liquid under pressure in typical conditions. Ex. 1003, ¶261. While this may be prevented by routing a source of heat to the vaporizer, such as from the engine cooling system (*see, e.g.*, Ex. 1010, ¶[0022]), such systems are more costly to design and build and more complicated to operate. Ex. 1003, ¶262.

Parlatore's two-stage fuel regulator system solves this problem by partially reducing the pressure in the first regulator, and then further reducing the pressure in the second-stage regulator to more precisely control delivery to the engine. *Id.*; Ex. 1010, ¶¶[0005]-[0006], [0014], [0016]-[0017]. Thus, a POSA would have been motivated to utilize Parlatore's fuel regulator system in Nakafushi's engine to

avoid regulator freezing and/or the need for a heat source, while maintaining better reliability and more precise control over LPG fuel delivery to the engine. Ex. 1003, ¶¶263-264.

A POSA would have reasonably expected success in implementing Parlatore's dual-stage fuel regulator system in Nakafushi's engine because it would have involved nothing more than replacing Nakafushi's vaporizer 14 with Parlatore's first and second regulators, or its dual-stage regulator, to achieve the same function of vaporizing the LPG and providing it to the engine at the desired pressure. Indeed, Parlatore expressly states that its fuel regulator system can be implemented in generators. Ex. 1010, ¶[0019].

e. Element [11.4]

Element [11.4] recites “a primary pressure regulator coupled to a service valve of the pressurized fuel source to regulate fuel supplied from the pressurized fuel source to a reduced pressure.”

Parlatore discloses a primary regulator 304 coupled to service valve 316 of the pressurized propane tank 300. Ex. 1010, ¶¶[0020]-[0023], Fig. 3. Regulator 304 regulates the propane to a reduced pressure. *Id.*, ¶[0016]; *see also* ¶[0020] (referring to the “primary regulator 304, as described previously [as primary regulator 106]”). Parlatore's Figure 3 shows an exemplary embodiment:

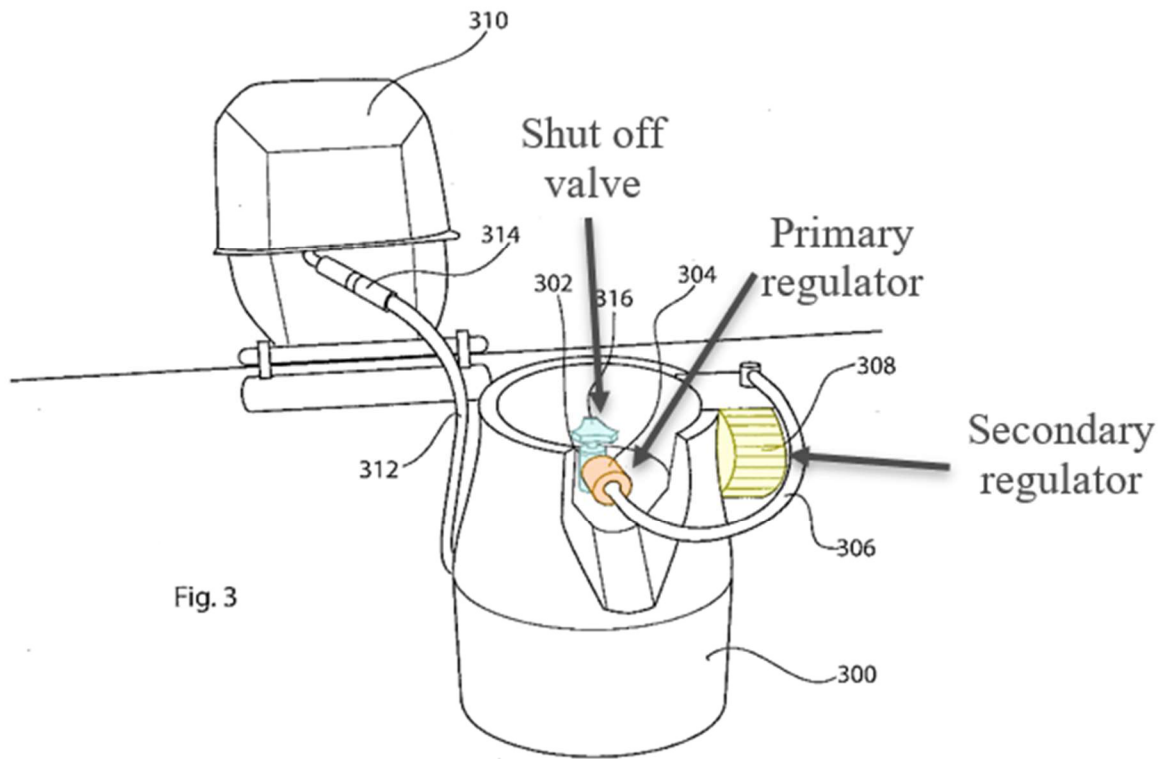


Fig. 3

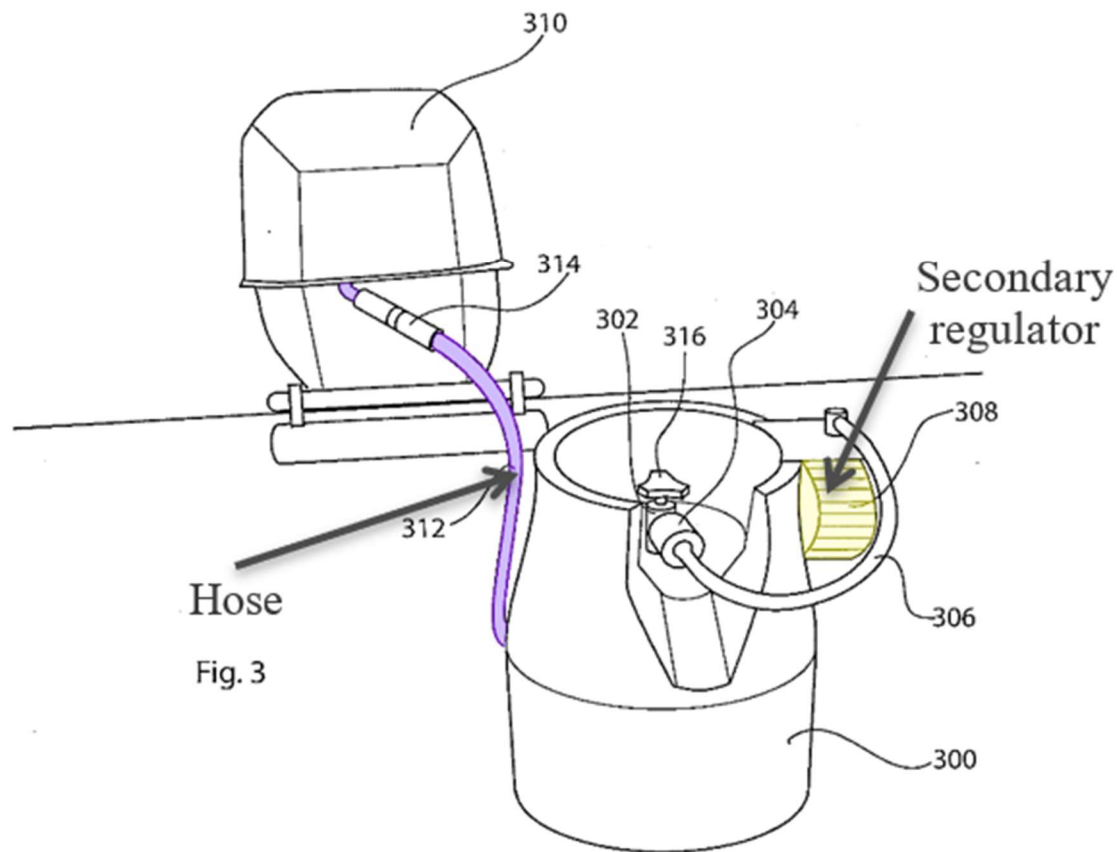
Ex. 1003, ¶¶267-68. Parlature's two-stage regulator 202 also comprises a primary, first-stage regulator coupled to the LPG tank. Ex. 1010, ¶¶[0019]-[0021], Fig. 2.

Parlature's fuel regulator system would have been obvious to incorporate into Nakafushi's engine as discussed. *Supra*, §VII.C.1.d. Similarly, it would have been obvious to use Parlature's LPG tank 300 along with its service valve 316 with Nakafushi's engine given that such LPG tanks having service valves were well-known and ubiquitous. Ex. 1003, ¶269. This would have involved nothing more than using Parlature's LPG tank configuration as the LPG fuel source for Nakafushi, with each performing their intended function without any unexpected results. *Id.*

f. Element [11.5]

Element [11.5] recites “a secondary pressure regulator coupled to the primary pressure regulator to regulate fuel supplied from the primary pressure regulator to a desired pressure for delivery through the gaseous fuel line to operate the engine.”

Parlatore discloses secondary pressure regulator 308, coupled to the primary pressure regulator 304, for regulating the propane to a low pressure for feeding to the carburetor through hose 312. Ex. 1010, ¶[0020], Fig. 3; *see also id.*, ¶¶[0005]-[0006], [0016]-[0017]. Parlatore’s two-stage regulator 202 also comprises a secondary, second-stage regulator for the same purpose. *Id.*, ¶¶[0019]-[0021]. Parlatore’s fuel regulator system, including its secondary regulator as described above, would have been obvious to incorporate into Nakafushi to provide gaseous LPG fuel to the engine at the desired pressure via a gaseous fuel line, i.e., where Parlatore’s hose 312 replicates Nakafushi’s gaseous fuel passage 13, as seen in Figure 3:



Supra, §VII.C.1.d; Ex. 1003, ¶¶272-273.

g. Element [11.6]

Element [11.6] recites “an electro-mechanical valve system coupled to the engine and operated by an electrical switch powered by one of the alternator[sic], a battery, and a magneto that controls fuel flow to the engine from the liquid fuel source and the pressurized fuel source.”

Nakafushi discloses an electro-mechanical valve system coupled to an engine that controls liquid and pressurized gas fuel flow via operation of an electrical switch (fuel switch 19) that is powered by battery 21. Ex. 1005,

¶¶[0013]-[0014], Fig. 1. Fuel switch 19 selectively connects or disconnects the valves (i.e., gasoline cut valve 17, LPG cut valve 18, and control valve 23) to/from the battery, thereby actuating the valves to their open or closed positions to control liquid and gas fuel flow. Ex. 1005, ¶¶[0013]-[0014], Fig. 1; *supra*, §VII.A.1.f. Because these valves are mechanical valves that open and close the fuel paths in response to electrical signals powered by a battery pursuant to switch 19, a POSA would have understood them to constitute an electro-mechanical valve system with an electrical switch. Ex. 1003, ¶¶275-276.

2. Claim 12

Claim 12 depends from Claim 11, and further recites “wherein the electro-mechanical valve system is configured to switch operation of the generator from multiple fuel sources while the generator is running.”

As explained for Claim 20, Nakafushi’s valve system is configured to switch operation of the engine among multiple fuel sources while the engine is running. *Supra* §VII.C.2. Those same arguments especially apply when Nakafushi’s engine includes an alternator to function in a generator (per the teachings of Jungmann (*supra*, §VII.C.1.a)), because a POSA would find it advantageous to be able to switch fuel sources while keeping the generator operating for a continuous source of power. Ex. 1003, ¶¶279-280.

3. Claim 13

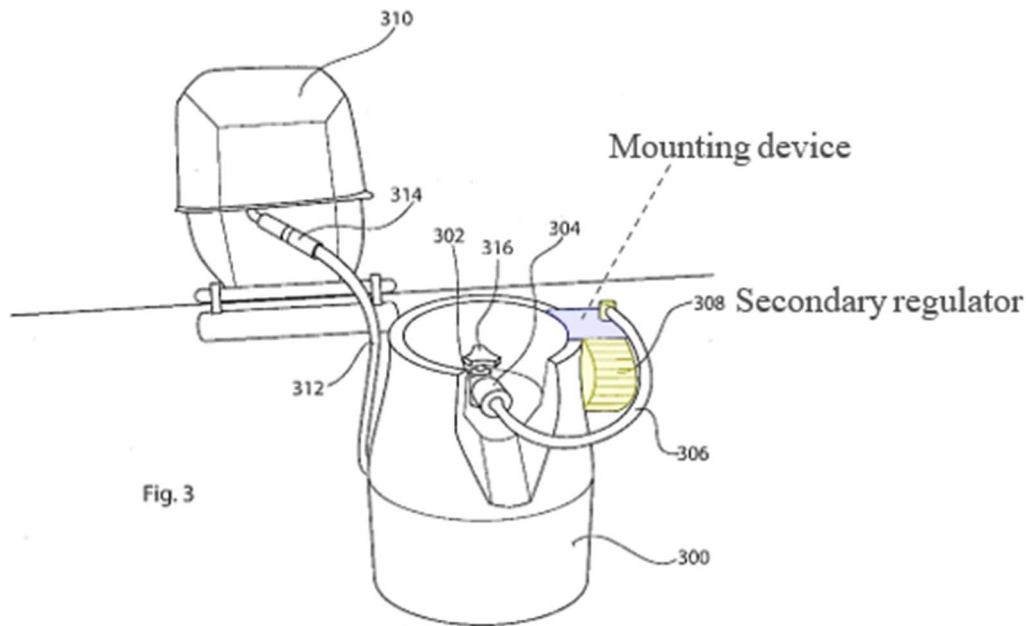
Claim 13 depends from Claim 11, and further requires “wherein the electro-mechanical valve system is configured to prevent simultaneous delivery of the liquid fuel and the gaseous fuel to the engine.”

As explained for Claim 22, Nakafushi’s valve system is configured to prevent simultaneous delivery of gasoline and LPG to the engine. *Supra*, §VII.C.4.

4. Claim 16

Claim 16 depends from Claim 11, and further requires “wherein the pressurized fuel source comprises a pressurized fuel container located off-board the generator having a regulator mounting device to secure at least the secondary pressure regulator thereto.”

Parlatore discloses LPG tank 300 located off-board its engine and a regulator mounting device to secure the secondary pressure regulator 308 to the LPG tank:



Ex. 1010, Fig. 3 (annotated); Ex. 1003, ¶¶285-286.

It would have been obvious to incorporate Parlatore's remote tank and mounting device into Nakafushi for the same reasons discussed. *Supra*, §VII.D.1.d-f; *see also infra* §VII.H.2.C.i.

5. ***Claim 17***

Claim 17 depends from Claim 11, and further requires that the “dual stage pressure regulator comprises the primary pressure regulator and the secondary pressure regulator.”

Parlatore discloses this element: “the regulator arrangement of the primary regulator 106 and the secondary regulator 110 may be such that they are combined as a single, two-stage, regulator 202.” Ex. 1010, ¶[0018], Fig. 2.

E. Ground 5: Claims 14-15 and 24 are obvious over Nakafushi in view of Jungmann and Parlatore, with Olmr and/or Bernhardsson

Claims 14-15 and 24 of the '034 Patent are obvious under 35 U.S.C. §103, as detailed below and in Dr. Morse's declaration (*see* Ex. 1003, ¶¶289-307).

1. Claim 14

Claim 14 depends from Claim 11.

a. Element [14.1]

Element [14.1] requires "a carburetor cutoff solenoid coupled to a carburetor to control liquid fuel flow to the engine."

As discussed, Nakafushi together with Olmr discloses a carburetor cutoff solenoid coupled to the carburetor to control gasoline flow to the engine via Nakafushi's valve 23. *Supra*, §§VII.A.1.d, VII.A.9.d.

b. Element [14.2]

Element [14.2] requires "a gaseous fuel cutoff solenoid coupled to the gaseous fuel line to control flow of the gaseous fuel to the engine."

As discussed, Nakafushi in combination with Bernhardsson discloses a gaseous fuel cutoff solenoid to control flow of LPG to the engine. *Supra*, §§VII.A.1.e, VII.A.2.b, VII.C.1.

2. Claim 15

Claim 15 depends from Claim 14, and further requires “a liquid fuel cutoff solenoid coupled to the liquid fuel line to control flow of the liquid fuel to the carburetor.”

As discussed, Nakafushi discloses a liquid fuel cutoff (gasoline cut valve 17), which is coupled to the gasoline line to control gasoline flow to the carburetor. *Supra*, §VII.A.9. For the same reasons, just as Bernhardsson discloses using a solenoid valve (i.e. valve 19) for cutting off the flow of gasoline from container 16 to carburetor 9 (*see* Ex. 1008, 2:13-18, Fig. 1), it would have been obvious to use a solenoid for Nakafushi’s LPG cut valve 18. *Supra*, §VII.C.1; Ex. 1003, ¶298. A POSA would have had the same motivations and reasonable expectation of success as discussed, given the general obviousness of using a solenoid for a gasoline cut valve. *Id.*

3. Claim 24

Claim 24 depends from Claim 18, with four additional elements.

a. Element [24.1]

Element [24.1] recites “an alternator driven by the engine to form a generator.”

As discussed, Jungmann discloses this limitation, and it would have been obvious to combine Jungmann with Nakafushi. *Supra*, §VII.D.1.a, VII.D.1.c.

b. Element [24.2]

Element [24.2] recites “a fuel regulator system located off-board the generator.”

As discussed, to the extent not disclosed in Nakafushi, Parlatores discloses the fuel regulator system, and it would have been obvious to a POSA to combine Parlatores with Nakafushi and Jungmann. *Supra*, §VII.D.1.d. Specifically, Parlatores’s fuel-regulator system comprises primary and secondary pressure regulators 304 and 308 positioned adjacent to the LPG tank, located “off-board” the engine. Ex. 1010, ¶¶[0019]-[0022], Fig. 3. It would have been obvious to a POSA to use the same configuration for a generator (i.e., Nakafushi’s engine operating in a generator per Jungmann), which is confirmed by Parlatores’s express suggestion for using its fuel regulator system with a generator. *Id.*, ¶[0019]; Ex. 1003, ¶303.

c. Element [24.3]

Element [24.3] recites “a primary pressure regulator coupled to a service valve of the pressurized fuel source to regulate the fuel supplied from the pressurized fuel source to a reduced pressure.”

As discussed, Parlatores discloses this element with its primary regulator 304. *Supra*, §VII.D.1.e.

d. Element [24.4]

Element [24.4] recites “a secondary pressure regulator coupled to the primary pressure regulator to regulate the gaseous fuel supplied from the primary pressure regulator to a desired pressure for delivery through the gaseous fuel line to operate the engine.”

As discussed, Parlato discloses this element with its secondary regulator 308. *Supra*, §VII.D.1.f.

F. Ground 6: Claims 1-3, 5-9, 11-14, 17-20, and 22-23 are anticipated by the Kubota DF972 Workshop Manual

Claims 1-3, 5-9, 11-14, 17-20, and 22-23 of the '034 Patent are anticipated under 35 U.S.C. §102, as detailed below and in Dr. Morse's declaration (*see* Ex. 1003, ¶¶308-421).

1. Claim 1

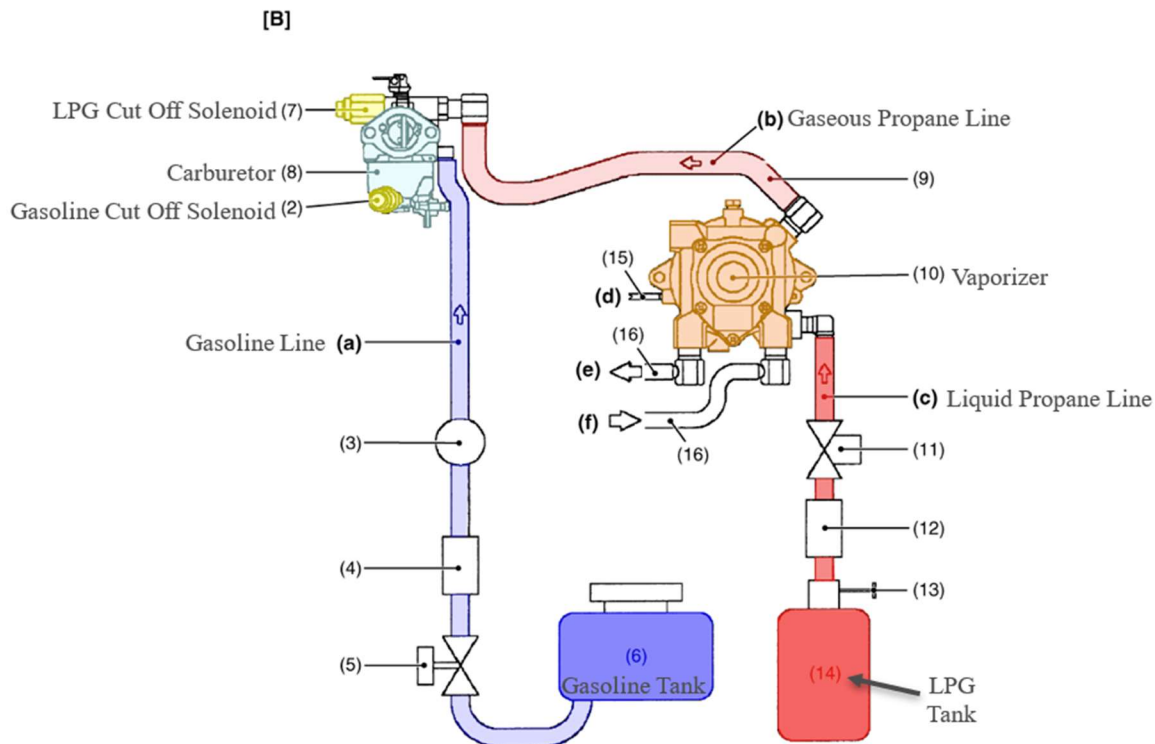
a. Element [1.0]: multi-fuel engine comprising:

To the extent the preamble is considered limiting, the Kubota DF972 Workshop Manual (“Workshop Manual”) discloses a “multi-fuel engine.”

The Workshop Manual discloses an engine having model number DF972-E2, which is a “GASOLINE, LPG, NATURAL GAS ENGINE.” Ex. 1012, 1, 53-81.

b. Element [1.1]: engine operable on liquid and gaseous fuel

The Workshop Manual teaches that the DF972-E2 engine uses both “[g]asoline fuel” and “LPG fuel.” *Id.*, 65. The figure below discloses the DF972-E2 fuel system:



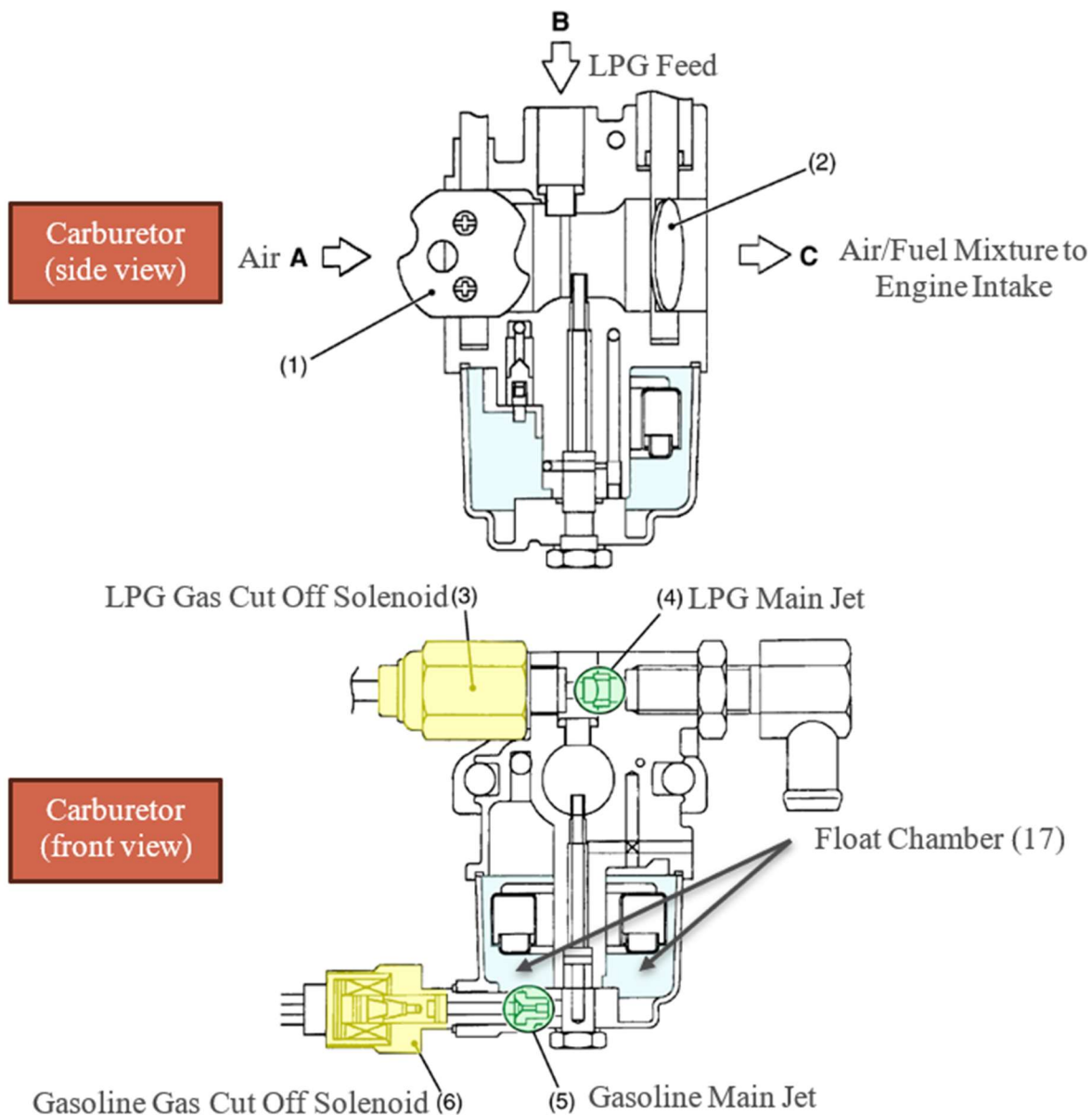
Id., 65 (annotated); Ex. 1003, ¶310. The Workshop Manual discloses operation on LPG/“LP Gas.” Ex. 1012, 1, 8, 10, 26, 30, 64, 68-69, 84. While tank (14) contains LPG in both liquid and vapor form, the Workshop Manual explains “[t]he liquid fuel is evaporated in vaporizer and is sent to the DF [dual fuel] carburetor (8) as a gaseous fuel.” *Id.*, 65 (also denoting “Gaseous Propane Line” (b)), 69 (describing the vaporizer operation).

c. Element [1.2]: carburetor

Regarding Element [1.2], the Workshop Manual discloses a carburetor that mixes air and fuel:

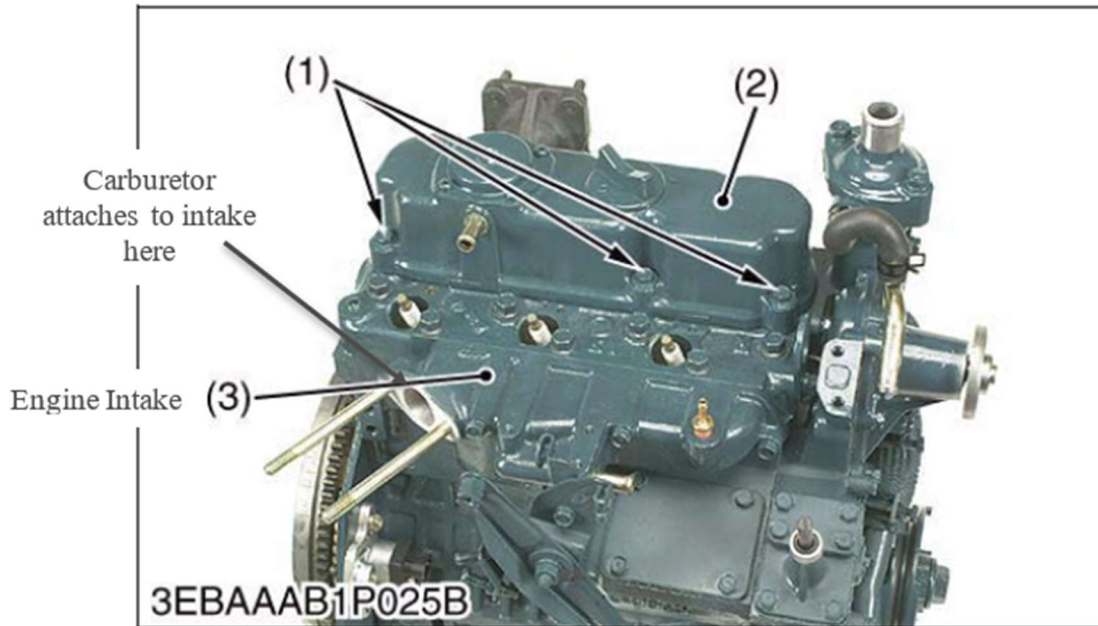
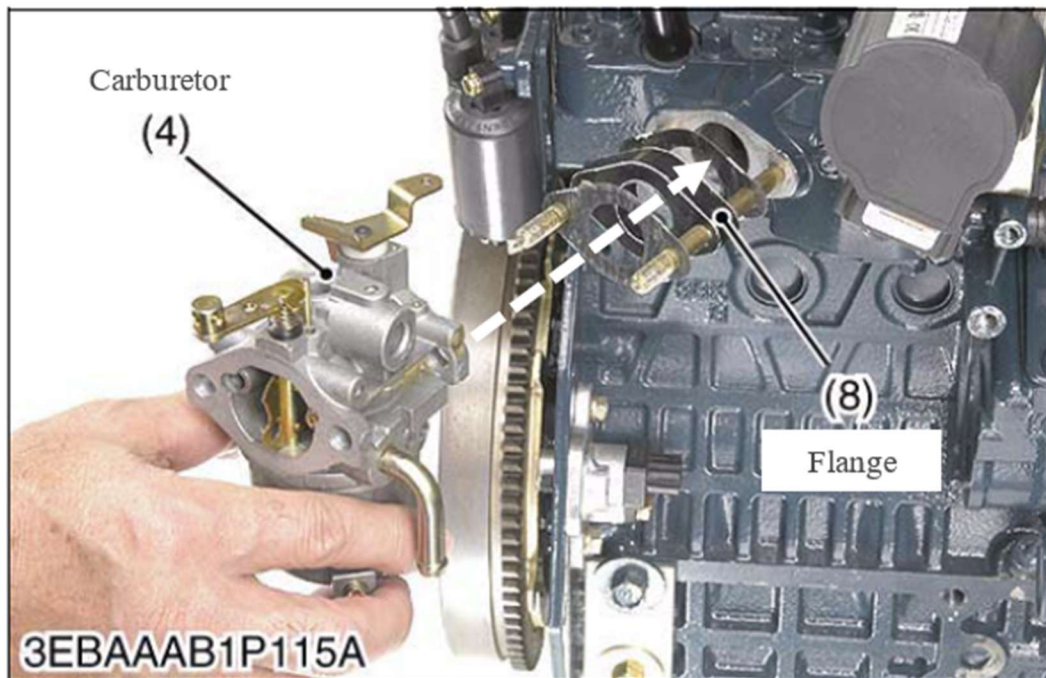
The mixer meters both fuel and air, and procedures [sic: produces] an air/fuel mixture that has the proper ratio as required by the engine. When the engine starts, the LPG furl [sic: fuel] flows out from main jet (4) to venture a constant amount and is mixed with air quantity corresponding to the opening of the throttle valve (1) and is supplied to the cylinder.

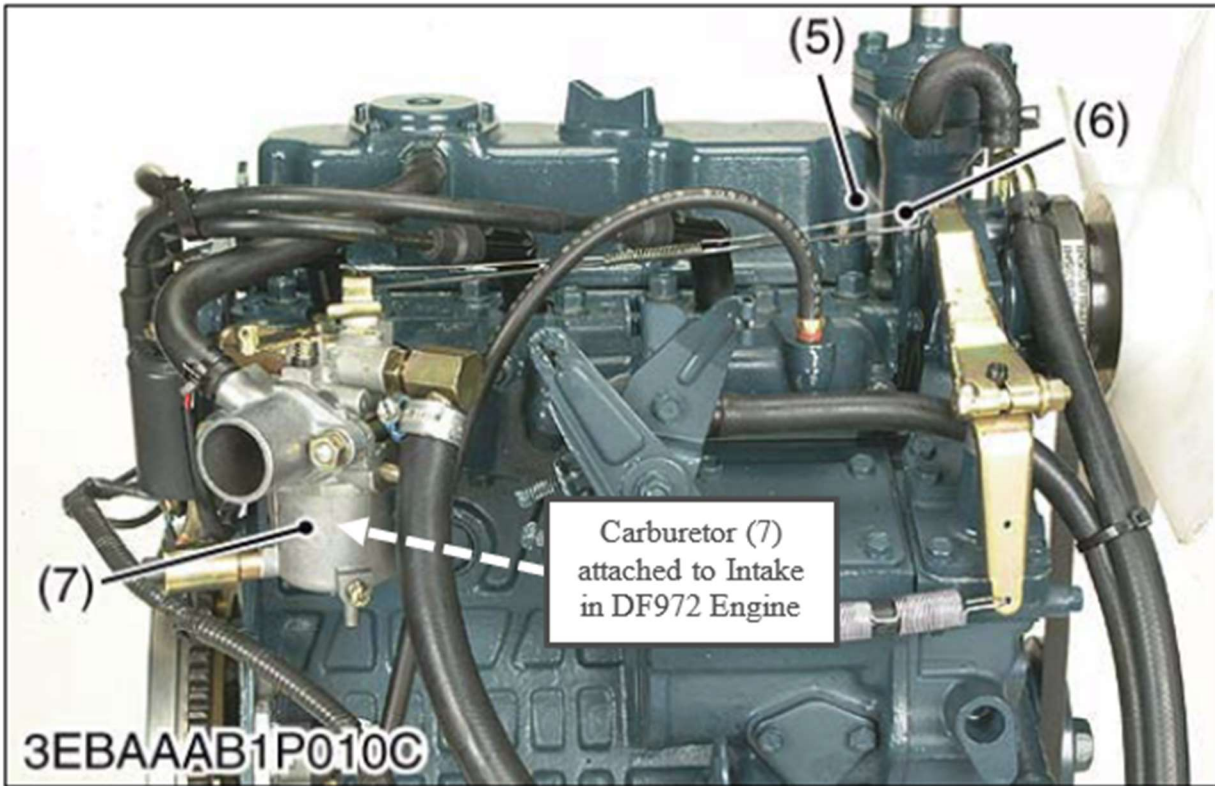
Id., 68. Workshop Manual figures illustrate the carburetor operation:



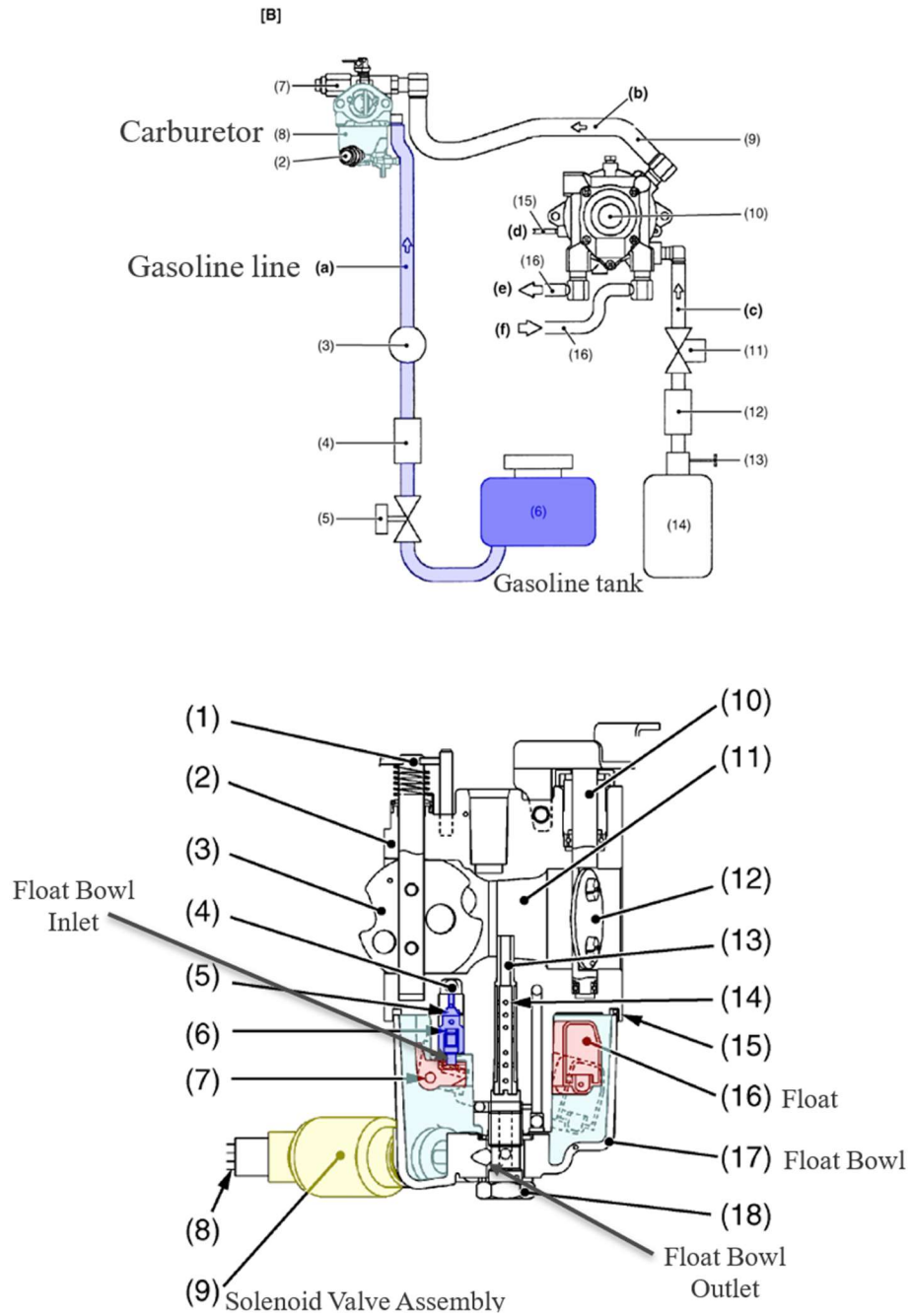
Id. (annotated); Ex. 1003, ¶313. The carburetor for the DF972 engine comprises a float bowl, labeled “float chamber (17)” in the Workshop Manual figure for the WG-972 figures (Ex. 1012, 67), which is the same for the DF-972 engine (*see id.*, 68 (noting that the DF carburetor operates the same as the gasoline-only carburetor when operating on gasoline)). Ex. 1003, ¶314.

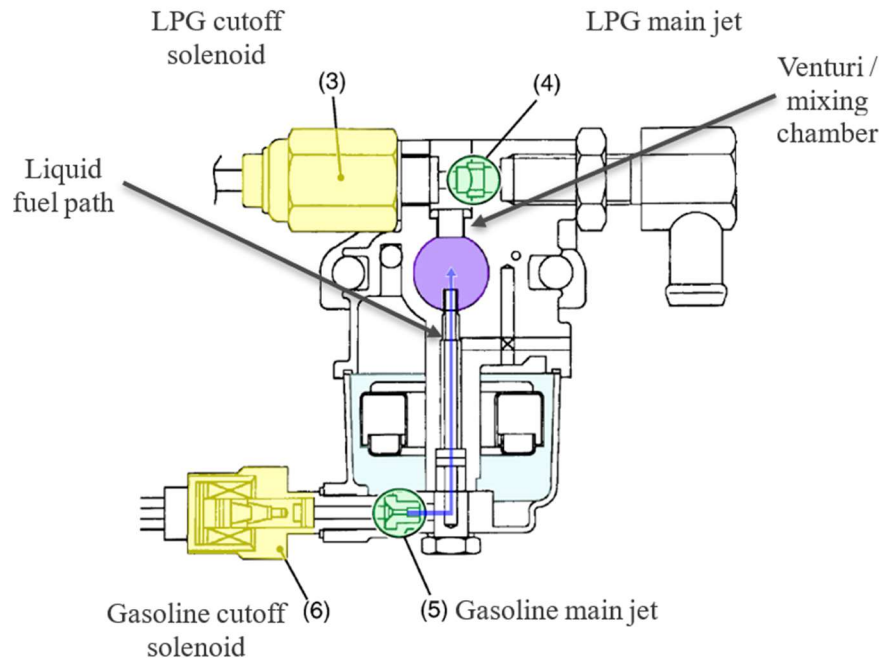
The Workshop Manual shows the carburetor is attached to the engine intake
(annotated):





Ex. 1012, 115, 119 (annotated); Ex. 1003, ¶315. The Workshop Manual also discloses that the carburetor connects a liquid fuel source (gasoline) to the engine intake, with gasoline supplied from the float bowl:

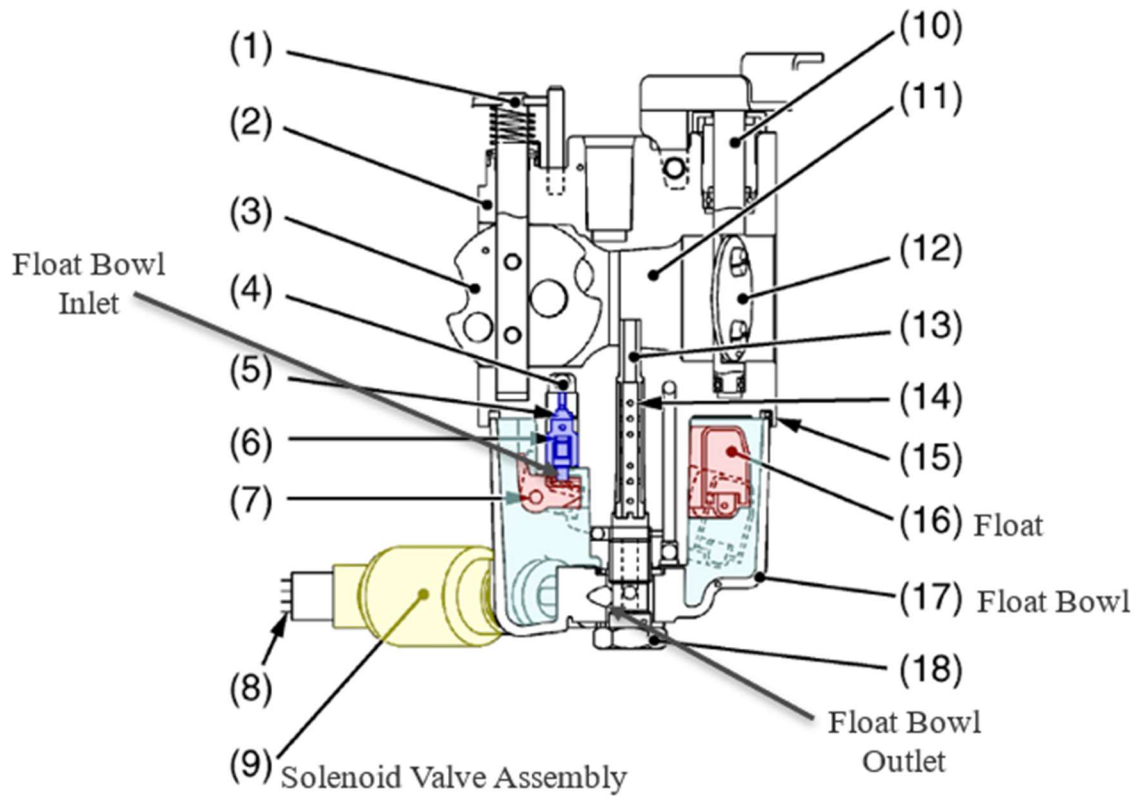




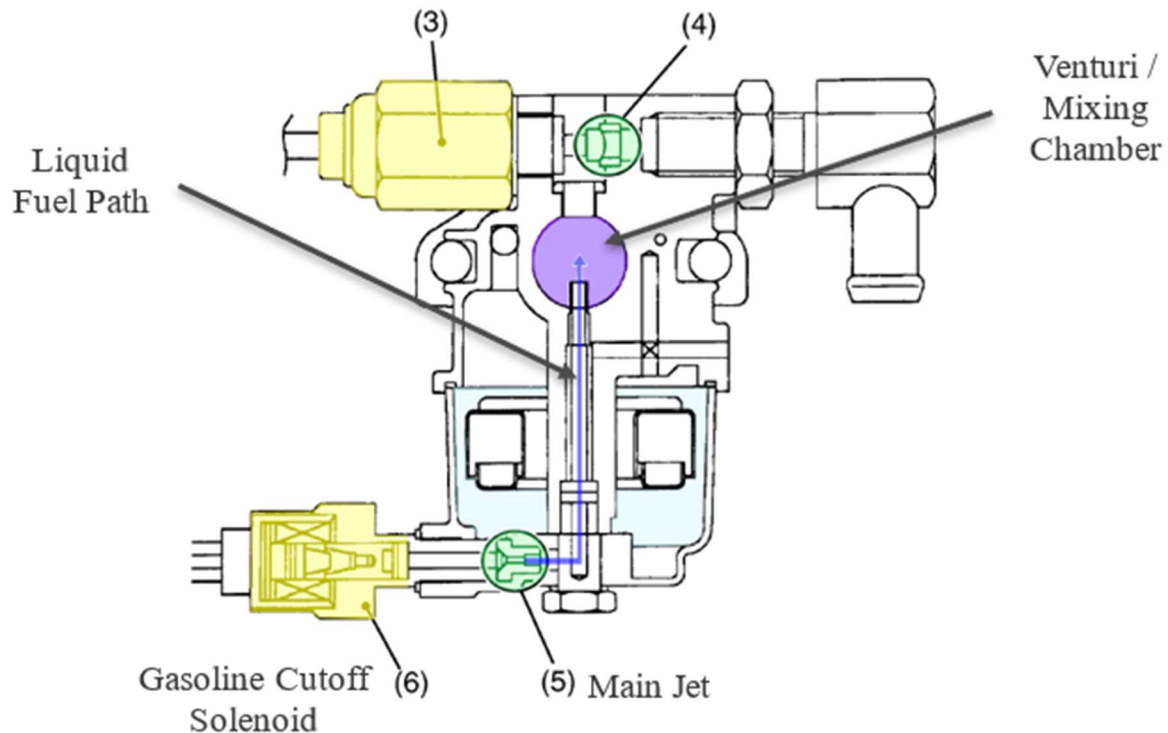
Ex. 1012, 65, 67, 68 (annotated); Ex. 1003, ¶316.

d. Element [1.3]: liquid cutoff solenoid

Regarding Element [1.3], the Workshop Manual discloses a liquid cutoff solenoid (i.e. a “Gasoline Cut Off Solenoid”) coupled to the carburetor that opens and closes a liquid fuel path downstream from the float bowl (i.e. “float chamber”). Ex. 1012, 65, 68 (“When the fuel select switch (8) in the “GASOLINE” position “D”..., the battery current flows to the gasoline cut off solenoid (6). ***Therefore gasoline fuel in the float chamber flows to the mixing chamber.***” (emphasis added)).



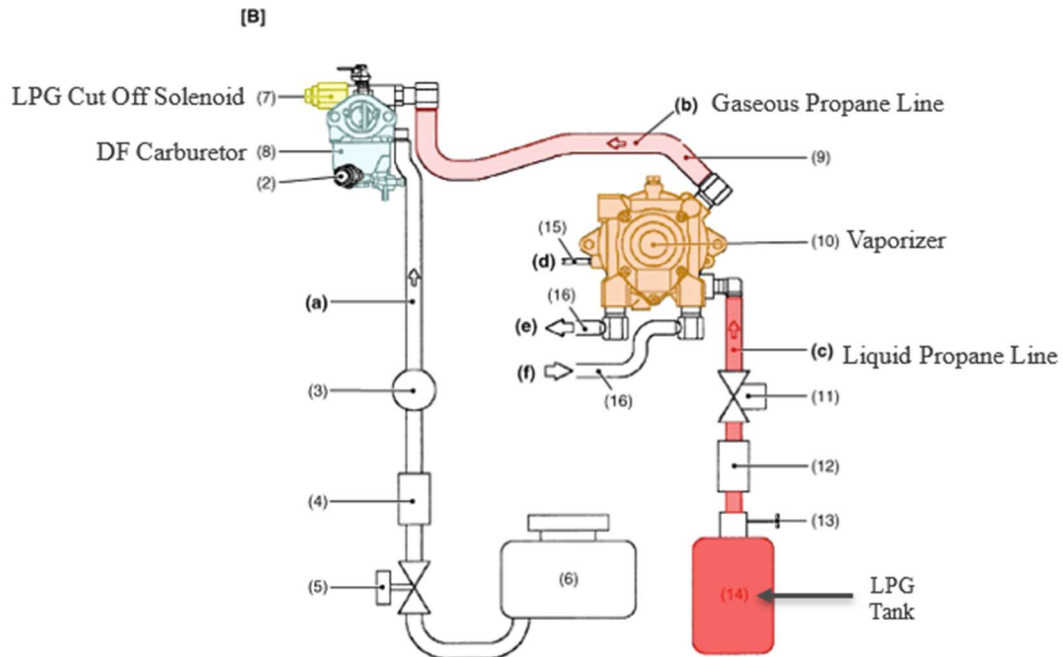
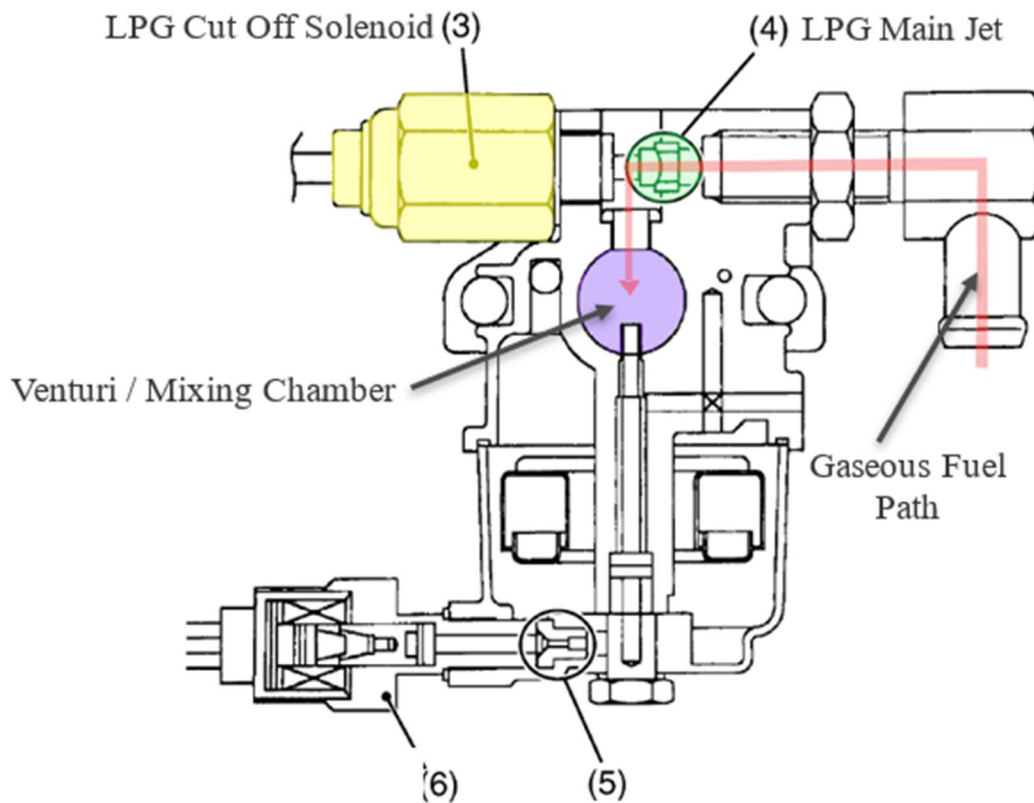
Id., 67 (annotated); Ex. 1003, ¶318.



Ex. 1012, 67 (annotated); Ex. 1003, ¶318.

e. Element [1.4]: gaseous cutoff

Regarding Element [1.4], the Workshop Manual discloses a gaseous cutoff (i.e. a “LPG Cut Off Solenoid”) that opens and closes a gaseous fuel source (i.e. the “LPG Tank (14)”) to the engine. Ex. 1012, 65, 68 (“When the fuel select switch (8) is turned to the “LPG” position “E”, the battery current... flows to the LPG cut off solenoid (3) and LPG shut off solenoid valve (9). Then, ...LPG fuel flows to the mixing chamber.”).



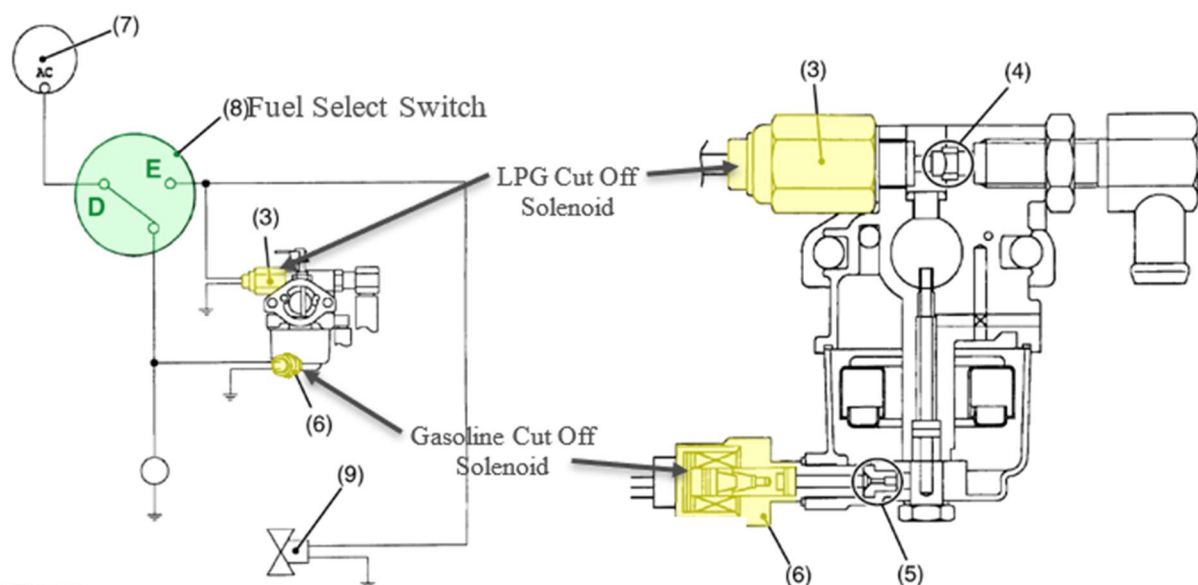
Id., 65, 68 (annotated); Ex. 1003, ¶320.

f. Element [1.5]: switch

Regarding Element [1.5], the Workshop Manual discloses a switch (i.e. a “Fuel Select Switch”) that selectively couples a power source to the liquid cutoff solenoid (i.e. the “Gasoline Cut Off Solenoid”) to open and close the liquid fuel path:

With the fuel select switch (8) in the “GASOLINE” position “D”..., the battery current flows to the gasoline cut off solenoid (6). Therefore gasoline fuel in the float chamber flows to the mixing chamber. When the fuel select switch (8) is turned to the “LPG” position “E,” the battery current stops to the gasoline cut off solenoid... [t]hen, the gasoline fuel flow is shut.

Ex. 1012, 68. This switch is also shown in the Workshop Manual figures:



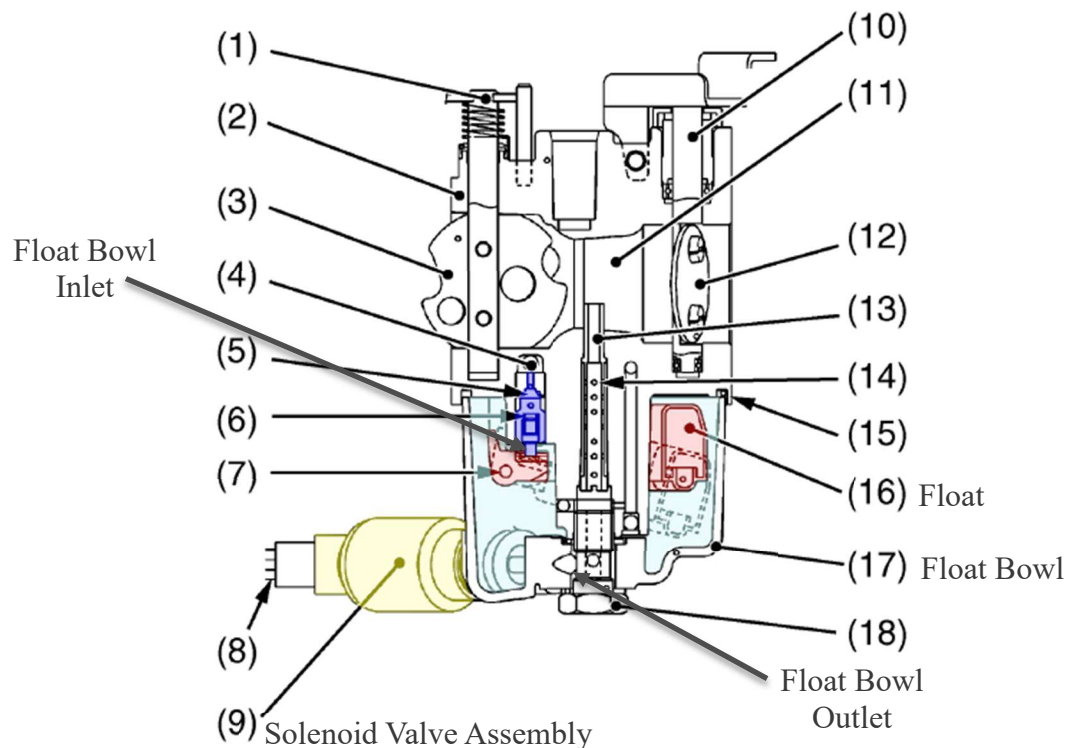
Id. (annotated); Ex. 1003, ¶¶323-323 n.8.

2. Claim 2

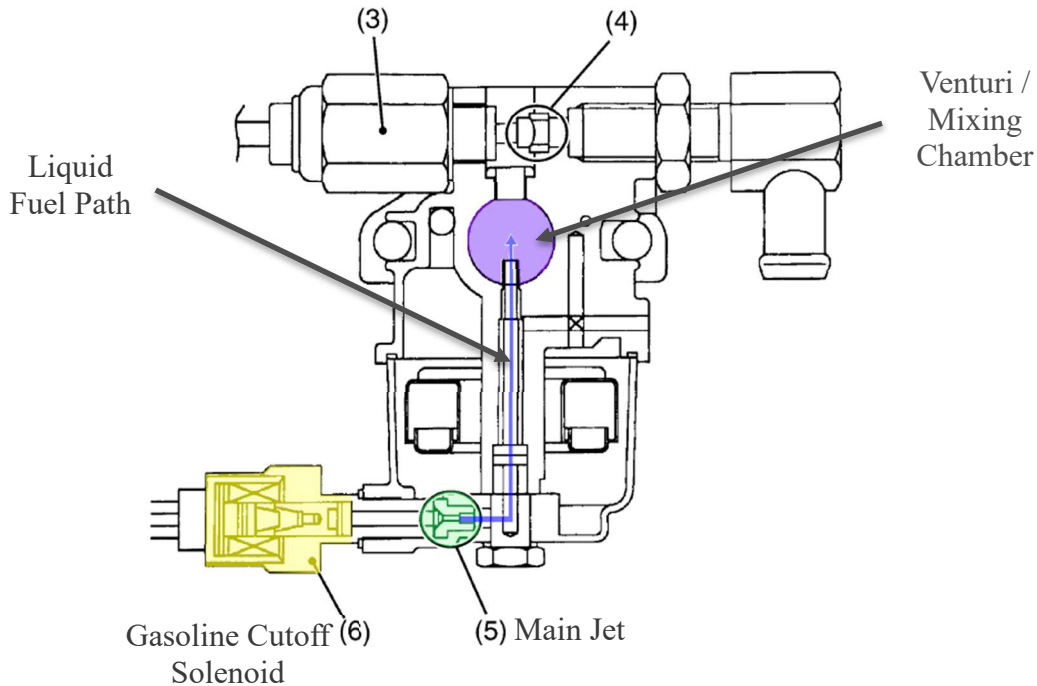
Claim 2 depends from Claim 1, with two additional elements.

a. Element [2.1]: liquid cutoff solenoid positioned on the liquid fuel path

Regarding Element [2.1], the Workshop Manual's Gasoline Cut Off Solenoid (*supra*, §VII.F.1.d) is positioned on a liquid fuel path between the float bowl and the carburetor mixer, which a POSA would understand to be the throat of the carburetor:



Id., 67 (annotated); Ex. 1003, ¶329.

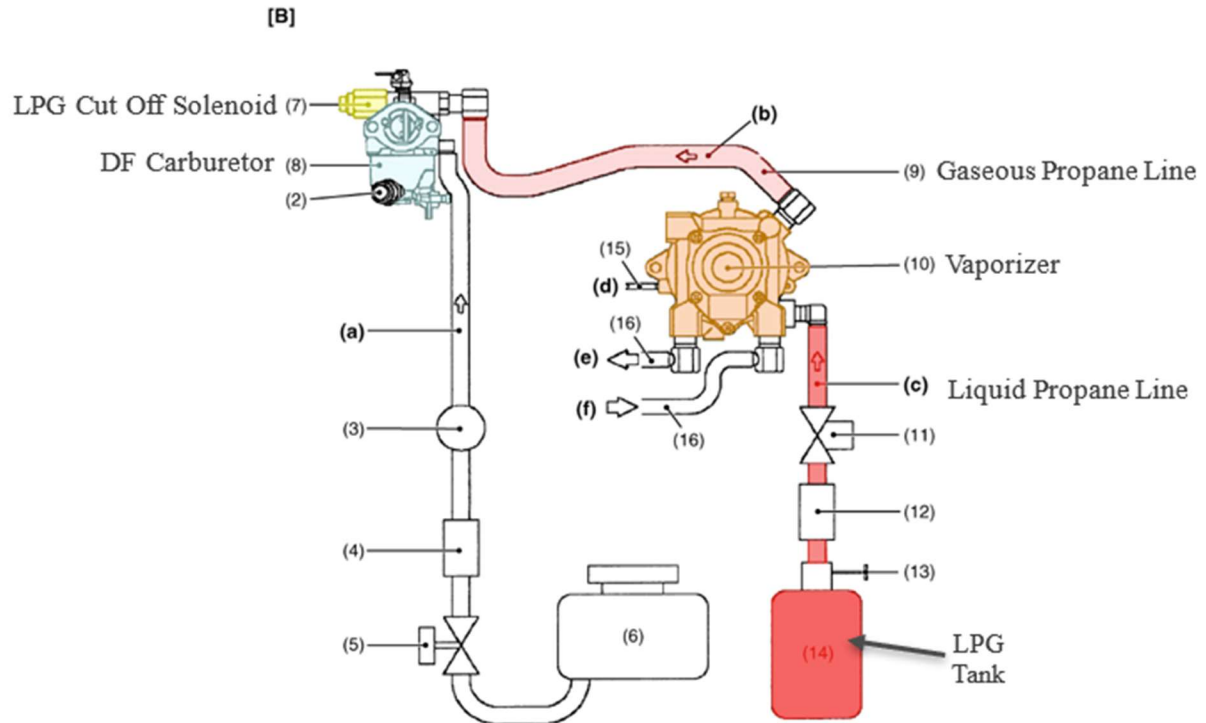
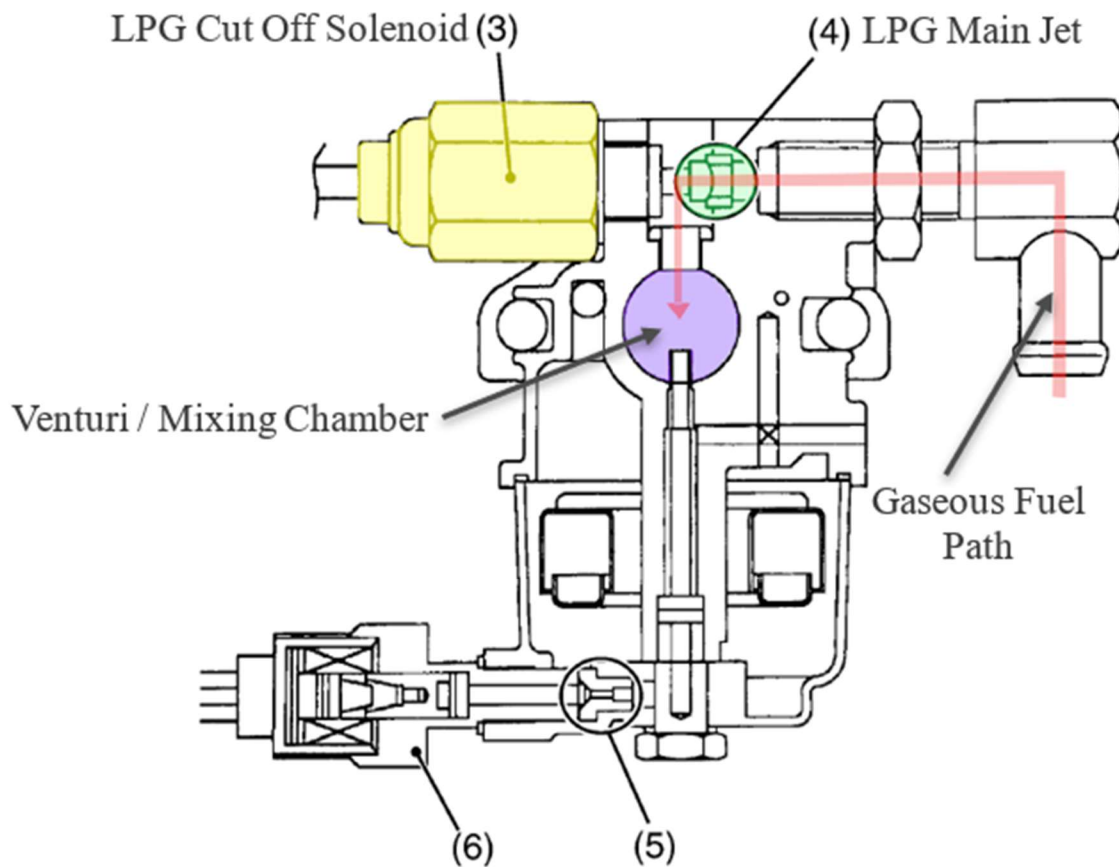


Id., 68 (annotated); Ex. 1003, ¶330.

The cutoff's positioning on the liquid fuel path between the float bowl and throat of the carburetor is shown in the figures of the Workshop Manual, and is further confirmed by U.S. Patent No. 5,809,979, to Tsuda and assigned to Kubota, describing Kubota's dual-fuel engines. Ex. 1018, 2:58-62, Fig. 1; Ex. 1003, ¶¶331-335.

b. Element [2.2]: gaseous cutoff controls flow of the gaseous fuel

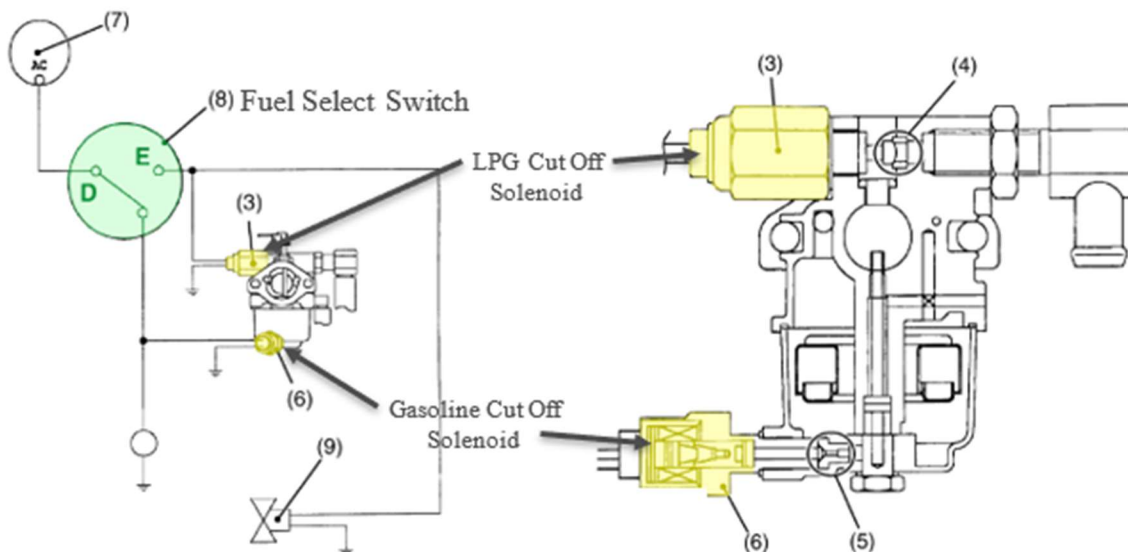
Regarding Element [2.2], as discussed previously (*supra*, §VII.F.1.e), the Workshop Manual's LPG Cut Off Solenoid controls the flow of gaseous fuel to the engine:



Ex. 1012, 65, 68 (annotated); Ex. 1003, ¶337.

3. Claim 3

Regarding Claim 3, as discussed previously (*supra*, §VII.F.1.f), the Workshop Manual describes the Fuel Select Switch switching between gasoline and LPG engine operation. Ex. 1012, 68. A POSA understood this description to convey that operating both cut-off solenoids with the same switch allows the engine to change between liquid and gaseous fuels whereby simultaneous flow from the liquid and gaseous fuel sources is prevented, because when one fuel line is opened the other is simultaneously closed, and vice versa. Ex. 1003, ¶¶339-340. This switching capability is illustrated below, where switching between gasoline and LPG involves closing the switch at position D or E, respectively:



Ex. 1012, 68 (annotated); Ex. 1003, ¶340.

The Fuel Select Switch allows switching between fuel sources “on-the-fly,” i.e., while the engine is running (Ex. 1001, 7:24-27). For example, a POSA would understand the user can toggle between positions “D” (Gasoline Position) and “E” (LPG Cut Off Solenoid) while the engine is running to switch between fuel sources on-the-fly. Ex. 1003, ¶342.

Confirming how a POSA would interpret the switching capabilities of the DF-972 engine, the Operator’s Manual notes that users can switch the fuel from gasoline to LPG and vice versa while operating the Kubota DF972-E2 engine:

In case of converting the fuel (gasoline ↔ LPG) *while running the engine*, the engine should be operated with the engine speed high and no-loaded.

Ex. 1013, 19 (emphasis added).

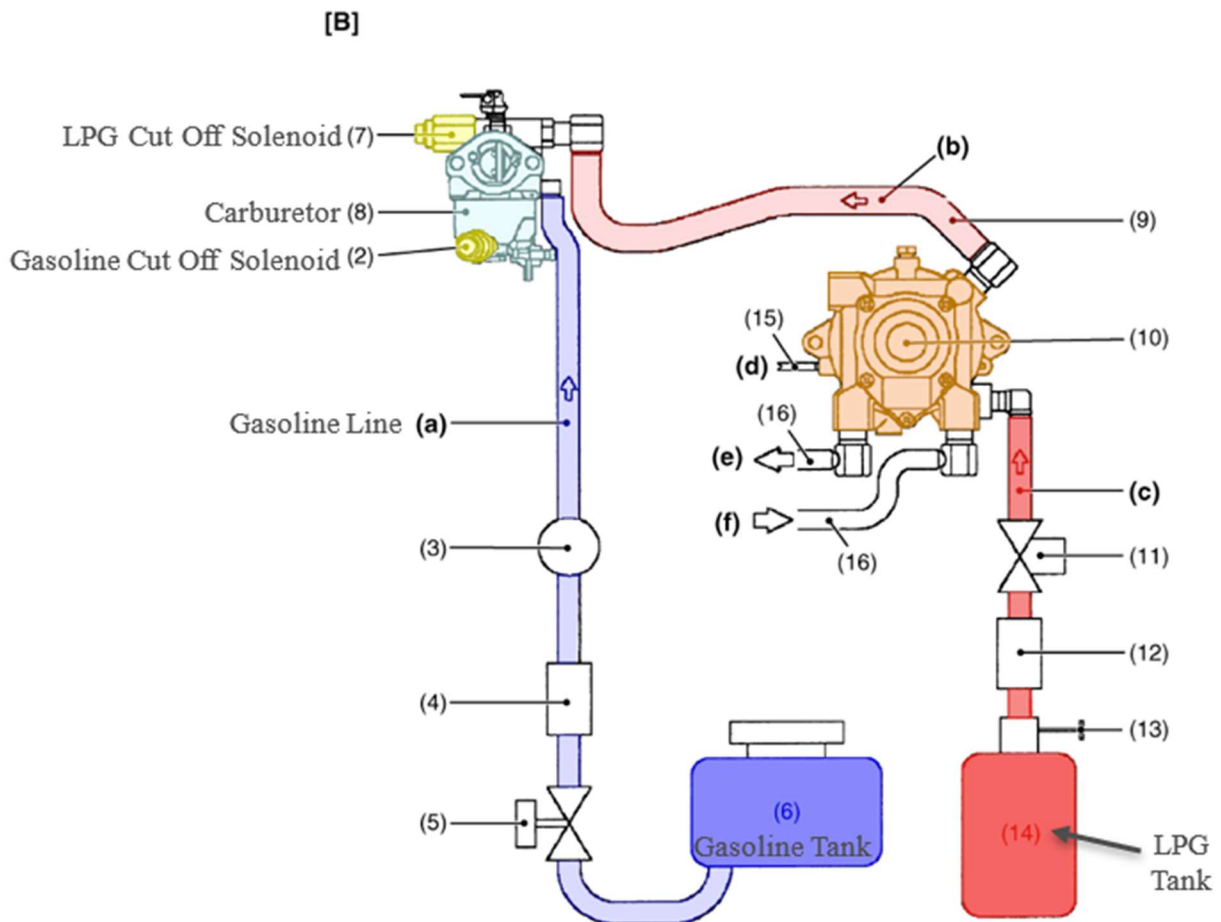
Should the Workshop Manual be deemed to not sufficiently disclose switching between fuel sources “on-the-fly,” it would have been obvious to a POSA to combine the teachings of the Workshop Manual and Operator’s Manual to satisfy this limitation. A POSA would have been motivated to combine the teachings from the manuals and would have had a reasonable expectation of success in their combination since they both disclose and discuss the configuration and operation of Kubota’s DF-972 engine. Ex. 1003, ¶344. Thus, a POSA would have learned from the Operator’s Manual that the Workshop Manual’s disclosed

DF-972 engine was configured to allow for on-the-fly switching between fuels, as claimed. *Id.*

The Workshop Manual thus anticipates Claim 3 under §102, as further informed by the Operator's Manual. In addition, Claim 3 is obvious in view of the Workshop and Operator's Manuals, and Petitioners respectfully request that this argument be assessed under §103 as needed.

4. Claim 5

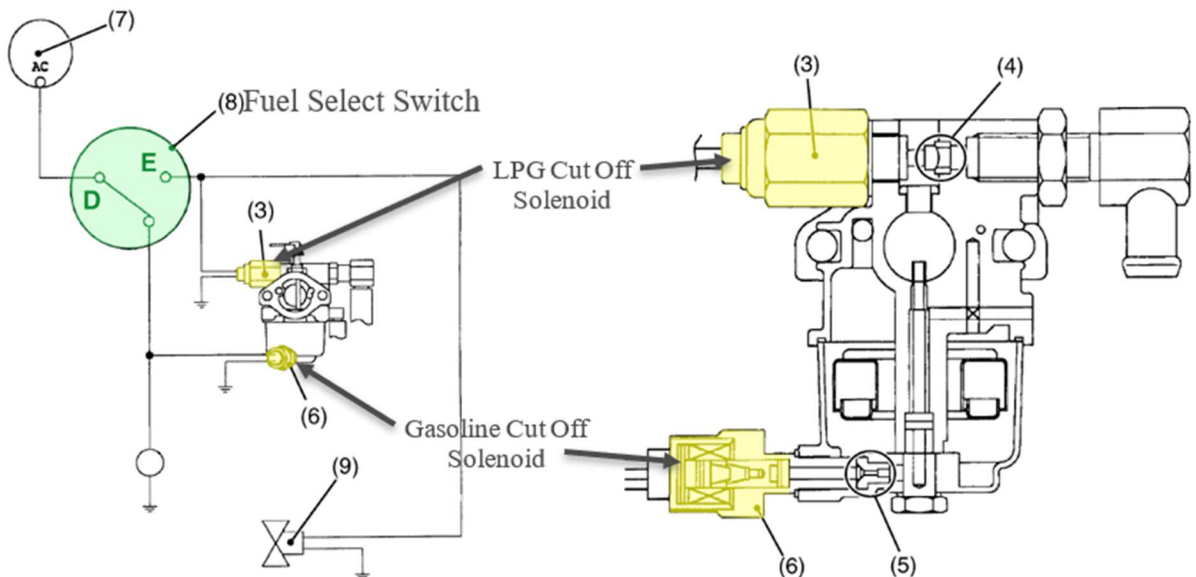
Regarding Claim 5, the Workshop Manual's dual-fuel engine operates on gasoline from Gasoline Tank (6) and LPG from LPG Tank (14):



Ex. 1012, 65 (annotated); *see also supra*, §VII.F.1.a; Ex. 1003, ¶347.

5. Claim 6

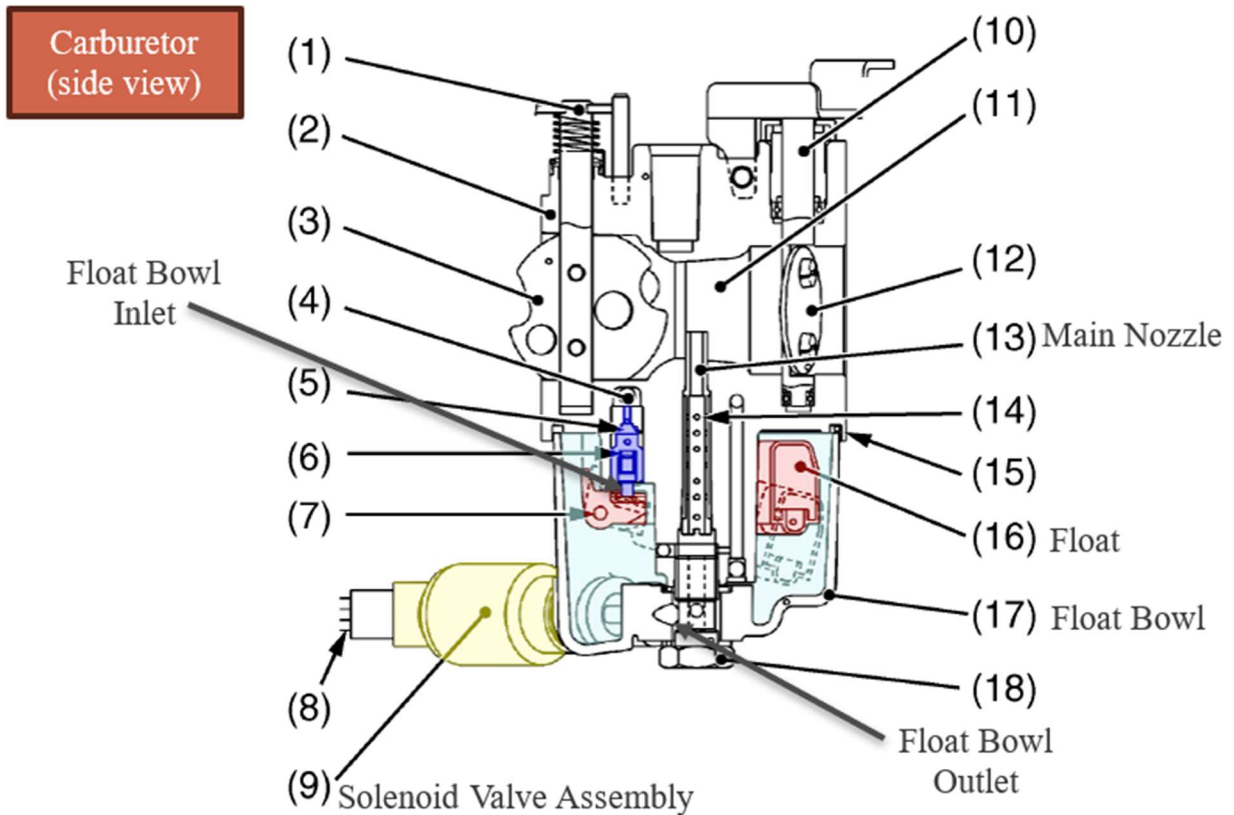
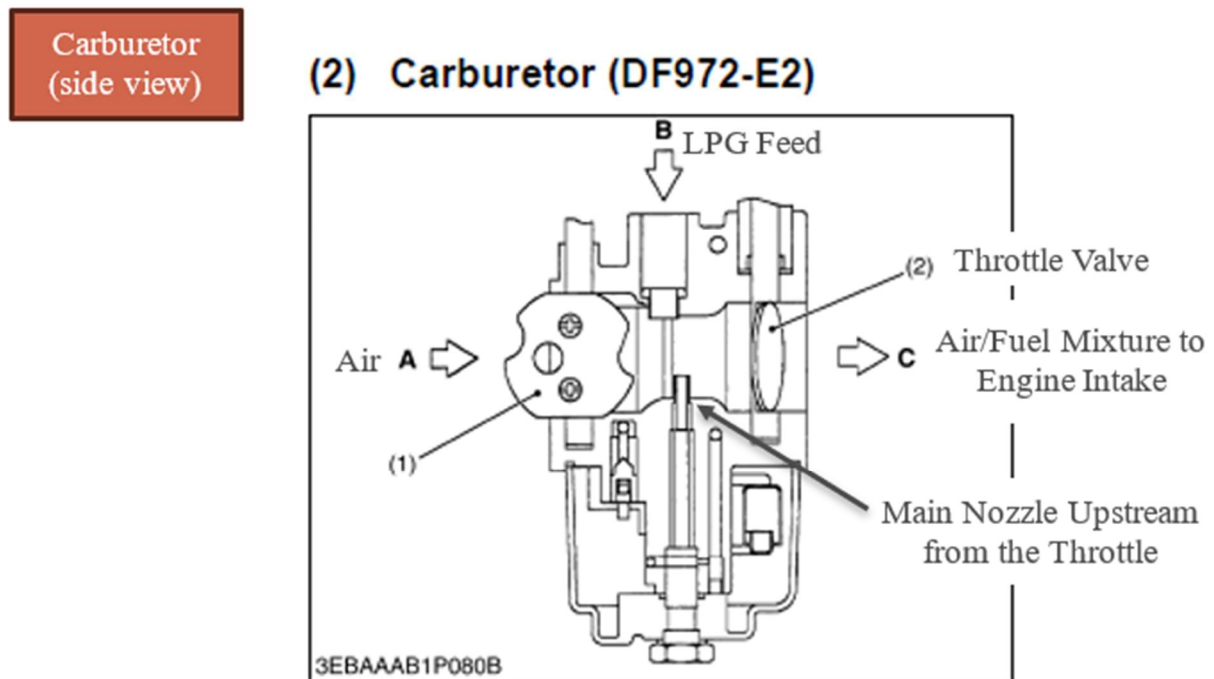
Regarding Claim 6, the Workshop Manual discloses this limitation (Ex. 1012, 68), as previously discussed. *Supra*, §§VII.F.1.f, VII.F.3. Switch operation for simultaneously activating the liquid cutoff to stop gasoline flow when the gaseous cutoff is activated will occur when the switch moves from position D to E in the schematic below:

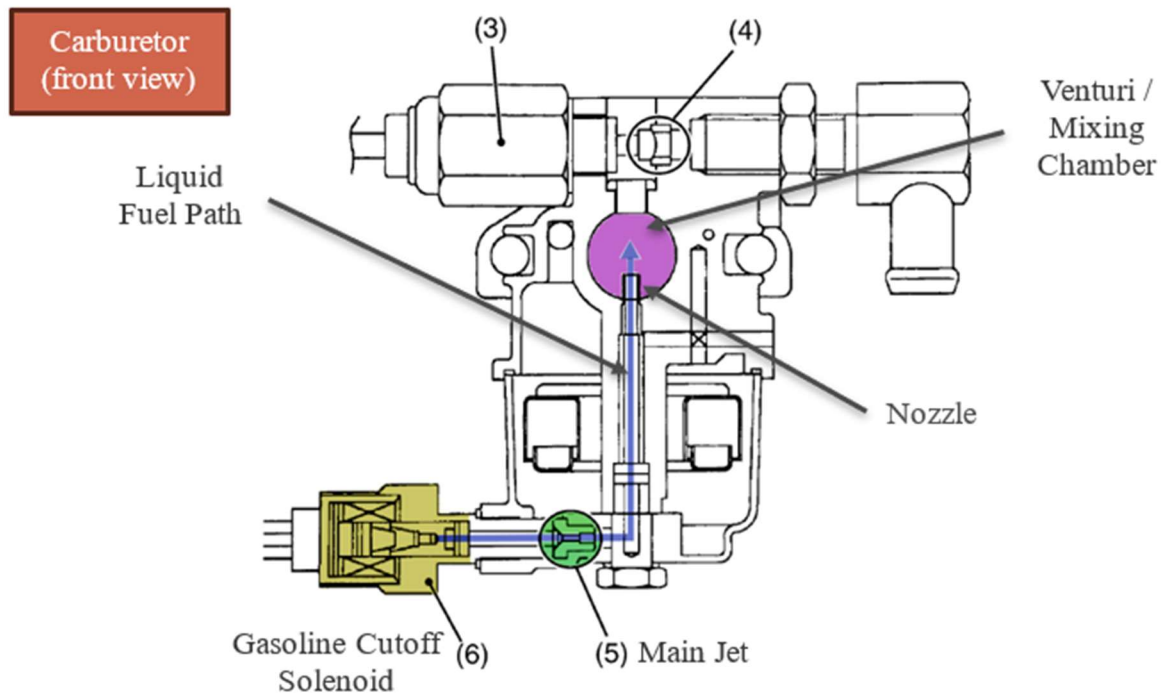


Id., 68 (annotated); Ex. 1003, ¶¶160, 351.

6. Claim 7

Regarding Claim 7, as discussed previously (*supra*, §§VII.F.1.d, VII.F.2.a), the Workshop Manual's Gasoline Cut Off Solenoid cuts off fuel flow between the Float Chamber and the Main Nozzle in the venturi of the carburetor upstream from the engine throttle ("Throttle Valve"), as depicted below:



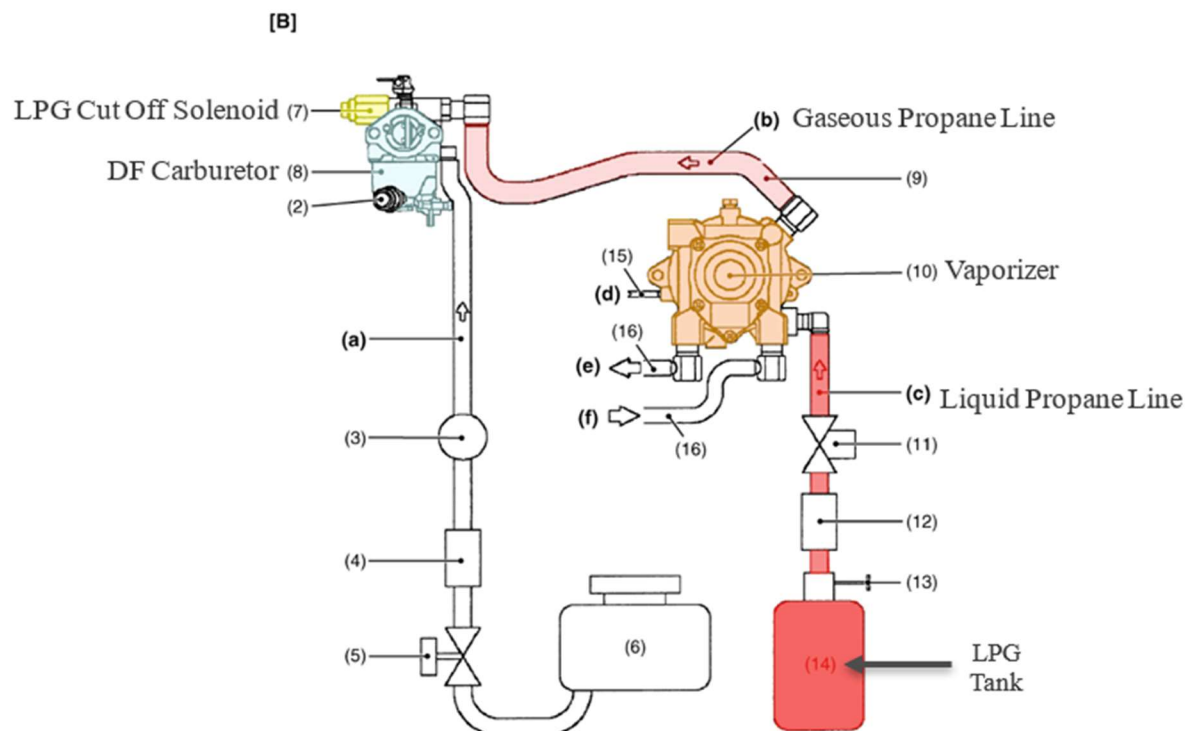


Id., 67-68 (annotated); Ex. 1003, ¶355.

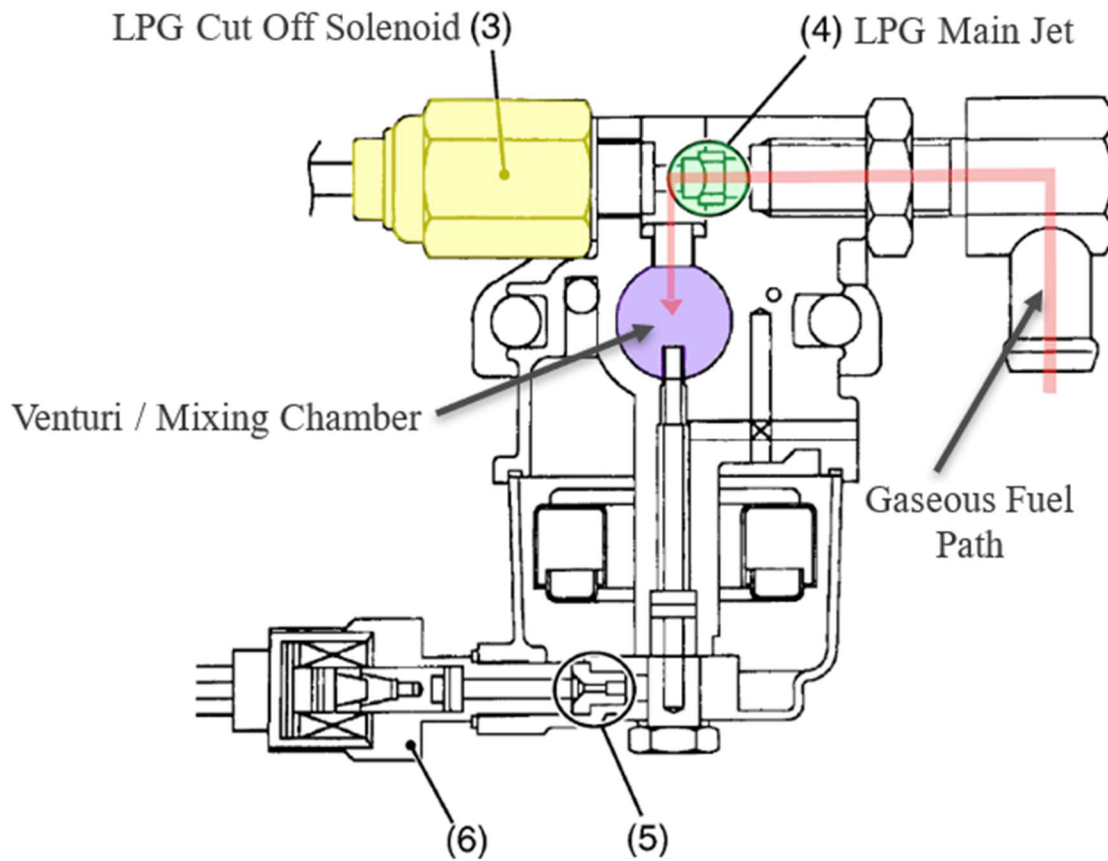
Specifically, liquid cutoff solenoid (6) stops gasoline flow to the nozzle that extends into the venturi of the carburetor throat/mixer, which is upstream from throttle (2). *Id.*, 67-68; *see also* Ex. 1018, 2:53-62, Figs. 1, 6; Ex. 1003, ¶356. As seen in the middle figure above, air A flows into the venturi from the left, mixes with fuel in the carburetor venturi section, then the air-fuel mixture flows to the engine intake via C. *Id.*; *see also supra*, §VII.F.2.

7. **Claim 8**

Regarding Claim 8, the Workshop Manual discloses a carburetor (*supra*, §VII.F.1.c) and LPG tank gaseous fuel source (*supra*, §VII.F.1.e). The carburetor connects the LPG Tank to the engine intake, as seen below:

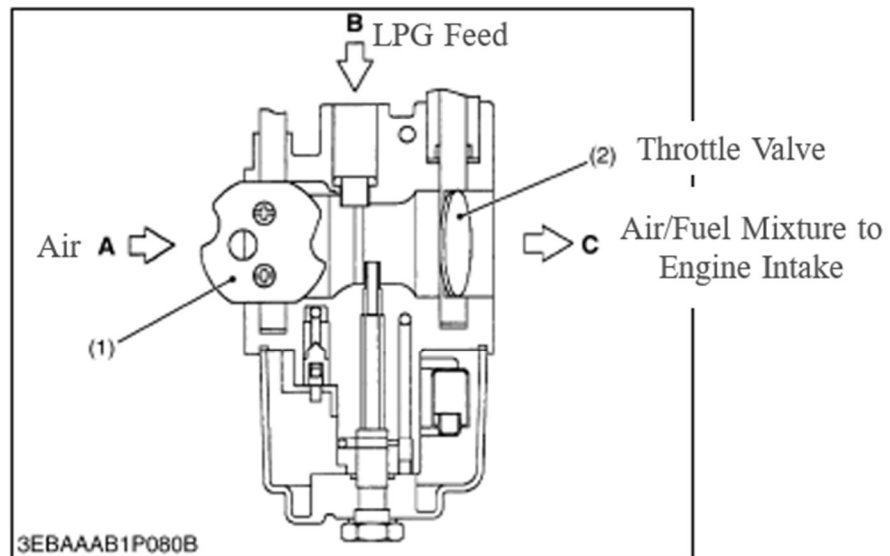


Ex. 1012, 65 (annotated); Ex. 1003, ¶359.



Carburetor
(side view)

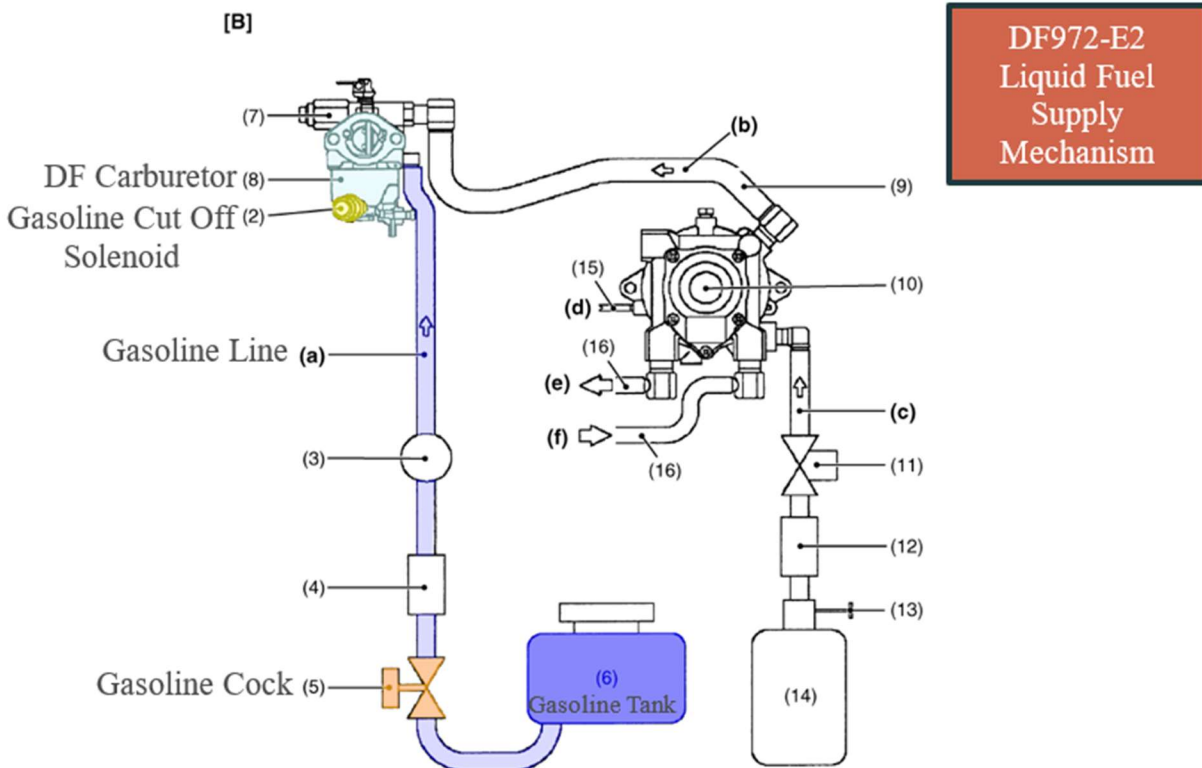
(2) Carburetor (DF972-E2)



Id., 68 (annotated); Ex. 1003, ¶359.

8. Claim 9

Regarding Claim 9, the Workshop Manual discloses a liquid fuel valve (i.e. “Gasoline Cock (5)”) and liquid fuel line (i.e. a “Gasoline Line (a)”). Ex. 1012, 65. The Workshop Manual also discloses a gasoline tank liquid fuel source and a carburetor. *Supra* §VII.F.1.c. As shown below, the Gasoline Cock is positioned on the Gasoline Line coupling the gasoline tank to the carburetor:



Ex. 1012, 65 (annotated); Ex. 1003, ¶362.

9. Claim 11

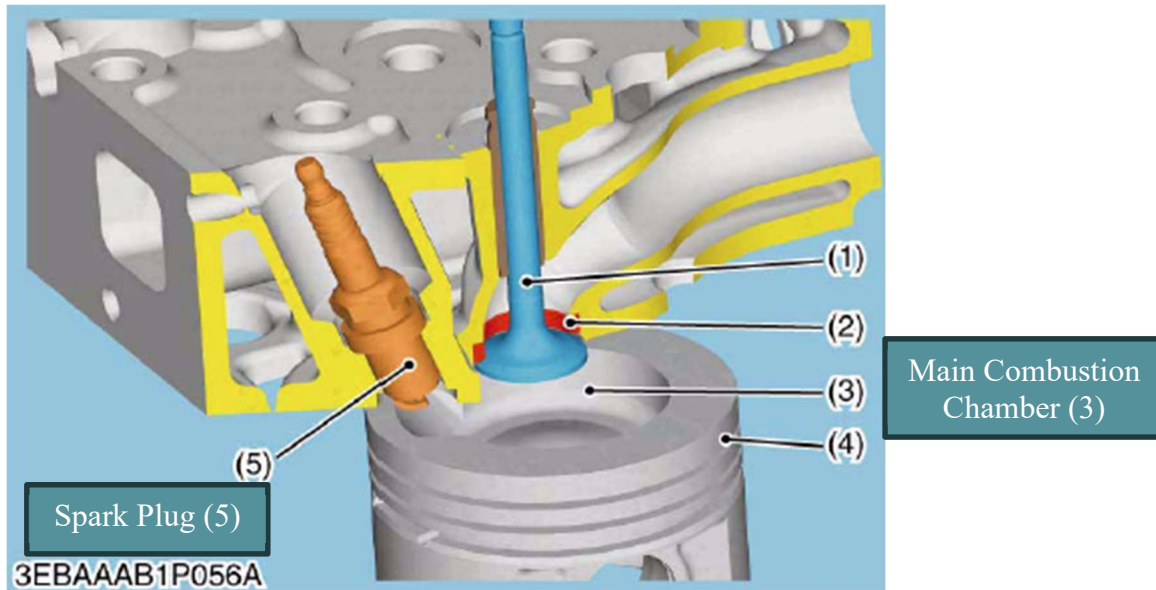
a. Element [11.0]: multi-fuel generator and fuel delivery system

Whether or not limiting, the Workshop Manual discloses a multi-fuel delivery system for a multi-fuel engine operating in a generator.

The Workshop Manual discloses a “GASOLINE, LPG, NATURAL GAS ENGINE.” Ex. 1012, 1; *supra*, §§VII.F.1.a-b. The engine includes “a rotating magnet type generator” (i.e., an alternator) that “produces higher voltage in slow speed rotation, and charges electric current to the battery during engine idling.” *Id.*, 77. The Workshop Manual specifies that the alternator outputs 150W at 12V. *Id.*, 8. Thus, Workshop Manual discloses a generator, powered by operation of the DF-972 engine. Ex. 1003, ¶364.

b. Element [11.1]: multi-fuel internal combustion engine

Regarding Element [11.1], as discussed (*supra*, §VII.F.1.b), the Workshop Manual discloses a multi-fuel internal combustion engine, where fuel (gasoline or LPG) is combusted inside the engine, ignited by spark plugs:



Ex. 1012, 54 (annotated); Ex. 1003, ¶366. The multi-fuel supply was discussed (*supra*, §VII.F.1.b), with LPG fuel being delivered by the pressure of the gaseous phase in the LPG tank. Ex. 1012, 65; Ex. 1003, ¶¶367-368.

c. Element [11.2]: alternator

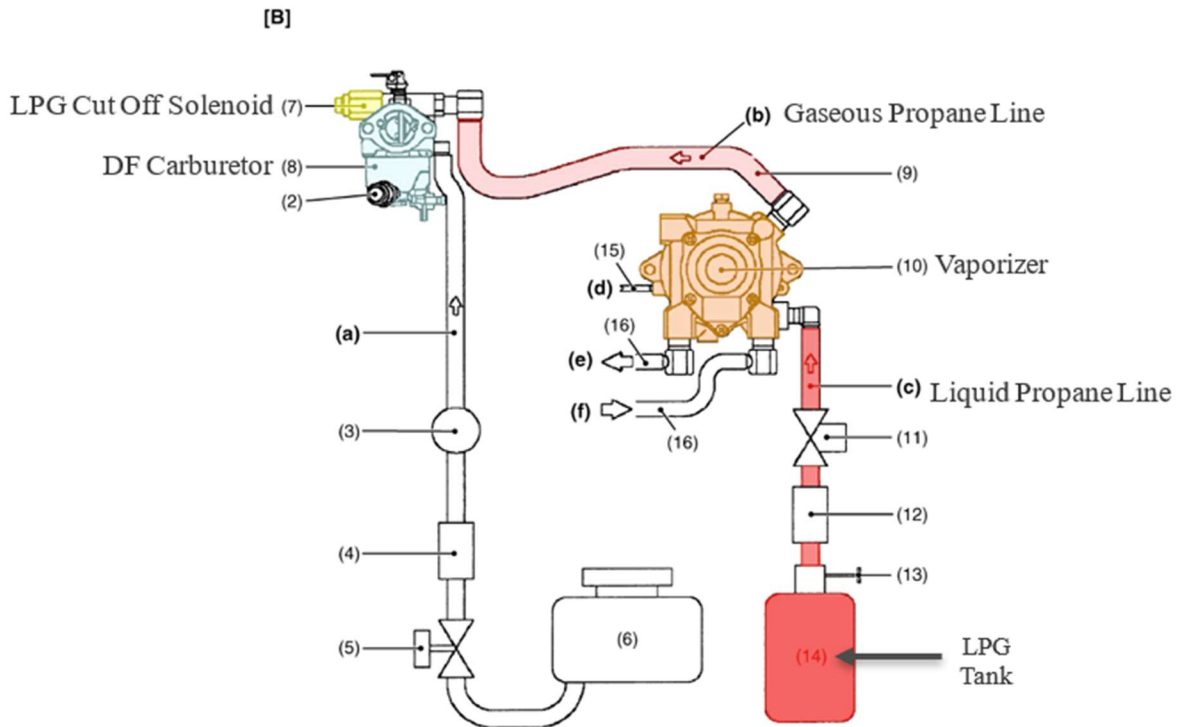
Regarding Element [11.2], the Workshop Manual discloses an alternator driven by the engine. *See* Ex. 1012, 77 (describing the construction of the alternator); *see also id.*, 8, 94, 111, 132; Ex. 1003, ¶¶369-372.

d. Element [11.3]: fuel regulator system

The “fuel regulator system” of Element [11.3] is described as including

one or more pressure regulators that reduce and control the pressure of the fuel from pressurized fuel container [] and delivers fuel at a desired pressure for operation of the engine.

Ex. 1001, 4:8-13. The Workshop Manual's discloses a fuel regulatory system (i.e. "Fuel System"):

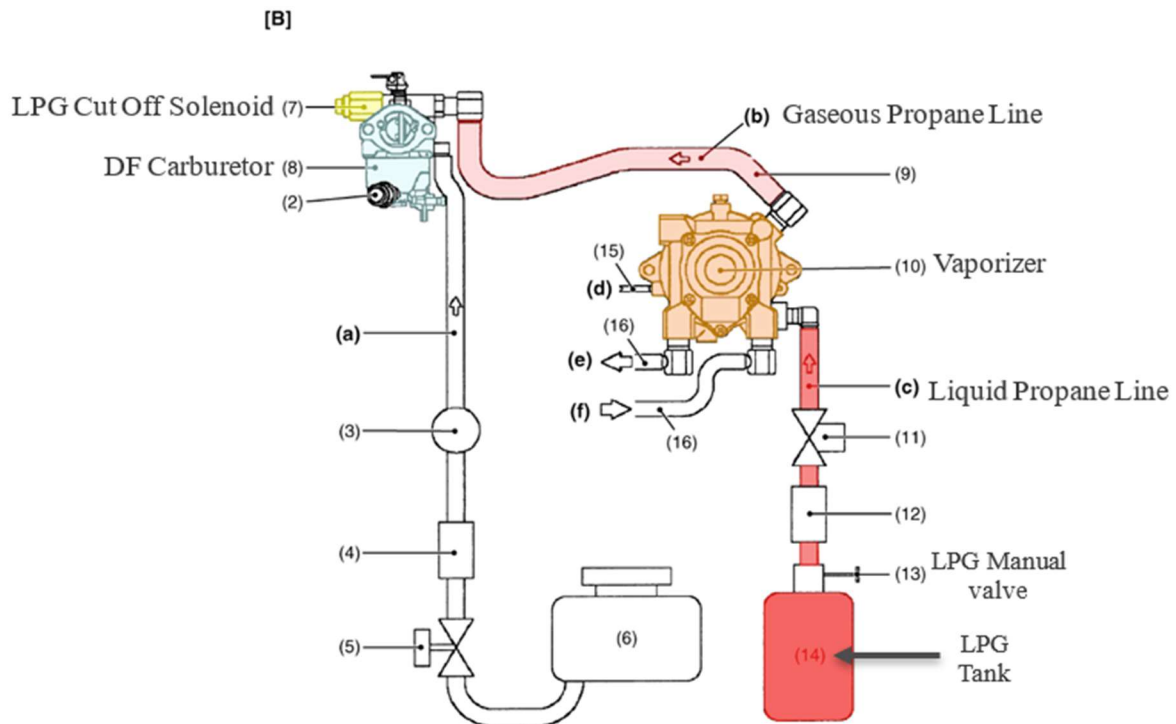


Ex. 1012, 65 (annotated) (explaining liquid LPG fuel is “evaporated in vaporizer and is sent to the DF carburetor (8) as a gaseous fuel of gas pressure near the atmospheric pressure”); Ex. 1003, ¶374. Thus, the vaporizer operates as the claimed “fuel regulator system” to reduce and control the LPG pressure from the pressurized tank for delivery at the desired pressure to the engine. *See* Ex. 1012, 69-71.

As discussed below, the vaporizer aligns with the “dual stage regulator” disclosed in the '034 Patent as an exemplary “fuel regulator system.” *See* Ex. 1001, 4:50-54, 5:1-7.

e. Element [11.4]: primary pressure regulator

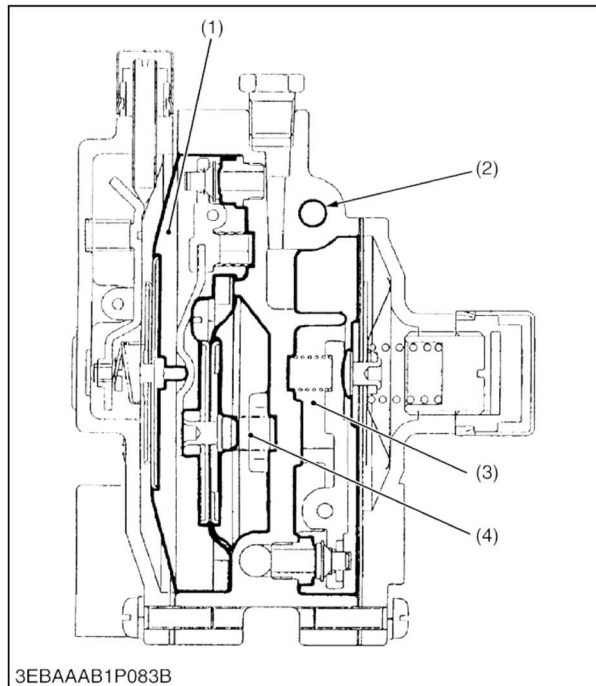
Regarding Element [11.4], the DF-972 engine obtains LPG fuel from the pressurized LPG tank, which has a service valve on its outlet (i.e., “LPG Manual Valve” (13)), to which vaporizer (10) is coupled:



Ex. 1012, 65 (annotated); Ex. 1003, ¶380.

The Workshop Manual describes the primary and secondary stages of the vaporizer as follows:

[3] VAPORIZER (DF972-E2)



Vaporizer is a device which converts the liquid fuel into the gaseous fuel and the following structures and functions are possessed.

■ **Primary Chamber**

The liquid fuel is decompressed (the first decompression) and it is evaporated.

■ **Secondary Chamber**

The fuel which flows in is decompressed from the primary chamber to the vicinity of the atmospheric pressure further (the second decompression).

■ **Water Passage**

The coolant of the engine is made to circulate as a heat source to evaporate the LPG.

■ **Vacuum Lock Chamber**

When the engine stops, the fuel from primary chamber is prevented from flowing out.

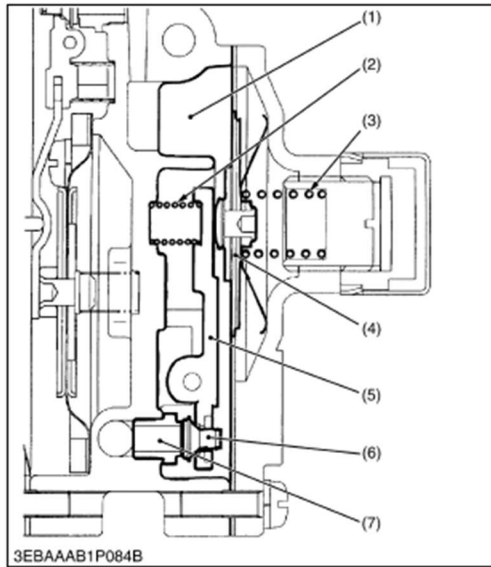
- | | |
|-----------------------|-------------------------|
| (1) Secondary Chamber | (3) Primary Chamber |
| (2) Water Passage | (4) Vacuum Lock Chamber |

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Ex. 1012, 64. The Workshop Manual thus discloses a primary pressure regulator (i.e. the “Primary Chamber”) coupled to the service valve (i.e. LPG Manual Valve (13)), whereby fuel from the pressurized tank is regulated to a reduced pressure.

Ex. 1012, 69 (explaining that in the Primary Chamber, “liquid fuel is *decompressed* (the first decompression) and it is evaporated.” (emphasis added));

Ex. 1003, ¶382. The Workshop Manual describes the “Primary Chamber” operation as follows:



Primary Chamber

The liquid fuel which pushes the primary valve (6) open passes between the valve and the valve seat (7), enters primary chamber (1), and decompresses and is evaporated.

When the inflow of the fuel continues and the primary chamber pressure rises more than the specified pressure 32.7 kPa (0.3 kgf/cm², 4.3 psi), the tension in the diaphragm spring (3) is overcome and do the push up of primary diaphragm (4).

At this time, do the push up of primary valve lever spring (2) of primary valve lever (5), primary valve (6) is shut, and the inflow of the fuel is intercepted.

The tension in the diaphragm spring (3) grows more than the primary chamber pressure when the fuel is consumed and the primary chamber pressure lowers more than a regulated value and a primary diaphragm is depressed below.

The primary valve lever (5) is depressed at the same time.

A primary valve opens and the fuel flows in again.

When the diaphragm tears by any chance and the fuel flows in the primary diaphragm spring side, the primary diaphragm spring side is connected with second chamber in the balance passage so that the fuel should not flow out outside.

- | | |
|--------------------------------|-------------------------|
| (1) Primary Chamber | (5) Primary Valve Lever |
| (2) Primary Valve Lever Spring | (6) Primary Valve |
| (3) Primary Diaphragm Spring | (7) Valve Seat |
| (4) Primary Diaphragm | |

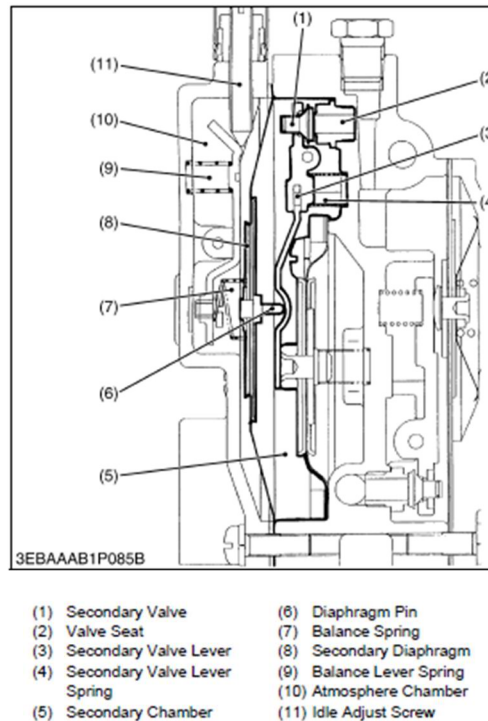
Ex. 1012, 70.

f. Element [11.5]: secondary pressure regulator

Regarding Element [11.5], the Workshop Manual discloses a secondary pressure regulator (i.e. the “Secondary Chamber” of the vaporizer) coupled to the Primary Chamber, to regulate fuel supplied from the Primary Chamber to a desired pressure for delivery through the gaseous fuel line to the DF-972 engine. *Supra*, §VII.F.9.e; Ex. 1012, 69; Ex. 1003, ¶385. The Workshop Manual depicts the Secondary Chamber and explains:

The fuel adjusted with primary chamber to the specified pressure enters secondary chamber (5) between secondary valve (1) and the valve seat (2) and is

decompressed to the vicinity of the atmospheric pressure almost.



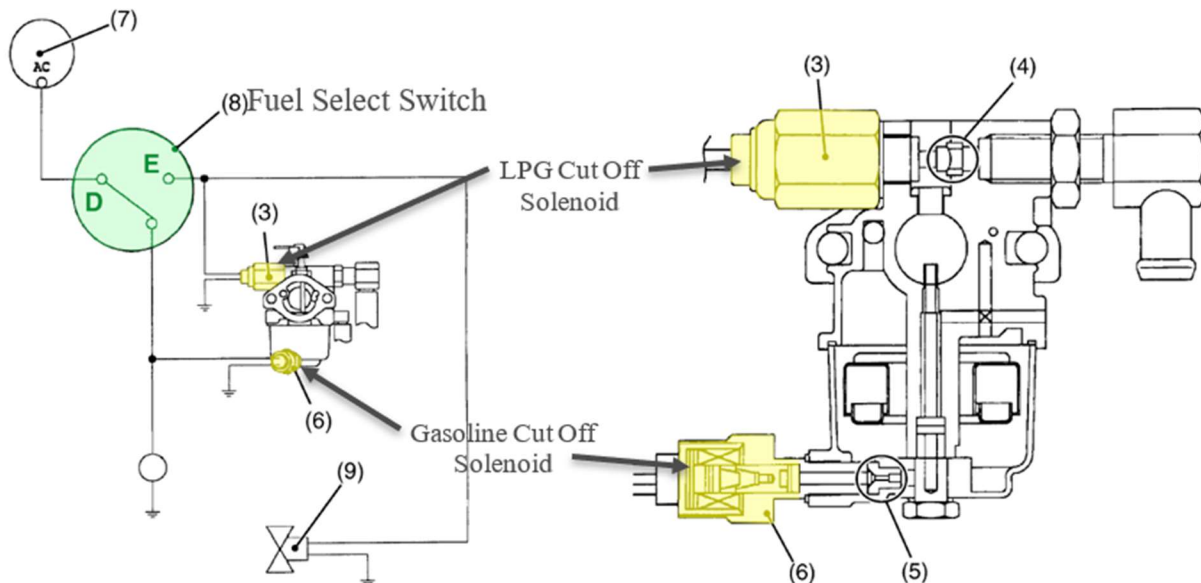
Ex. 1012, 71. Thus, the Secondary Chamber further reduces the LPG pressure to near atmospheric pressure for delivery to the carburetor of the DF-972 engine. Ex. 1003, ¶386.

g. Element [11.6]: electro-mechanical valve system

Regarding Element [11.6], the Workshop Manual discloses an electro-mechanical valve system (i.e. a “Fuel System”) with an electrical switch (i.e. a “Fuel Select Switch”). See Ex. 1012, 68; *supra*, §VII.F.1.f. The Fuel System includes electro-mechanical valves, such as the “LPG Shut Off Solenoid Valve.”

Id. The Fuel Select Switch is powered by a battery and controls fuel flow to the engine from the liquid fuel source (i.e. Gasoline Tank) and the pressurized fuel source (i.e. LPG Tank) by operating the gasoline and LPG cutoff valves.

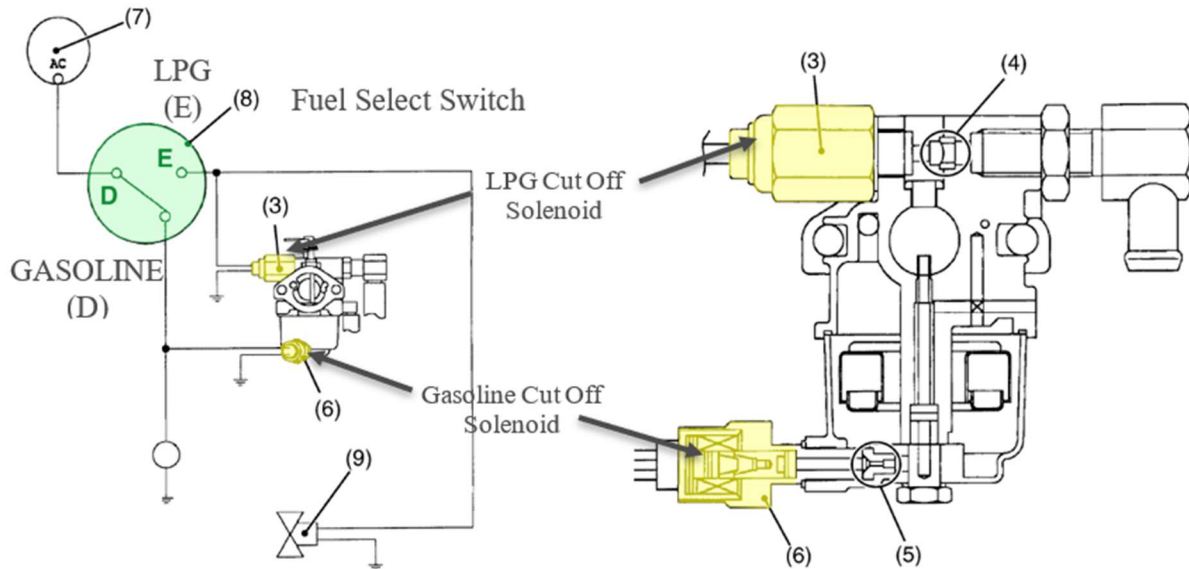
Id., 68; Ex. 1003, ¶388. The Workshop Manual also illustrates the operation of the electro-mechanical valve system (i.e., the gasoline and LPG cut off solenoids) and electrical switch:



Ex. 1012, 68 (annotated); Ex. 1003, ¶389.

10. Claim 12

Regarding Claim 12, the Workshop Manual's Fuel Select Switch can be toggled between positions D (gasoline) and E (LPG) and is therefore configured to switch between the fuels used for generator/engine operation:



Ex. 1012, 68 (annotated); *see also supra*, §§VII.F.1.f, VII.F.9.g; Ex. 1003, ¶391.

A POSA would have understood the switch could be toggled between gasoline and LPG positions to switch between fuel sources while the generator/engine is running via operation of the gasoline and LPG cut off solenoids. *Id.* As discussed, this understanding is further confirmed by the Operator's Manual. *See supra*, §VII.F.3 (quoting Ex. 1013, 7).

Should the Workshop Manual be deemed to not sufficiently disclose allowing for switching between fuel sources while the generator is running, it would have been obvious to a POSA to combine the teachings of the Workshop Manual and Operator's Manual to satisfy this limitation, for the same reasons discussed. *Id.*; Ex. 1003, ¶393.

The Workshop Manual thus anticipates Claim 12, as further informed by the Operator's Manual. In addition, Claim 12 is obvious in view of the Workshop and

Operator's Manuals, and Petitioners respectfully request that this argument be assessed under §103 as needed.

11. Claim 13

Regarding Claim 13, the Workshop Manual discloses the elements of this claim, as discussed. *See supra*, §§VII.F.3, VII.F.5; Ex. 1003, ¶396. Specifically, the gasoline and LPG cut off solenoids are configured to operate such that when one solenoid valve is open by virtue of the Fuel Select Switch position, the other solenoid valve is closed. *Id.*

12. Claim 14

The Workshop manual discloses the additional elements of Claim 14.

a. Element [14.1]: carburetor cutoff

Regarding Element [14.1], the Workshop Manual's Gasoline Cut Off Solenoid is coupled to the carburetor to control liquid fuel flow to the engine. *See supra*, §§VII.F.1.d, VII.F.2.a, VII.F.9.d.

b. Element [14.2]: gaseous fuel cutoff

Regarding Element [14.2], the Workshop Manual's LPG Cut Off Solenoid controls flow of the gaseous fuel to the engine through gaseous fuel line (b). *Supra*, §§VII.F.1.e, VII.F.2.b.

13. Claim 17

Regarding Claim 17, the Workshop Manual discloses a dual-stage vaporizer having primary and secondary chambers. *See* §§VII.F.9.e-f. A POSA would

understand these chambers are primary and secondary regulators as required by Claim 17. Ex. 1003, ¶403.

14. Claim 18

a. Element [18.0]: multi-fuel internal combustion engine

The Workshop Manual discloses a multi-fuel internal combustion engine.

See supra, §§VII.F.1.a, VII.F.9.b.

b. Element [18.1]: engine operable on liquid and gaseous fuel

Regarding Element [18.1], the Workshop Manual discloses this element.

See supra, §§VII.F.3, VII.F.9.b.

c. Element [18.2]: carburetor

Regarding Element [18.2], the Workshop Manual discloses this element.

See supra, §§VII.F.1.c, VII.F.2.b.

d. Element [18.3]: carburetor cutoff solenoid

Regarding Element [18.3], for purposes of this Petition only and without waiving any invalidity arguments related to the wording of this element, Petitioners assume that this claim term refers to the solenoid being “coupled” to the carburetor, following similar language in claim elements [1.3] and [14.1].

As discussed, the Workshop Manual discloses this element. *See supra*, §§VII.F.1.d, VII.F.1.f, VII.F.2.a, VII.F.9.d.

a. Element [18.4]: gaseous fuel valve

Regarding Element [18.4], the Workshop Manual discloses this element.

See supra, §§VII.F.1.e, VII.F.2.b, VII.F.9.d.

15. Claim 19

Regarding Claim 19, the Workshop Manual discloses this element. *See supra*, §§VII.F.1.e, VII.F.2.b.

16. Claim 20

Regarding Claim 20, the Workshop Manual discloses this element. *See supra*, §§VII.F.1.f, VII.F.I.F.103.

Should the Workshop Manual be deemed to not sufficiently disclose a switch that changes between fuel sources while the engine is running, it would have been obvious to a POSA to combine the teachings of the Workshop Manual and Operator's Manual to satisfy this element, for the same reasons discussed. *Id.*; Ex. 1003, ¶415.

The Workshop Manual thus anticipates Claim 20, as further informed by the Operator's Manual. In addition, Claim 20 is obvious in view of the Workshop and Operator's Manuals, and Petitioners respectfully request that this argument be assessed under §103 as needed.

17. Claim 22

Regarding Claim 22, as discussed, the Workshop Manual discloses the switch required by this claim. *See supra*, §§VII.F.1.f, VII.F.3, VII.F.6.

18. Claim 23

Regarding Claim 23, as discussed, the Workshop Manual's LPG Cut Off Solenoid is a gaseous fuel cutoff solenoid. *See* §§VII.F.1.e., VII.F.2.b., VII.F.12.b., VII.F.14.b. The Workshop Manual Gasoline Cut Off Solenoid is a carburetor cut off solenoid. *See supra* §§VII.F.1.d, VII.F.1.f, VII.F.2.a, VII.F.9.d., VII.F.14.d.

The Workshop Manual teaches that “both gasoline fuel and LPG fuel can not flow to the mixing chamber” when “current stop to the both of [sic] solenoids.” Ex. 1012, 68; *see also id.* (“When the fuel select switch (8) is turned to the ‘LPG’ position ‘E’, the battery current stops to the gasoline cut off solenoid (6) and flows to the LPG cut off solenoid (3) and LPG shut off solenoid valve (9).”). A POSA would understand that valves that only open when a current is applied are “normally closed.” Ex. 1003, ¶421.

G. Ground 7: Claim 4 is obvious over the Workshop Manual in view of Duffy

Claim 4 is obvious under 35 U.S.C. §103. Ex. 1003, ¶¶422-424. Although the Workshop Manual does not expressly disclose a specific timing for operating its gasoline and LPG cutoff valves, it would have been obvious to add a time-delay circuit to the liquid cutoff solenoid to practice the sequence claimed in Claim 4 for the same reasons discussed in §VII.B.1.

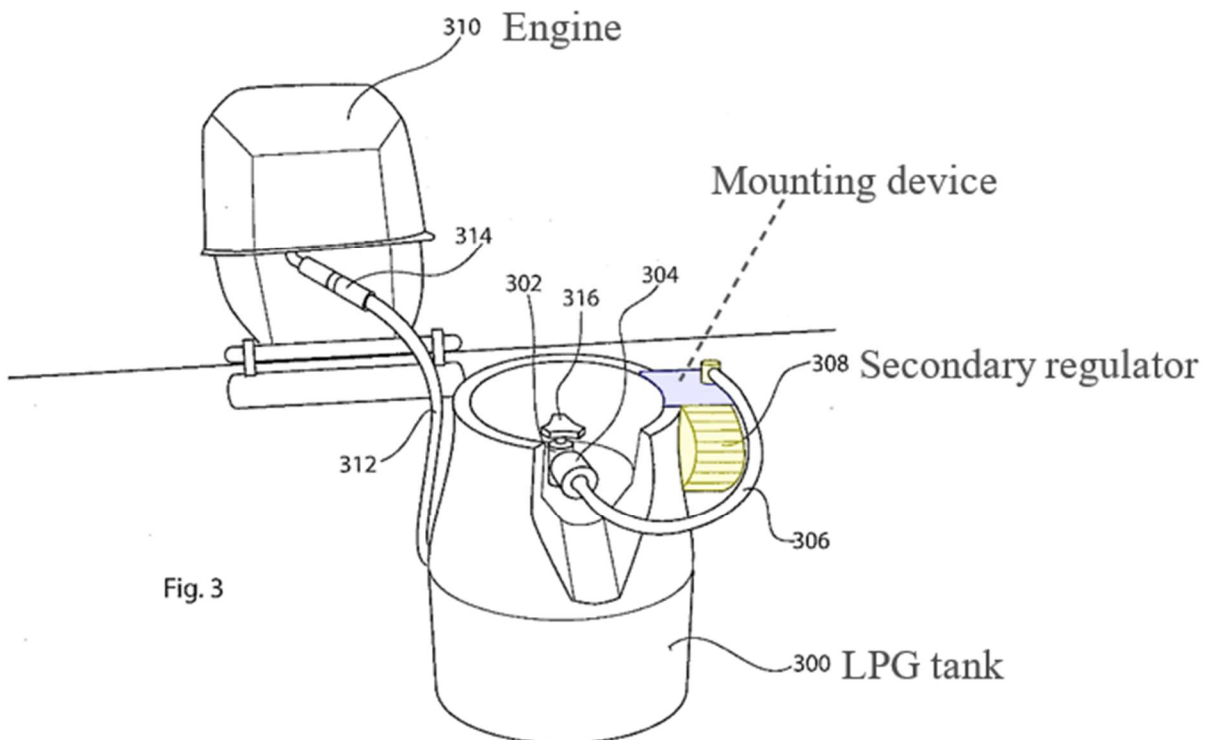
H. Ground 8: Claims 16 and 24 are obvious over the Workshop Manual in view of Parlatore and/or the Tri-Fuel Video

Claim 24 of the '034 Patent is obvious under 35 U.S.C. §103, as described below. Ex. 1003, ¶¶425-451.

1. Claim 16

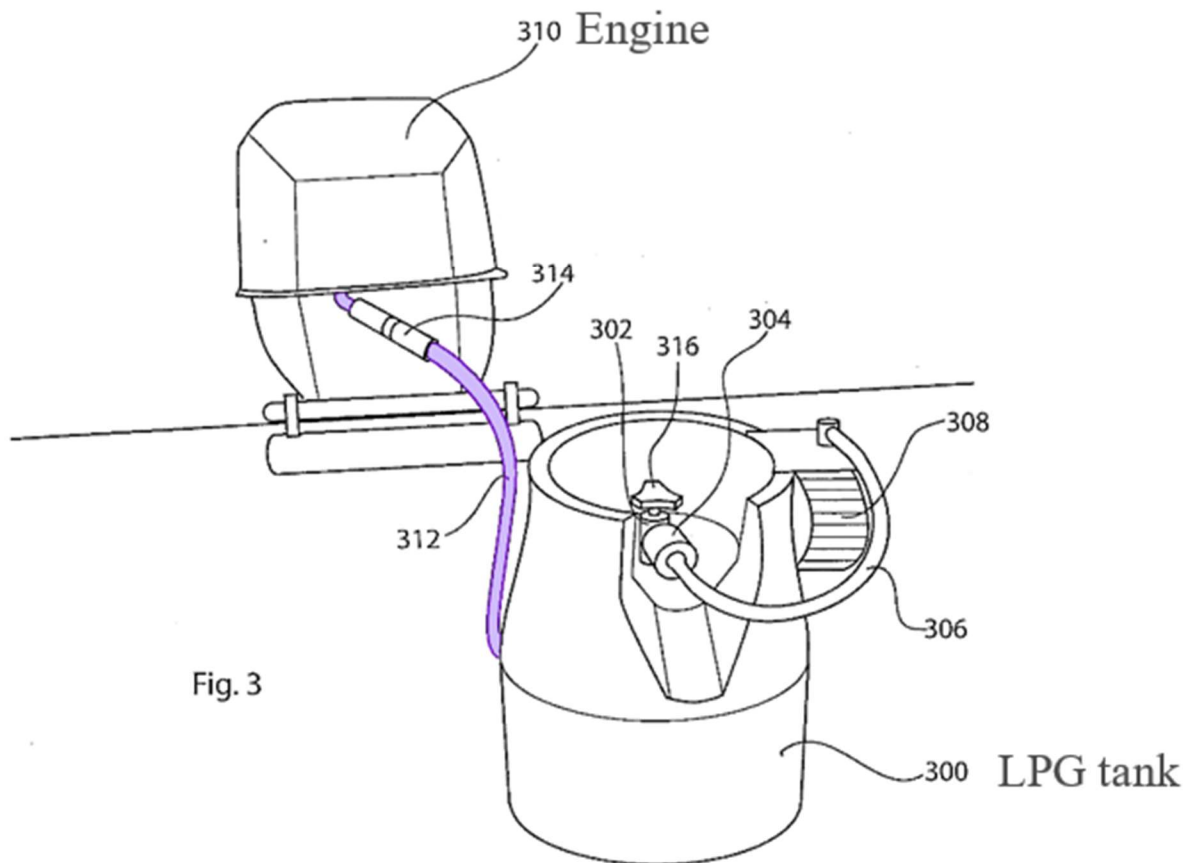
Claim 16 depends from Claim 11, and further requires “wherein the pressurized fuel source comprises a pressurized fuel container located off-board the generator having a regulator mounting device to secure at least the secondary pressure regulator thereto.”

Parlatore discloses such a mounting device, as shown below:



Ex. 1010, Fig. 3 (annotated); Ex. 1003, ¶427.

The LPG tank is connected to the engine through hose 312, as shown below.



Id. (annotated); Ex. 1003, ¶428.

2. Claim 24

Claim 24 depends from Claim 18, and requires four additional elements.

a. Element [24.1]: alternator

Regarding Element [24.1], the Workshop Manual discloses an alternator.

Supra, §VII.F.9.c.

b. Element [24.2]: fuel regulator system located off-board the generator

Regarding Element 24.2, the Workshop Manual discloses a fuel regulator system. *Supra*, §VII.F.9.d. While the Workshop Manual does not expressly describe the location of its fuel regulator system, both Parlatore and the Tri-Fuel Video teach a multi-fuel generator with an “off-board” fuel regulator system having the claimed primary and secondary regulators. *Supra*, §VII.E.3.b; Ex. 1021, 1:13-3:23³.

A POSA would have found it obvious to use an off-board fuel regulator system for the gaseous fuel supply to the Workshop Manual’s generator, as explained below.

i. Motivation to Combine / Reasonable Expectation of Success

One reason to locate the fuel delivery regulators off-board from the generator and near or at the LPG tank is so that the fuel line leading to the engine will already be at the relatively lower pressure set by the output of the secondary regulator. Ex. 1003, ¶444-49. This enhances safety in case this fuel line is punctured or damaged in some way, since the fuel in this line will be at a lower pressure. *Id.*

³ Citations are to the video time stamp.

In addition, connecting a separate gaseous fuel source (e.g. a propane tank) to a dual-fuel generator using a hose offers additional flexibility and convenience, including that an off-board propane tank can be larger compared to an onboard tank if desired, providing larger fuel capacity. *Id.*, ¶407.

Another benefit is that a remote, detachable propane tank can be stored safely away from the generator and swapped out easily. This modular approach means users can keep multiple tanks and simply rotate as needed, rather than needing to re-fill an onboard tank that is more likely to be connected or strapped onto the generator/end-use device. *Id.*, ¶408.

Parlatore shows that a POSA would have had a reasonable expectation of success using an off-board fuel regulator system. *See supra*, §VII.E.3.b. Likewise, the Tri-Fuel Video teaches a successful gaseous fuel connection of an off-board fuel regulator system (e.g., a remote propane tank with first and second regulators attached in series directly to the tank) to a dual-fuel generator using a hose. Ex. 1003, ¶409; Ex. 1021, 1:08-7:00.

c. Element [24.3]: primary pressure regulator

Regarding Element [24.3], the Workshop Manual, Parlatore, and the Tri-Fuel Video disclose this element. *See supra* §§VII.F.9.e; VII.E.3.c; Ex. 1021, 2:01-2:23.

d. Element [24.4]: secondary pressure regulator

Regarding Element [24.4], the Workshop Manual, Parlatore, and the Tri-Fuel Video disclose this element. *Supra*, §§VII.F.9.f, VII.E.3.d; Ex. 1021, 2:10-2:57.

VIII. MANDATORY NOTICES AND FEES

A. Real Parties-In-Interest

In addition to Petitioners, Harbor Freight Holdings, Inc., Generac Holdings Inc., MWE Equipment Sales, LLC are listed as potential real-parties-in-interest.

B. Related Matters

The '034 Patent is or has been involved in several pending litigations.

Patent Owner has asserted the '034 Patent and related 10,221,780 ('780 Patent), 10,697,398 ('398 Patent), 11,143,120 ('120 Patent), 11,143,145 ('145 Patent), 11,492,985 ('985 Patent), 11,530,654 ('654 Patent), 11,840,970 ('970 Patent), and 11,905,895 ('895 Patent), as well as other non-family member patents, in *Champion Power Equipment Inc. v. Firman Power Equipment Inc.*, 23-cv-02371-DWL (D. Ariz.).

Patent Owner has asserted the related '398 Patent, '120 Patent, '145 Patent, '985 Patent, '654 Patent, '970 Patent, '895 Patent, as well as other non-family member patents, in *Champion Power Equipment Inc. v. Generac Power Systems Inc.*, 24-cv-01281-LA (E.D. Wis.).

Petitioner Harbor Freight has filed a declaratory judgment action alleging non-infringement of the '034 Patent and related '654 Patent, '985 Patent, '780 Patent, '398 Patent, '120 Patent, '145 Patent, '970 Patent, '895 Patent, as well as other non-family member patents, in *Harbor Freight Tools USA, Inc. v. Champion Power Equipment, Inc.*, 24-cv-08722-SVW-AS (C.D. Cal.).

Patent Owner asserted the '034 Patent and related '780 Patent, '398 Patent, '120 Patent, '145 Patent, '985 Patent, '654 Patent, '970 Patent, '895 Patent, as well as other non-family member patents, against Petitioner Harbor Freight in *Champion Power Equipment Inc. v. Harbor Freight Tools USA Inc.*, 24-cv-01302-PP (E.D. Wis.). This case was dismissed on April 29, 2025, in favor of the earlier filed action in C.D. California cited above.

C. Counsel and Service Information

Pursuant to 37 C.F.R. §42.8(b)(3) and 42.10(a), Petitioner provides the following counsel and service information. Pursuant to 37 C.F.R. §42.10(b), a Power of Attorney for each Petitioner accompanies this Petition.

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Petitioner consents to electronic service directed to the following email address:

HarborFreight-Champion-034IPR@foley.com.

D. Payment of Fees

The Office is authorized to charge fees for this Petition to Deposit Account No. 190741. Any additional fees that might be due are also authorized.

IX. CONCLUSION

Trial should be instituted and the Challenged Claims cancelled.

U.S. Patent No. 10,393,034

Date: April 29, 2025

Respectfully submitted,

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**CERTIFICATE OF COMPLIANCE WITH TYPE-VOLUME LIMITATION,
TYPEFACE REQUIREMENTS, AND TYPE STYLE REQUIREMENTS**

1. This Petition complies with the type-volume limitation of 14,000 words, comprising **13,995** words, as counted using the Microsoft Word software that was used to prepare this paper, excluding the parts exempted by 37 C.F.R. § 42.24(a).

2. This Petition complies with the general format requirements of 37 C.F.R. § 42.6(a) and has been prepared using Microsoft® Word in 14-point Times New Roman.

Date: April 29, 2025

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that on April 29, 2025, true and correct copies of the foregoing document and supporting materials were served in its entirety on the Patent Owner at the following address of record listed on the USPTO's Patent Center via FedEx Overnight:

26629 - ZIOLKOWSKI PATENT SOLUTIONS GROUP, SC (ZPS)
136 S WISCONSIN ST
PORT WASHINGTON, WI

Courtesy copies of the same documents were served electronically on Patent Owner's litigation counsel by email at the following address:

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