

U.S. Patent No. 10,697,398

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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**BEFORE THE PATENT TRIAL AND APPEAL BOARD**

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

v.

CHAMPION POWER EQUIPMENT, INC.,  
  
Patent Owner.

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Patent No. 10,697,398

Issued: Jun. 30, 2020

Title: BATTERYLESS DUAL FUEL ENGINE WITH LIQUID FUEL CUT-OFF

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*Inter Partes* Review No. IPR2025-01271

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**PETITION FOR *INTER PARTES* REVIEW**

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**EXHIBIT LIST**

| <b>Exhibit No.</b> | <b>Description</b>                                                                 |
|--------------------|------------------------------------------------------------------------------------|
| 1001               | U.S Patent No. 10,697,398 to Collie et al. (“the ’398 Patent”)                     |
| 1002               | File History for U.S. Patent No. 10,697,398 (“the ’398 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               | Reserved                                                                           |
| 1009               | U.S. Patent No 1,931,698 (“Holzapfel”)                                             |
| 1010               | Reserved                                                                           |
| 1011               | Reserved                                                                           |
| 1012               | Kubota DF972-E2 Workshop Manual (“Workshop Manual”)                                |
| 1013               | Reserved                                                                           |
| 1014               | Declaration from Mr. James Strepek re Kubota Manuals                               |
| 1015               | Declaration from Mr. Scott Schlabach re Kubota Manuals                             |

| <b>Exhibit No.</b> | <b>Description</b>                       |
|--------------------|------------------------------------------|
| 1016               | Reserved                                 |
| 1017               | Reserved                                 |
| 1018               | U.S. Patent No. 5,809,979 (“Tsuda”)      |
| 1019               | Reserved                                 |
| 1020               | Reserved                                 |
| 1021               | Reserved                                 |
| 1022               | Reserved                                 |
| 1023               | Reserved                                 |
| 1024               | Reserved                                 |
| 1025               | Reserved                                 |
| 1026               | Reserved                                 |
| 1027               | Reserved                                 |
| 1028               | Reserved                                 |
| 1029               | U.S. Patent No. 5,161,496 (“Matsushima”) |
| 1030               | U.S. Patent No. 7,549,403 (“Yamamoto”)   |
| 1031               | U.S. Patent No. 4,776,988 (“Neal”)       |

| <b>Exhibit No.</b> | <b>Description</b>                                                                                                |
|--------------------|-------------------------------------------------------------------------------------------------------------------|
| 1032               | U.S. Patent No. 6,213,083 (“Winberg”)                                                                             |
| 1033               | Champion’s Infringement Contentions with Respect to Petitioner Generac’s Model PM4500DF and GP7500E DF Generators |
| 1034               | Photos of Generac PM7500DF Generator                                                                              |
| 1035               | Video 1 of Generac PM7500DF Generator                                                                             |
| 1036               | Video 2 of Generac PM7500DF Generator                                                                             |
| 1037               | Video 3 of Generac PM7500DF Generator                                                                             |
| 1038               | Process Control, Instrument Engineers’ Handbook, Liptak, Béla G., (1995) (“Liptak”)                               |
| 1039               | U.S. Patent Pub. No. 2007/0137591 (“Sugimoto”)                                                                    |

**CHALLENGED CLAIMS**

| <b>Element</b> | <b>Claim Language</b>                                                                                                                          |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>[1.0]</b>   | A dual-fuel engine comprising:                                                                                                                 |
| <b>[1.1]</b>   | an engine operable on a gaseous fuel and a liquid fuel;                                                                                        |
| <b>[1.2]</b>   | a switch to change operation of the engine between gaseous fuel and liquid fuel;                                                               |
| <b>[1.3]</b>   | a carburetor attached to an intake of the engine to mix air and fuel and connect to a gaseous fuel source and a liquid fuel source;            |
| <b>[1.4]</b>   | a liquid fuel valve positioned along a liquid fuel line coupling the liquid fuel source to the carburetor;                                     |
| <b>[1.5]</b>   | a gaseous fuel valve positioned along a gaseous fuel line coupling the gaseous fuel source to the carburetor; and                              |
| <b>[1.6]</b>   | a liquid fuel cut-off incorporated into the carburetor to interrupt liquid fuel upon actuation of the switch from liquid fuel to gaseous fuel. |
| <b>2</b>       | The dual fuel engine of claim 1, wherein the engine is a pull start, batteryless engine.                                                       |
| <b>3</b>       | The dual fuel engine of claim 1, wherein the gaseous fuel is LPG and the liquid fuel is gasoline.                                              |
| <b>4</b>       | The dual fuel engine of claim 1, wherein the engine is a pull-start engine having an electrical power generator to supply electrical power.    |

| Element      | Claim Language                                                                                                                                                                                                       |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>[5.1]</b> | The dual fuel engine of claim 4, wherein the switch is an electro-mechanical switch connecting one fuel source to the carburetor and connected to the electrical power generator; and                                |
| <b>[5.2]</b> | wherein the liquid fuel cut-off is a solenoid connected to open and close a fuel path to the pull-start engine in response to reception of electrical power from the switch.                                         |
| <b>6</b>     | The dual fuel engine of claim 4, wherein the liquid fuel cut-off is a solenoid valve that operates within the carburetor to control liquid fuel flow to the engine and is powered by the electrical power generator. |
| <b>7</b>     | The dual fuel engine of claim 6, wherein the switch selectively powers the solenoid valve by controlling electrical connection between the solenoid valve and the electrical power generator.                        |
| <b>8</b>     | The dual fuel engine of claim 6, wherein the solenoid valve is normally open to provide liquid fuel to the engine when the solenoid valve is unpowered.                                                              |
| <b>9</b>     | The dual fuel engine of claim 8, wherein a pull-starter drives the electrical power generator to power and close the solenoid valve while starting the engine on gaseous fuel.                                       |
| <b>10</b>    | The dual fuel engine of claim 6, wherein the electrical power generator comprises a magneto or an alternator coupled to a voltage regulator to provide a regulated voltage to the solenoid valve.                    |
| <b>11</b>    | The dual fuel engine of claim 6, wherein the solenoid valve is open to provide liquid fuel to the engine when the solenoid valve is powered.                                                                         |

| Element | Claim Language                                                                                                                                                                                              |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12      | The dual fuel engine of claim 11, wherein a pull-starter drives the electrical power generator to power and open the solenoid valve while starting the engine on liquid fuel.                               |
| 13      | The dual fuel engine of claim 6 further comprising a microcontroller to close the solenoid valve when the engine operates on gaseous fuel and open the solenoid valve to operate the engine on liquid fuel. |
| 14      | The dual fuel engine of claim 13, wherein the microcontroller closes the solenoid valve during engine shutdown from operation on liquid fuel.                                                               |
| 15      | The dual fuel engine of claim 1, wherein the liquid fuel cut-off is manually actuated to interrupt liquid fuel.                                                                                             |
| 16      | The dual fuel engine of claim 1, wherein the liquid fuel cut-off actuates to interrupt liquid fuel free from linear motion.                                                                                 |
| [17.1]  | The dual fuel engine of claim 1, wherein the liquid fuel cut-off comprises: a rotating shaft extending through an aperture in the carburetor;                                                               |
| [17.2]  | a fuel seal around the shaft to seal the aperture; and                                                                                                                                                      |
| [17.3]  | a blocking member coupled to the shaft in the carburetor that rotates between a blocking and a non-blocking position to selectively block a liquid fuel path to the engine.                                 |
| 19      | The dual fuel engine of claim 1, wherein the liquid fuel cut-off is magnetically actuated to selectively interrupt liquid fuel.                                                                             |
| [20.1]  | The dual fuel engine of claim 1 further comprising: a spring pushing the liquid fuel cut-off to interrupt liquid fuel; and                                                                                  |

| Element       | Claim Language                                                                                                                                                                                       |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>[20.2]</b> | an actuating magnet coupled to the carburetor to selectively pull the liquid fuel cut-off against the spring away from a position interrupting liquid fuel.                                          |
| <b>[21.1]</b> | The dual fuel engine of claim 20 further comprising a housing at least partially enclosing the liquid fuel cutoff, the housing including:                                                            |
| <b>[21.2]</b> | a first section enclosing a plunger of the liquid fuel cut-off to the carburetor and holding the spring against the plunger; and                                                                     |
| <b>[21.3]</b> | a second section coupled to the first section and enclosing the actuating magnet.                                                                                                                    |
| <b>22</b>     | The dual fuel engine of claim 1, wherein the liquid fuel cut-off is physically attached to an outer surface of the carburetor.                                                                       |
| <b>[23.0]</b> | A batteryless dual fuel generator comprising:                                                                                                                                                        |
| <b>[23.1]</b> | a housing containing a pull start engine coupled to drive an alternator, the engine operable on a gaseous fuel and a liquid fuel;                                                                    |
| <b>[23.2]</b> | a carburetor attached to an intake of the engine comprising: a throat to mix fuel with air, a float bowl, and a fuel passage extending from the float bowl to the throat to provide liquid fuel; and |
| <b>[23.3]</b> | a fuel shutoff attached to the carburetor to close the fuel passage upon selection of engine operation to gaseous fuel.                                                                              |
| <b>24</b>     | The batteryless dual fuel generator of claim 23, wherein the fuel shutoff actuates to close the fuel passage free from linear motion.                                                                |

| Element | Claim Language                                                                                                                                                                |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [25.1]  | The batteryless dual fuel generator of claim 23, wherein the fuel shutoff comprises: a rotating shaft extending through an opening in the carburetor; and                     |
| [25.2]  | a valve member coupled to the shaft in the carburetor that rotates to control fuel flow into the fuel passage.                                                                |
| 26      | The batteryless dual fuel generator of claim 25, wherein the valve member is positioned in the float bowl and the shaft extends substantially horizontal through the opening. |
| [32.1]  | The batteryless dual fuel generator of claim 23 further comprising: a spring pushing the fuel shutoff to close the fuel passage; and                                          |
| [32.2]  | an actuating magnet coupled to the carburetor to selectively pull the fuel shutoff against the spring to open the fuel passage.                                               |
| [33.1]  | The batteryless dual fuel generator of claim 32 further comprising a housing at least partially enclosing the fuel shutoff, the housing including:                            |
| [33.2]  | a first section enclosing a plunger of the fuel shutoff to the carburetor and holding the spring against the plunger; and                                                     |
| [33.3]  | a second section coupled to the first section and enclosing the actuating magnet.                                                                                             |
| [34.1]  | The batteryless dual fuel generator of claim 23, wherein the fuel shutoff is a carburetor cutoff solenoid; and                                                                |
| [34.2]  | wherein the generator further comprises: a charge winding to generate electrical power to operate the carburetor cutoff solenoid, and                                         |

| Element       | Claim Language                                                                                                                                                                                                                                                                      |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>[34.3]</b> | a switch to selectively power the carburetor cutoff solenoid by controlling electrical connection between the carburetor cutoff solenoid and the charge winding.                                                                                                                    |
| <b>35</b>     | The batteryless dual fuel generator of claim 34, wherein the carburetor cutoff solenoid is normally open to provide liquid fuel to the engine when the carburetor cutoff solenoid is unpowered.                                                                                     |
| <b>36</b>     | The batteryless dual fuel generator of claim 35, wherein a pull-starter drives the engine operating the charge winding to power and close the carburetor cutoff solenoid while starting the engine on gaseous fuel.                                                                 |
| <b>37</b>     | The batteryless dual fuel generator of claim 34, wherein the switch is an electro-mechanical switch connected to the charge winding and connecting at least one fuel source to the carburetor to selectively control fuel flow from the at least one fuel source to the carburetor. |
| <b>38</b>     | The batteryless dual fuel generator of claim 34, wherein the charge winding is coupled to a voltage regulator to provide a regulated voltage to the carburetor cutoff solenoid.                                                                                                     |
| <b>39</b>     | The batteryless dual fuel generator of claim 34, wherein the carburetor cutoff solenoid is open to provide liquid fuel to the engine when the carburetor cutoff solenoid is powered.                                                                                                |
| <b>40</b>     | The batteryless dual fuel generator of claim 39, wherein a pull-starter drives the engine operating the charge winding to power and open the carburetor cutoff solenoid while starting the engine on liquid fuel.                                                                   |

| Element | Claim Language                                                                                                                                                                                                                                                        |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 41      | The batteryless dual fuel generator of claim 34, wherein the switch is a microcontroller configured to close the carburetor cutoff solenoid when the engine operates on gaseous fuel and to open the carburetor cutoff solenoid to operate the engine on liquid fuel. |
| 42      | The batteryless dual fuel generator of claim 41, wherein the microcontroller closes the carburetor cutoff solenoid during engine shutdown from operation on liquid fuel.                                                                                              |
| [43.0]  | A carburetor having a fuel shutoff comprising:                                                                                                                                                                                                                        |
| [43.1]  | a carburetor comprising: a float bowl, a throat, and a fuel passage extending from the float bowl to the throat; and                                                                                                                                                  |
| [43.2]  | a fuel shutoff coupled to the carburetor having a first end in the carburetor that actuates to close the fuel passage and a second end external to the carburetor to actuate the first end; and                                                                       |
| [43.3]  | wherein the fuel shutoff actuates free from linear motion.                                                                                                                                                                                                            |
| 44      | The carburetor having a fuel shutoff of claim 43, wherein the fuel shutoff is a manually actuated fuel shutoff.                                                                                                                                                       |
| 45      | The carburetor having a fuel shutoff of claim 43, wherein the fuel shutoff comprises a shaft extending into the carburetor through an aperture in the float bowl and coupled to a valve tip in the float bowl that rotates to open and close the fuel passage.        |
| 46      | The carburetor having a fuel shutoff of claim 45, wherein the valve tip rotates parallel to an inlet of the fuel passage between a first position permitting fuel flow into the inlet and a second position blocking fuel flow into the inlet.                        |

| Element       | Claim Language                                                                                                                                                                                          |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>53</b>     | The carburetor having a fuel shutoff of claim 45, wherein the valve tip comprises thermoplastic.                                                                                                        |
| <b>54</b>     | The carburetor having a fuel shutoff of claim 45, wherein the valve tip comprises one of an oval and stadium shape.                                                                                     |
| <b>56</b>     | The carburetor having a fuel shutoff of claim 43, wherein the fuel shutoff extends through an opening into the float bowl such that the first end actuates in the float bowl to close the fuel passage. |
| <b>[57.0]</b> | A method of assembling a dual fuel engine comprising:                                                                                                                                                   |
| <b>[57.1]</b> | providing an engine operable on a gaseous fuel and a liquid fuel;                                                                                                                                       |
| <b>[57.2]</b> | attaching a carburetor to an intake of the engine, the carburetor comprising;                                                                                                                           |
| <b>[57.3]</b> | a throat to mix gaseous fuel with air and liquid fuel with air,                                                                                                                                         |
| <b>[57.4]</b> | a float bowl, and                                                                                                                                                                                       |
| <b>[57.5]</b> | a fuel passage extending from the float bowl to the throat to provide liquid fuel;                                                                                                                      |
| <b>[57.6]</b> | coupling a switch to the engine to change operation of the engine between gaseous fuel and liquid fuel; and                                                                                             |
| <b>[57.7]</b> | attaching a liquid fuel cut-off to the carburetor to close the fuel passage upon actuation of the switch from liquid fuel to gaseous fuel.                                                              |
| <b>58</b>     | The method of claim 57 further comprising coupling a manually operated control operatively to the liquid fuel cut-off.                                                                                  |

Harbor Freight Tools USA, Inc. (“Harbor Freight”), 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 1-17, 19-26, 32-46, 53-54, and 56-58 (“the Challenged Claims”) of U.S. Patent No. 10,697,398 (“the ’398 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 ’398 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.

| <b>Ground</b> | <b>Claim(s) Challenged</b>           | <b>35 U.S.C. §</b> | <b>Reference(s)</b>                                       |
|---------------|--------------------------------------|--------------------|-----------------------------------------------------------|
| <b>1</b>      | <b>1, 3, 22, 57</b>                  | 102                | Workshop Manual                                           |
| <b>2</b>      | <b>2, 4-14, 19-21, 23, 32-42, 58</b> | 103                | Workshop Manual in view of Matsushima, Yamamoto, and Olmr |
| <b>3</b>      | <b>1, 3, 22, 57</b>                  | 102                | Nakafushi                                                 |
| <b>4</b>      | <b>2, 4-14, 19-21, 23, 32-42, 58</b> | 103                | Nakafushi in view of Matsushima, Yamamoto, and Olmr       |

| <b>Ground</b> | <b>Claim(s) Challenged</b> | <b>35 U.S.C. §</b> | <b>Reference(s)</b>                       |
|---------------|----------------------------|--------------------|-------------------------------------------|
| <b>5</b>      | <b>1, 15-16, 43-44</b>     | 102                | Holzapfel                                 |
| <b>6</b>      | <b>43-46, 56</b>           | 102                | Neal                                      |
| <b>7</b>      | <b>43-46, 53-54, 56</b>    | 102                | Winberg                                   |
| <b>8</b>      | <b>17, 23-26</b>           | 103                | Holzapfel in view of Neal and Yamamoto    |
| <b>9</b>      | <b>17, 23-26</b>           | 103                | Holzapfel in view of Winberg and Yamamoto |

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. EX1003, ¶¶1-574.

## **II. STATE OF THE ART**

### **A. Carburetors**

A carburetor is a device that supplies an air-fuel mixture to a spark-ignition engine. EX1003, ¶34. The diagram below shows a carburetor's basic elements.

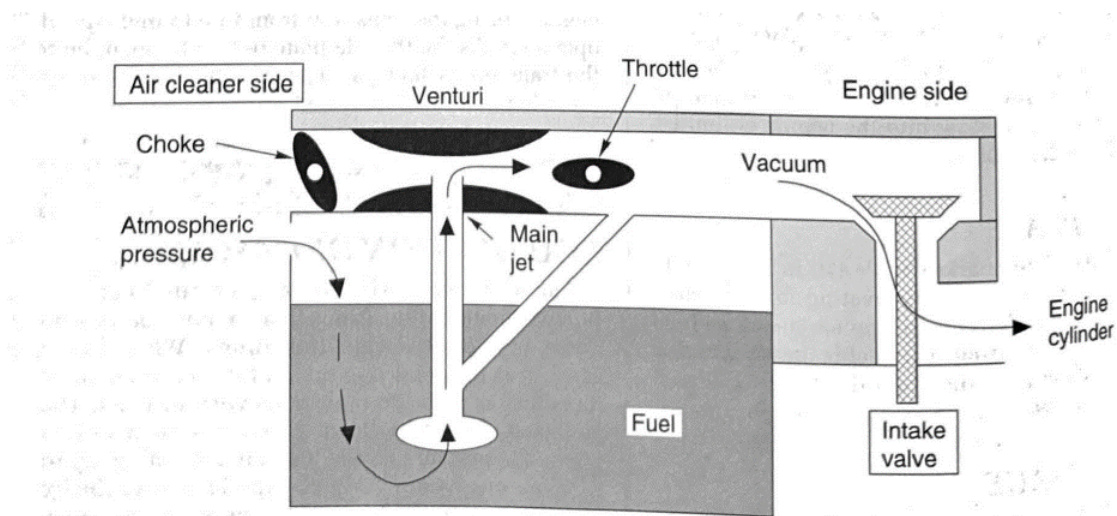


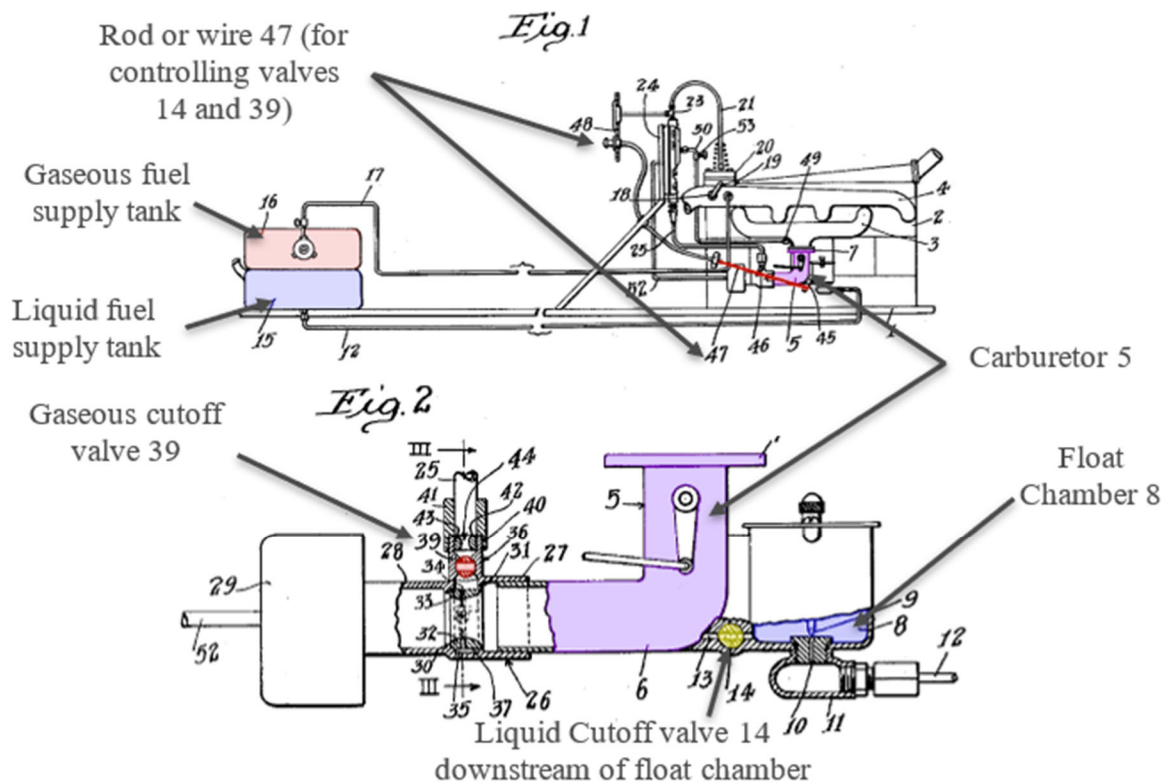
Fig. 4-7 Choke system. (Courtesy of William A. Schuster)

EX1006, 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. EX1003, ¶35.

## 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.” EX1009, 1:1-42. A “rod or wire 47” controls both the liquid and gaseous valves:



*Id.*, Figs. 1-2 (annotated).

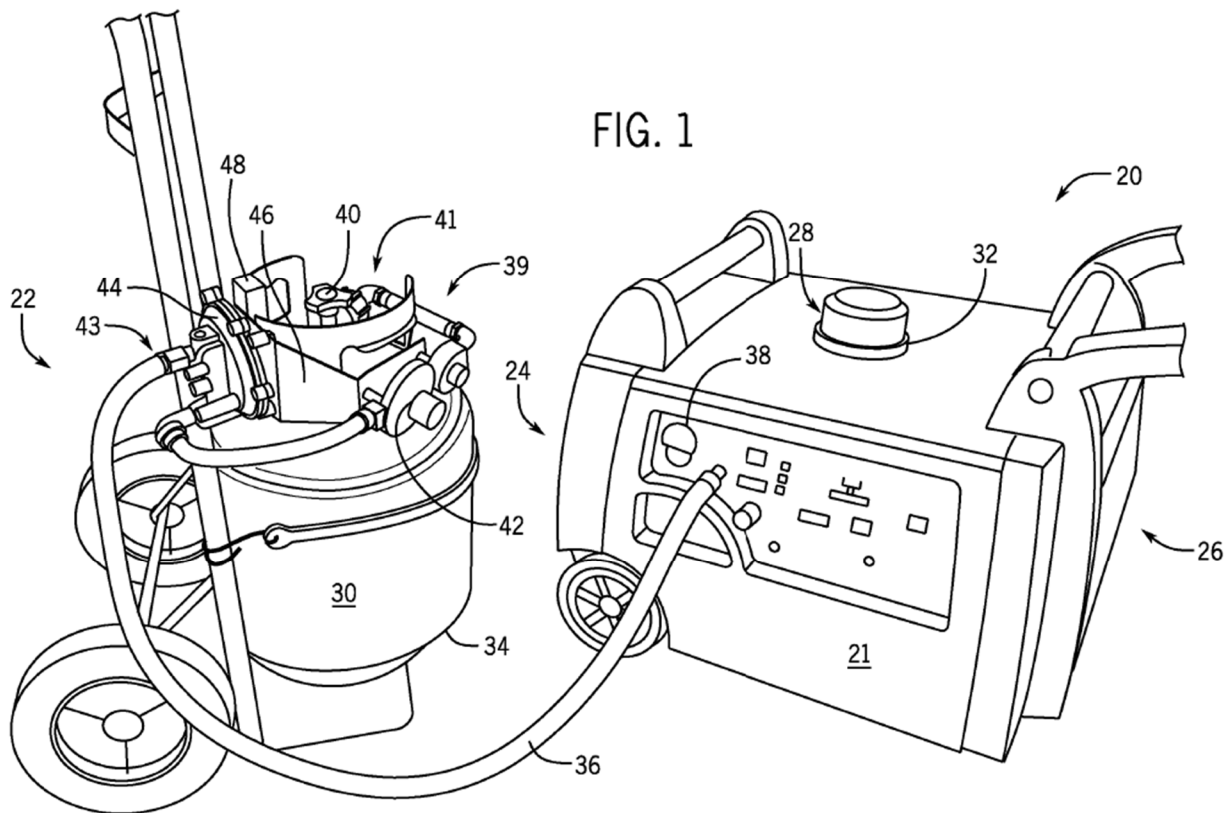
Notably, Holzapfel's liquid cutoff 14 is located downstream from float chamber 8. EX1009, 1:100-107, Fig. 2.

### III. SUMMARY OF THE '398 PATENT

#### A. The '398 Patent

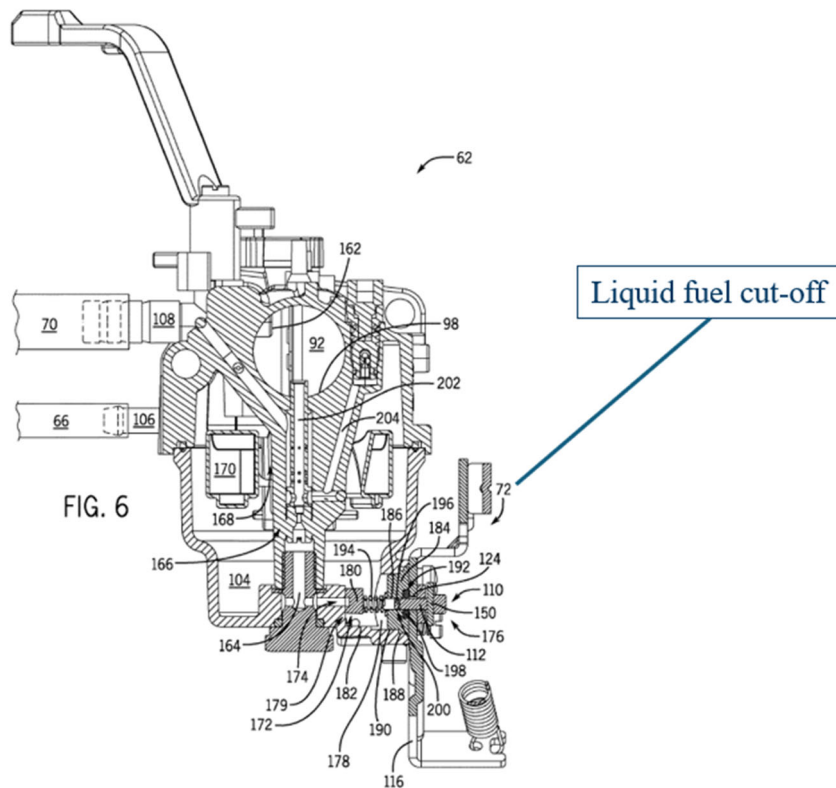
The '398 Patent discloses embodiments of dual-fuel engines/generators operable on liquid or gaseous fuels. EX1001, 1:14-16. The '398 Patent acknowledges that dual-fuel generators typically run on liquid fuel (such as gasoline) and an alternative gaseous fuel (such as propane/LPG). *Id.*, 1:18-35.

Figure 1 of the '398 Patent discloses a perspective view of a generator with such an engine, as shown below:



The '398 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.*, 1:53-67. The '398 Patent purports to solve this problem by implementing a switch that powers cutoff solenoids for controlling liquid and gaseous fuel flow. *Id.*, 2:7-15.

The '398 Patent also couples a liquid fuel cut-off to the carburetor to prevent excess gasoline from passing to the engine, as depicted in Figure 6:



*Id.*, 8:29-40. The '398 Patent's liquid fuel cut-off can be manually or electrically operated, such as by a solenoid. *Id.*

The '398 Patent discloses that the engine may be a pull-start engine with a recoil starter. *Id.*, 8:55-9:5. In this embodiment, during engine startup, the recoil starter cranks the engine, causing a magneto to supply electrical power to the solenoid of the liquid fuel cut-off. *Id.*

## **B. Prosecution History**

The '398 Patent is part of a family that includes at least 13 U.S. patents and/or pending applications.<sup>1</sup>

The '398 Patent issued from U.S. Application No. 14/925,441 (“the ’441 Application”), which was filed on October 28, 2015, and is a continuation-in-part of U.S. Application No. 14/738,060, which was filed on June 12, 2015.

The '398 Patent’s prosecution history includes multiple rejections and amendments. The Examiner primarily relied on U.S. Patent No. 4,489,669 (“Poehlman”), U.S. Patent No. 5,809,979 (“Tsuda”), and U.S. Publication No. 2007/0137591 (“Sugimoto”) to reject the pending claims, prior to allowing the ’441 Application after the Applicant made several amendments and filed an Appeal Brief. EX1002, 119-129, 148-157, 175-189, 208-226, 331-347, 358-374, 384-398, 404-424, 428-442, 448-460, 474-489, 501-547, 558-560.

The Examiner initially asserted that Poehlman disclosed the “liquid fuel cut-off incorporated into the carburetor” of claim 1, but subsequently acknowledged that Poehlman did not disclose this element. *Id.*, 119-120, 385-386. The Examiner then rejected claim 1 as obvious over Poehlman in view of Tsuda, contending it

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<sup>1</sup> Family members include U.S. Patent App. Nos. 14/738,060; 15/285,215; 15/332,264; 16/191,503; 16/358,822; 16/783,455; 16/946,438; 16/946,439; 17/937,046; 18/183,734; 18/443,487; and 19/026,996.

would have been obvious to incorporate Poehlman's liquid valve into the carburetor, as taught by Tsuda. *Id.*, 385-386.

In response, Patent Owner admitted in its Appeal Brief that Tsuda taught the "liquid fuel cut-off incorporated into the carburetor" of claim 1, but argued there was no motivation for the combination. *Id.*, 511-516. Patent Owner also argued that incorporating Poehlman's liquid valve into the carburetor (as taught by Tsuda) would nonetheless be deficient because then there would be no second liquid fuel valve positioned along a liquid fuel line coupling the liquid fuel source to the carburetor," which is also recited in claim 1. *Id.*

Instead of responding to Patent Owner's Appeal Brief, the Examiner allowed the claims, quoted the language of claim 1, and stated:

The closest prior art references, Poehlman [] and Tsuda et al. [], teach a similar engine but are deficient in having a liquid cut-off incorporated into the carburetor. It would not have been obvious to further modify the combination of Poehlman and Tsuda et al. to include the additional fuel cut-off.

*Id.*, 558. The Examiner did not explain this conclusion with regard to Tsuda (this was not even an argument raised by Patent Owner), and did not comment on the reasons for allowance for the other independent claims (issued claims 23, 43, and 57). *Id.*

#### **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 degree in mechanical engineering, physics, materials science, or related fields, and three years of work experience in combustion engines. EX1003, ¶32. Additional higher graduate education could substitute for work experience, and additional work experience/training could substitute for formal education. *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 person of ordinary skill in the art and the prosecution history. Petitioner has not identified any claim terms that need construction in order to

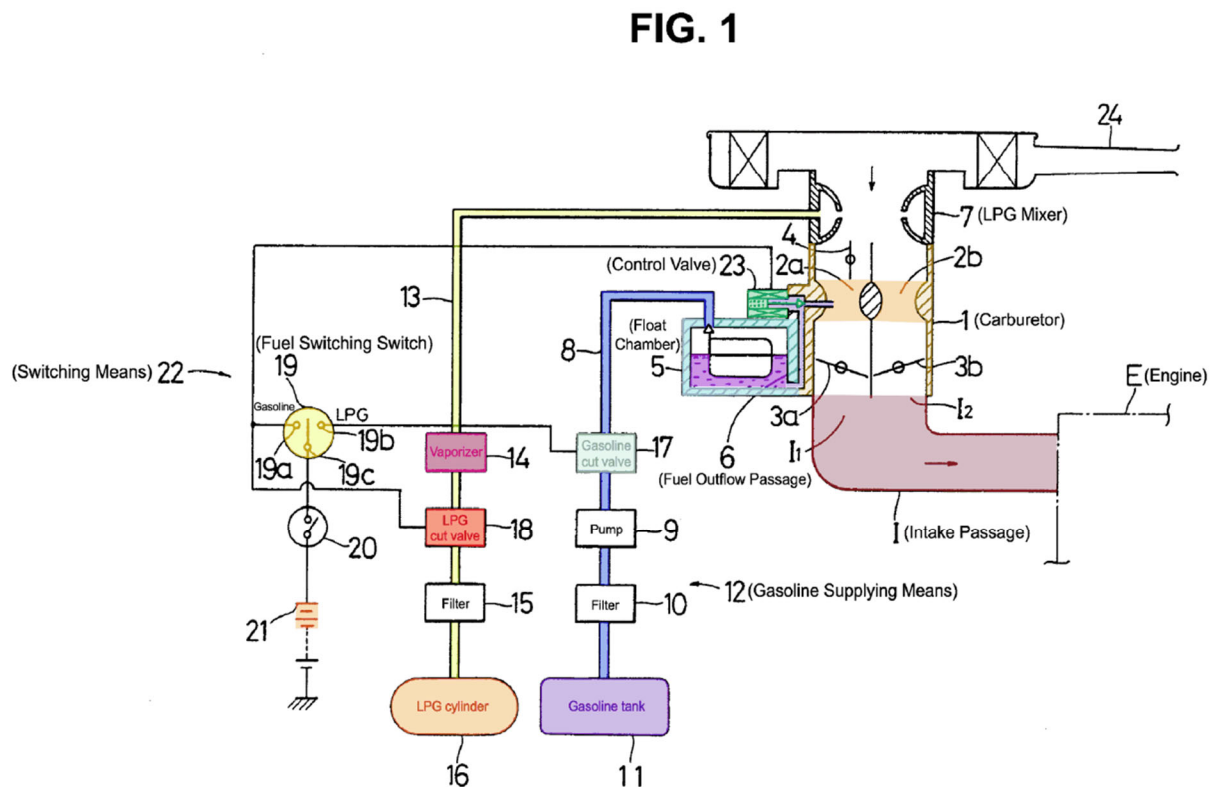
address the issues raised by this petition, but Petitioner reserves the right to respond to any constructions offered by Patent Owner or the Board.

## VI. OVERVIEW OF THE ASSERTED PRIOR ART

### A. JPS61283734A (“Nakafushi”)

Nakafushi (EX1004 (original); EX1005 (certified translation)) was filed in 1985 and published in 1986. Nakafushi is prior art under §102(a).

Nakafushi discloses an engine configured to selectively use gasoline or LPG:



EX1005, Fig. 1 (annotated).

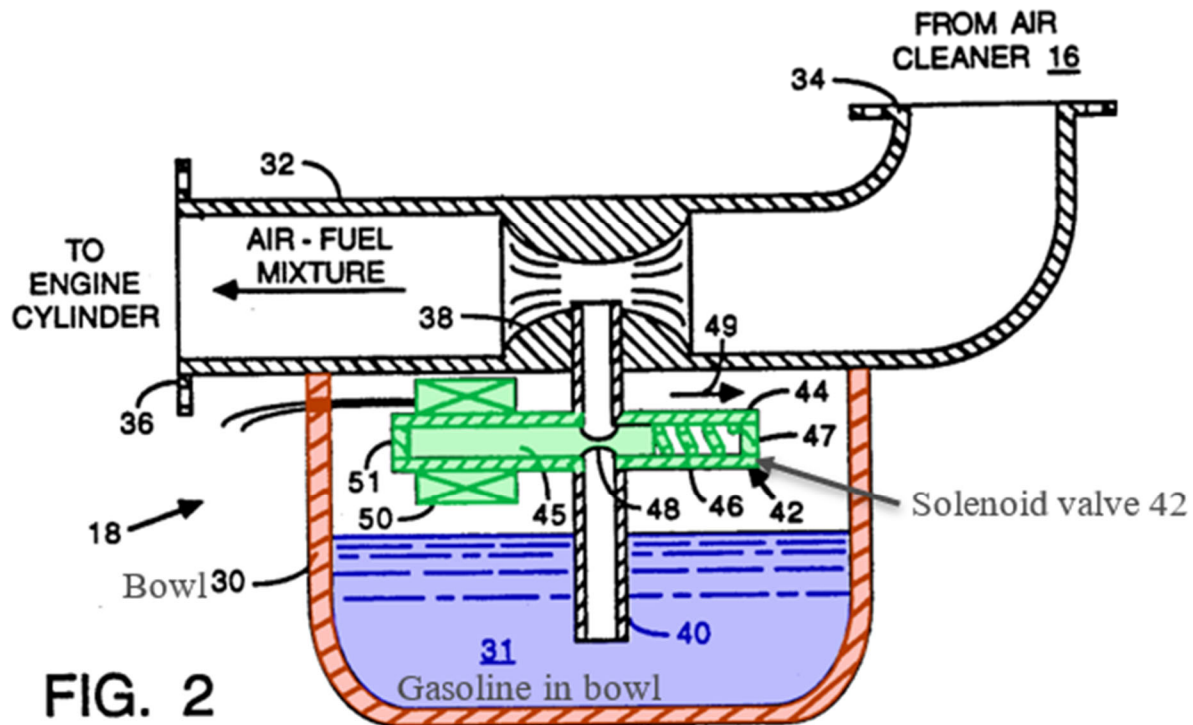
Nakafushi notes that when operation is switched from gasoline to LPG, a residual amount of gasoline remains in the float chamber (i.e., float bowl) and gets mixed with the LPG, resulting in over-rich air-to-fuel ratio. *Id.*, ¶¶[0003]-[0004]. Also, because the residual gasoline is drained from the float 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 control valve 23 downstream of the float chamber to prevent it from being emptied of gasoline when switching to LPG operation. *Id.*, ¶¶[0006]-[0008], 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.*

**B. U.S. Patent No. 5,301,644 (“Olmr”)**

Olmr issued in 1994. EX1007. Olmr is prior art under §102(a).

Olmr teaches solenoid valve 42 within float bowl 30 of a carburetor:



EX1007, Fig. 2 (annotated), 1:33-48, 2:30-42.

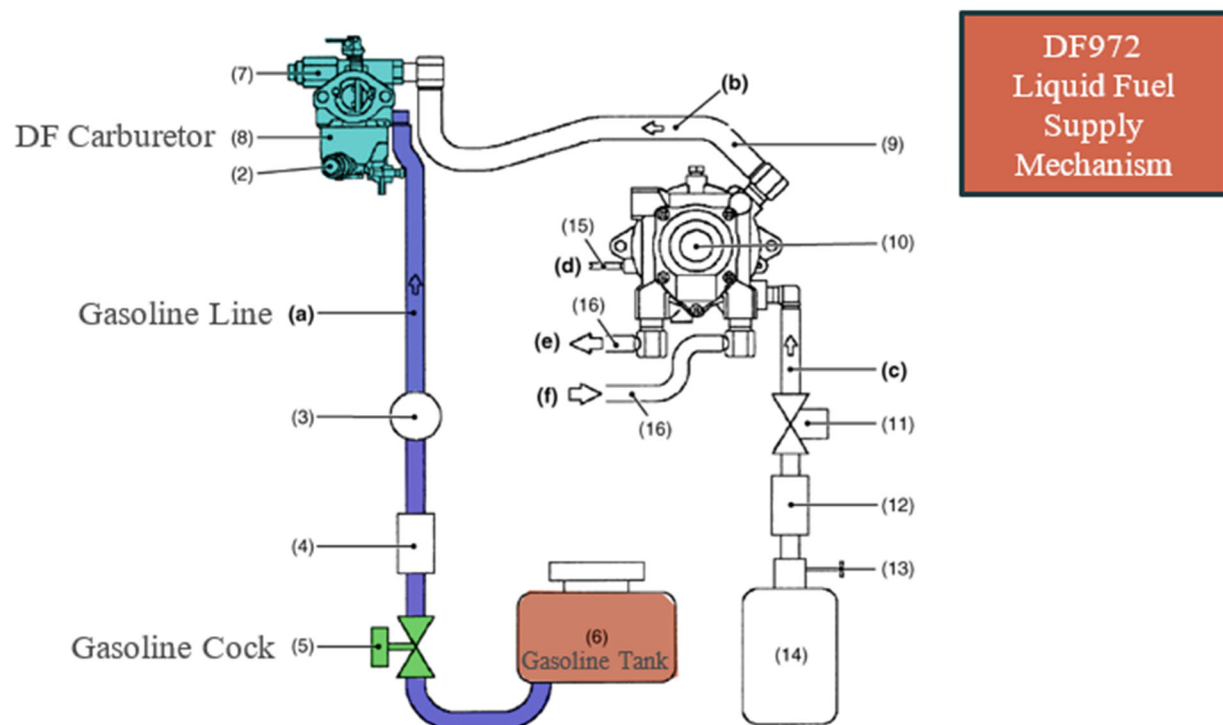
Solenoid valve 42 “provide[s] a mechanism for cutting off the supply of fuel to an internal combustion engine when the engine is being stopped.” *Id.*, 1:33-37.

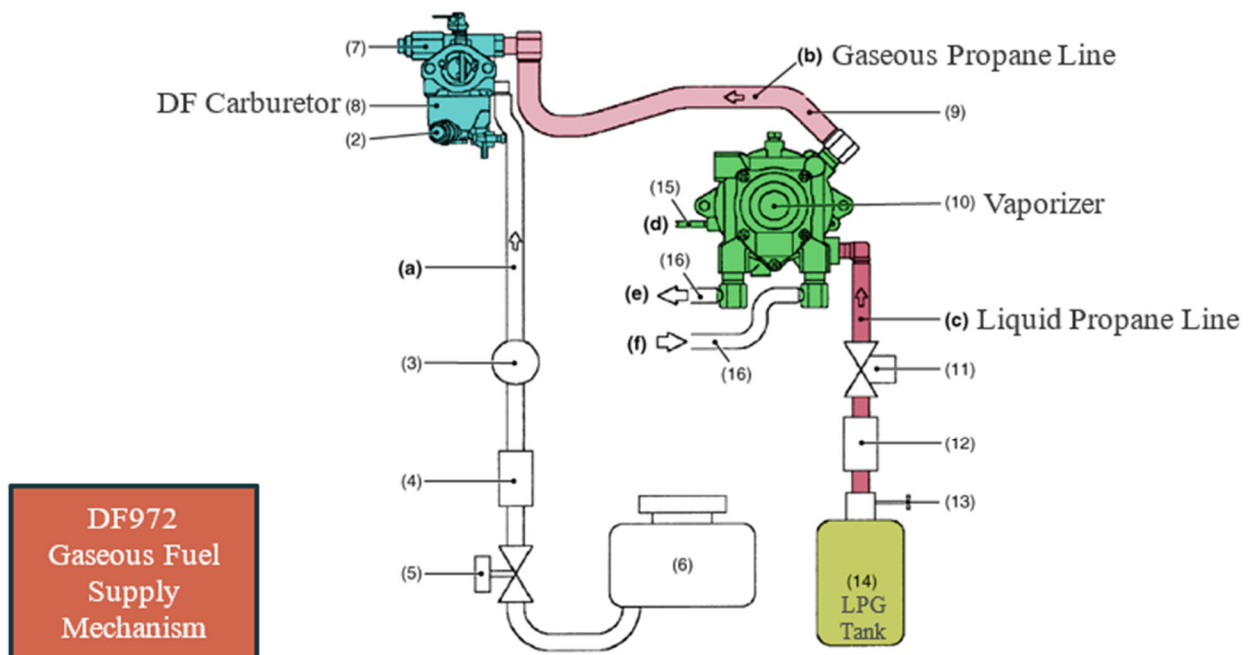
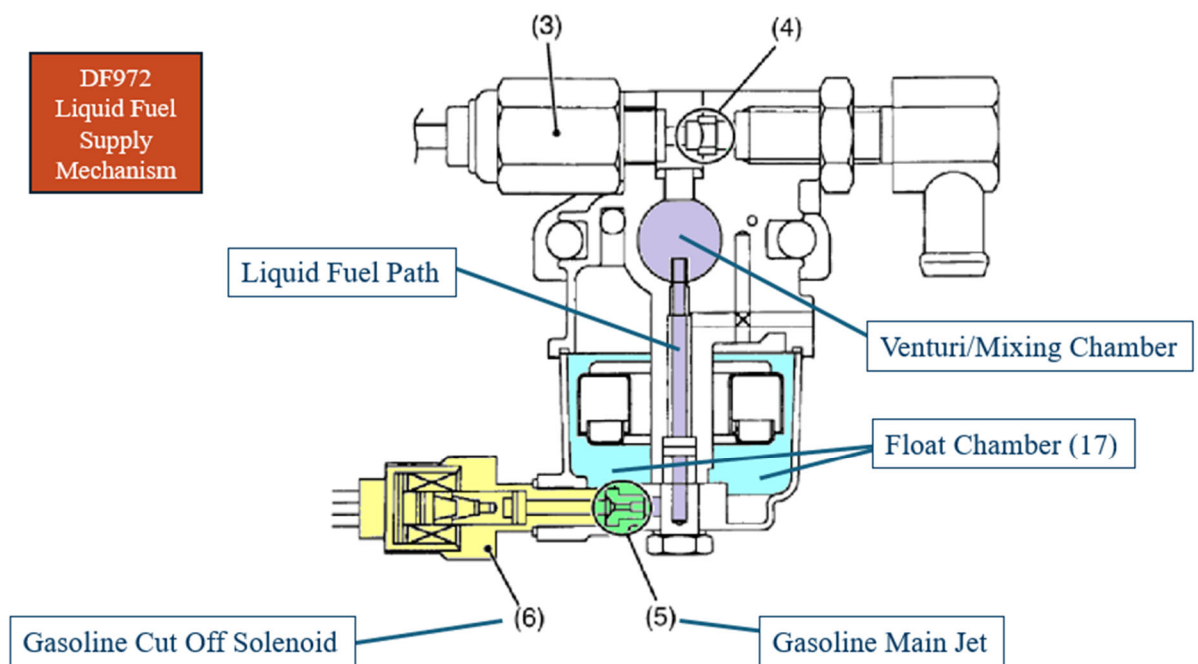
### C. Kubota DF972-E2 Workshop Manual (“Workshop Manual”)

The Workshop Manual (EX1012) was published/publicly available at least by June 2009 (EX1014, ¶¶4-10; EX1015, ¶¶4-14), before the earliest priority date (i.e., June 12, 2015). The Workshop Manual is a public, non-confidential document that was publicly accessible to purchasers, end-users, and service personnel working on Kubota DF972 engines, through their exercise of reasonable diligence (e.g., requesting a copy directly from Kubota, obtaining a copy from a Kubota

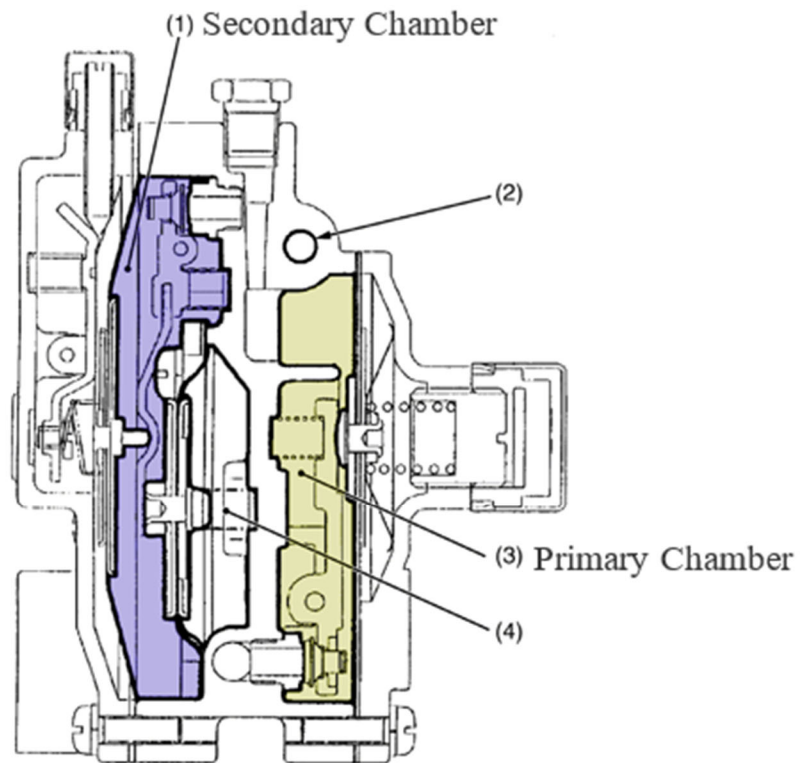
service center, etc.). *Id.* The Workshop Manual was created for dissemination to the interested public to provide instructions about how to safely assemble/disassemble, maintain, and service the DF972 engine, and is prior art to the '398 Patent under §102(a). *Weber, Inc. v. Provisur Technologies, Inc.*, 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 gasoline or LPG. EX1012, 8, 65. The Workshop Manual discloses a dual-fuel (“DF”) carburetor:



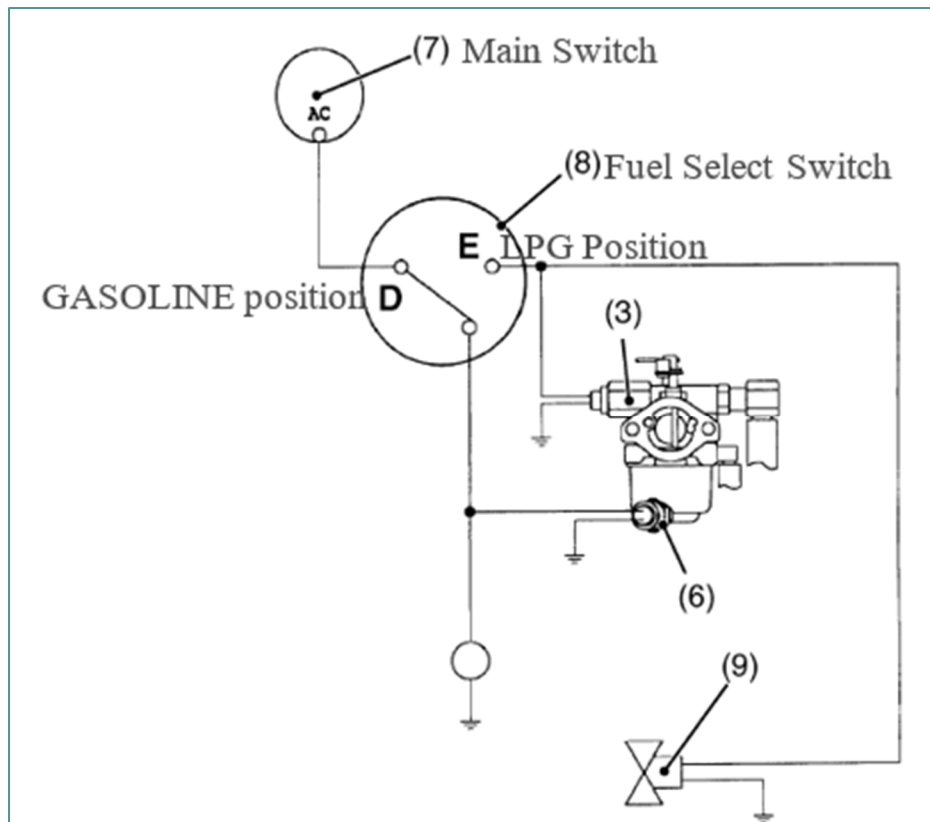


DF972  
Gaseous Fuel  
Supply  
Mechanism



*Id.*, 65, 67, 69 (annotated); EX1003, ¶62.

The Workshop Manual teaches a fuel-select switch (8) that controls whether a normally-closed Gasoline Cut Off Solenoid (located downstream of the float bowl) allows gasoline to pass through the carburetor, or whether a normally-closed LPG Cut Off Solenoid allows LPG to pass through the carburetor, to power the engine/generator:



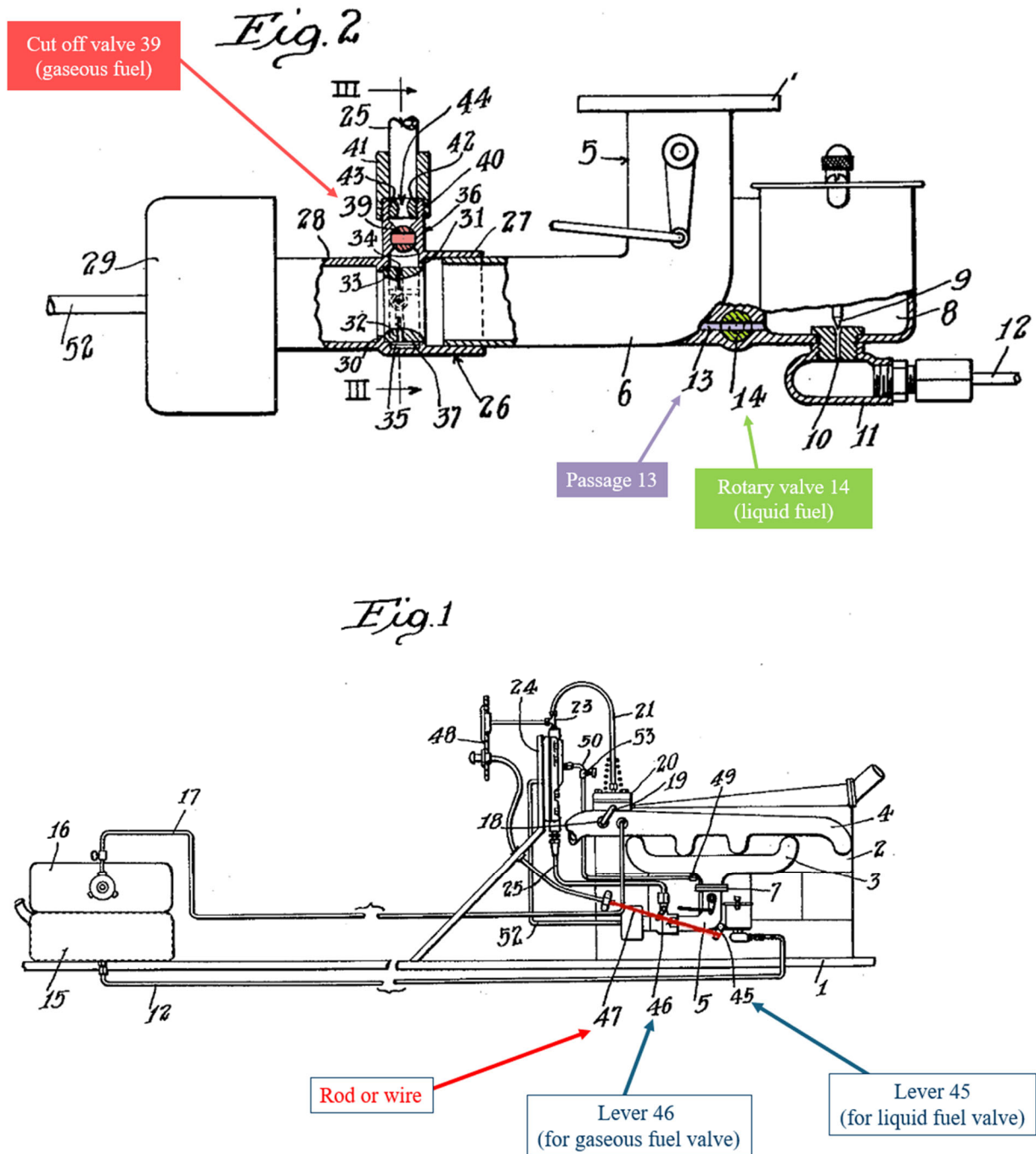
EX1012, 68 (annotated); EX1003, ¶63.

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

Holzapfel issued in 1933. EX1009. It is prior art under §102(a).

Holzapfel discloses “a fuel system embodying the supplying of liquid fuel and gaseous fuel to an engine in alternation at will.” EX1009, 1:1-5.

A “rod or wire 47” controls levers 45 and 46 for the liquid and gaseous valves 14 and 39, respectively. EX1009, 1:100-106, 2:86-123, Figs. 1-2. The liquid valve 14 is a rotary valve located in the fuel passage between the float bowl in the intake. *Id.*

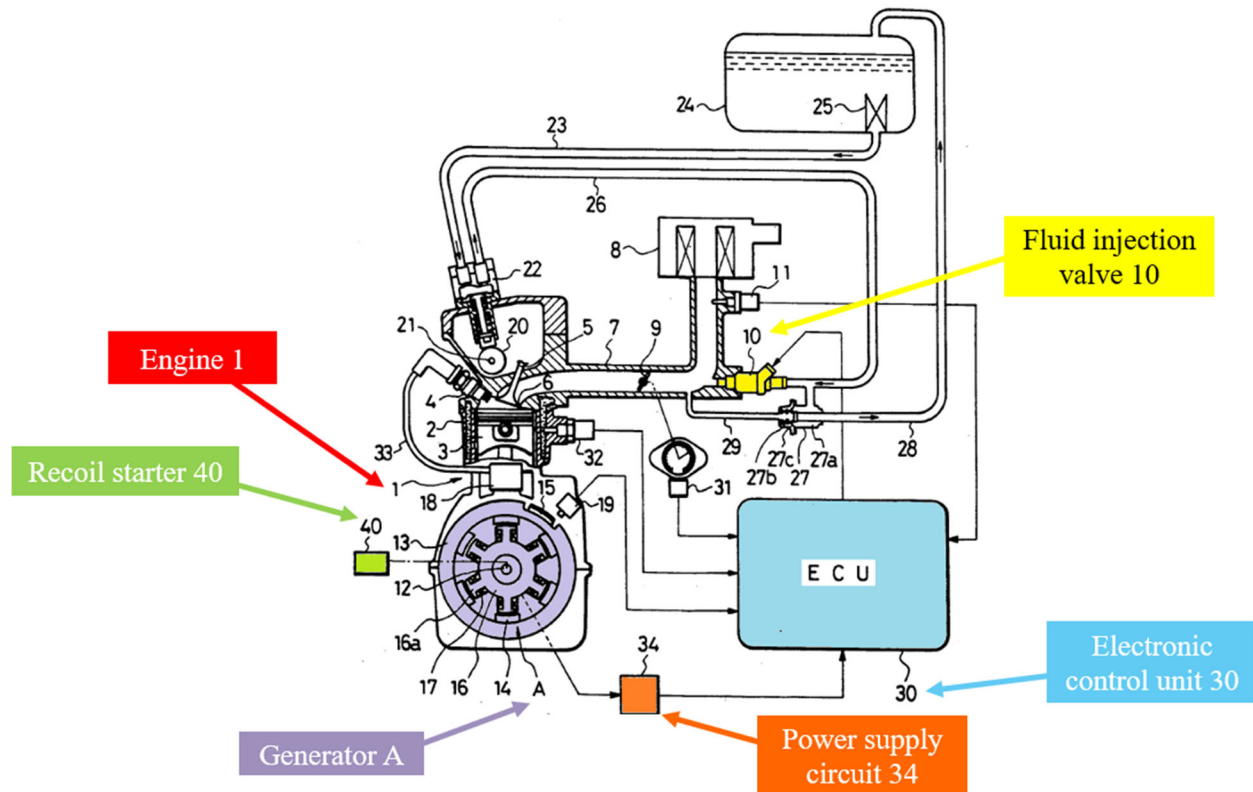


*Id.*, Figs. 1-2 (annotated).

**E. U.S Patent No. 5,161,496 (“Matsushima”)**

Matsushima issued in 1992. EX1029. It is prior art under §102(a).

Matsushima discloses an internal combustion engine and generator with no battery that is started using a manual recoil starter 40:



EX1029, Fig. 1 (annotated), 1:38-2:2, 3:53-66, 4:43-68.

During engine startup, the generator supplies voltage to electronic control unit (ECU) 30, as well as fuel pump 22, spark plug 4, and fuel injection valve 10.

*Id.*, 5:1-48.

#### **F. U.S. Patent No. 7,549,403 (“Yamamoto”)**

Yamamoto issued in 2009. EX1030. It is prior art under §102(a).

Yamamoto discloses a battery-less internal combustion engine and generator with a recoil starter 39:

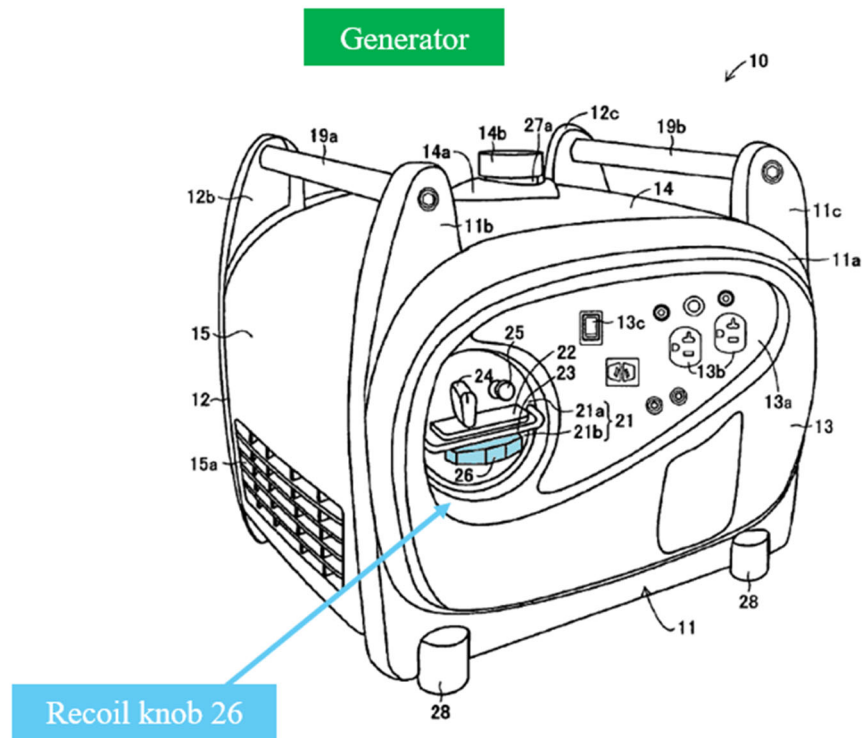


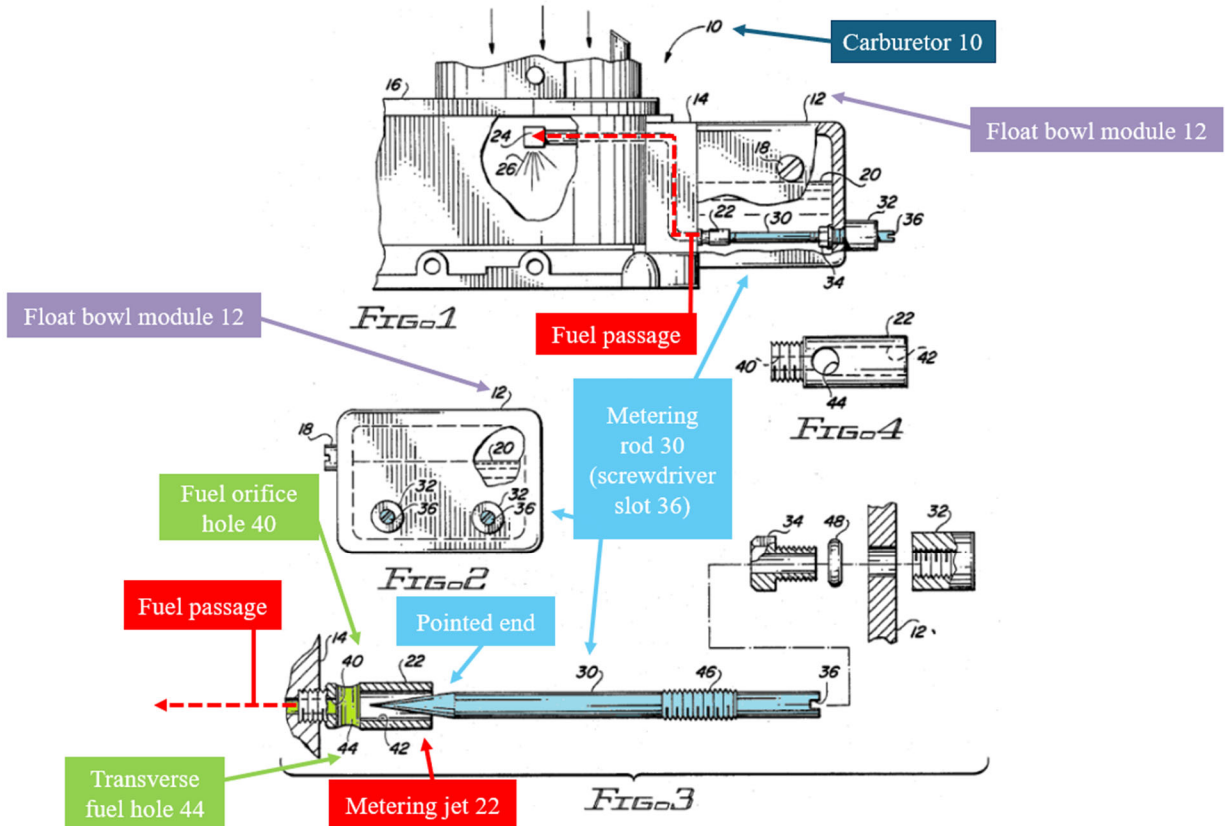
*Figure 1*

EX1030, Fig. 1 (annotated); 2:58-3:13, 4:35-40, 5:22-45.

**G. U.S. Patent No. 4,776,988 (“Neal”)**

Neal issued in 1998. EX1031. It is prior art under §102(a).

Neal discloses a valve in the form of a metering rod 30 in float bowl 12 of an internal combustion engine for controlling the flow of gasoline to the engine:



EX1031, Figs. 1-4 (annotated), 4:25-52; 6:15-42.

The metering rod 30 rotates using a screwdriver from the exterior of the float bowl to control the opening of the metering jet and, thus, the flow of fuel to the engine. *Id.*

#### H. U.S. Patent No. 6,213,083 (“Winberg”)

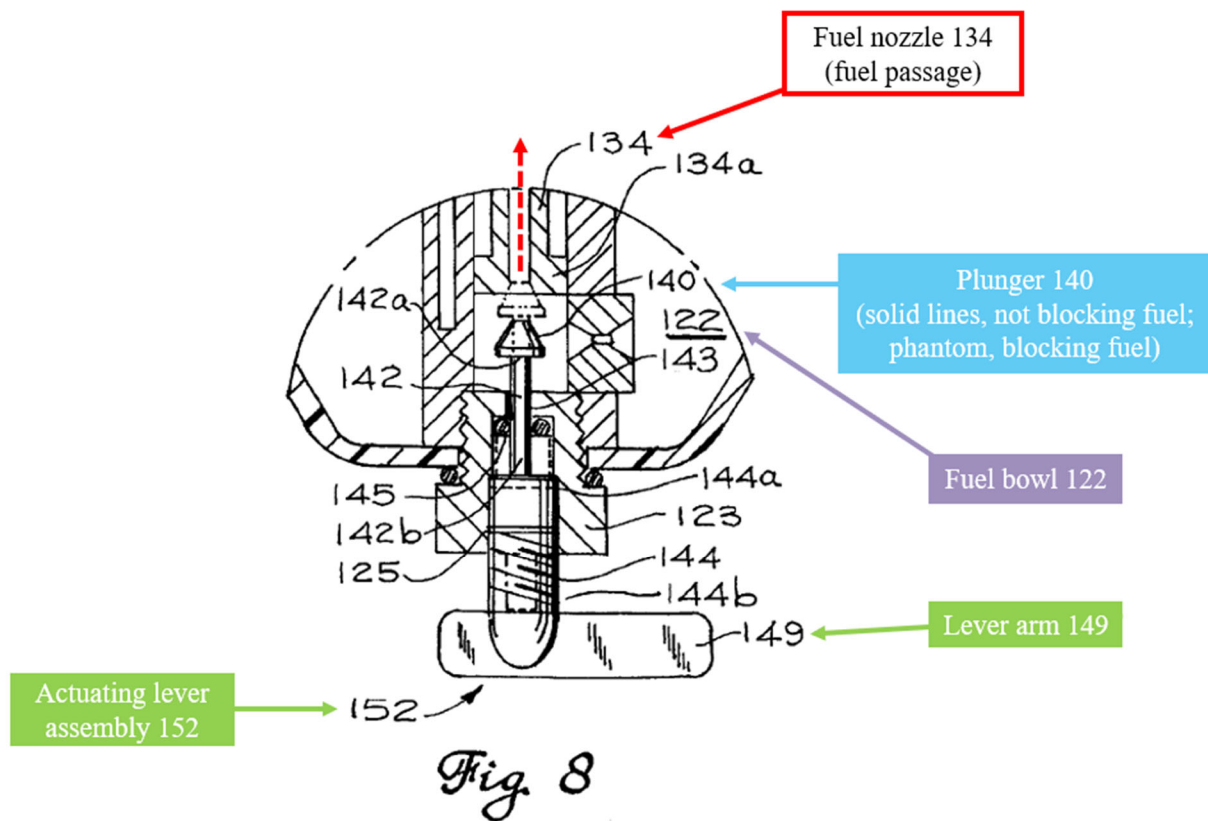
Winberg issued in 2001. It is prior art under §102(a).

Winberg discloses a fuel shutoff system in the float bowl of an engine.

EX1032, Abstract, Figures 1-8, 3:61-4:33, 5:34-6:43, 7:31-64, 7:65-8:52. The fuel shutoff includes a blocking member or plunger 40/140 that blocks and unblocks the flow of fuel from the float bowl to the fuel passage in fuel nozzle 34/134, thus

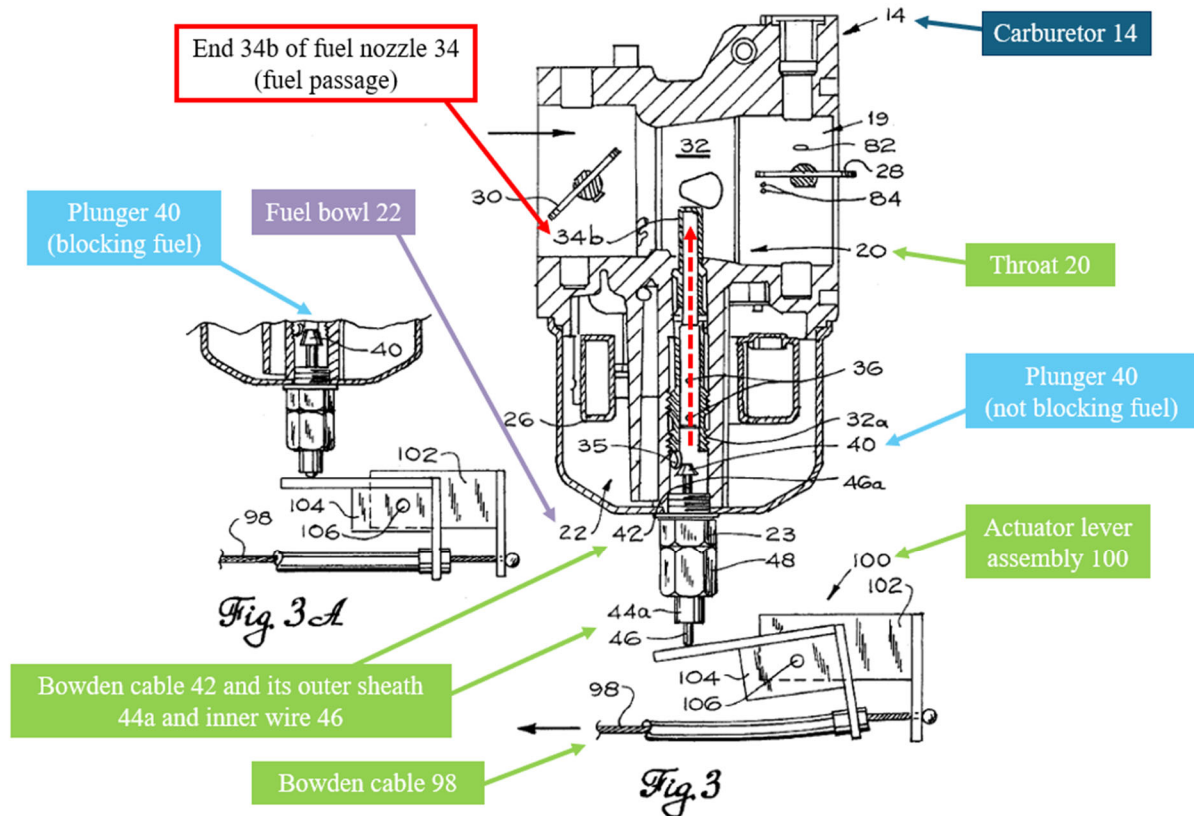
blocking the flow of fuel from the float bowl to the throat. *Id.*, Figures 1-8, 5:34-6:16, 7:31-55, 7:65-8:52.

In the Figure 8 embodiment, the fuel shutoff actuates by rotating actuating lever assembly 152, which moves plunger 140 between a blocking position and a non-blocking position:



*Id.*, Fig. 8 (annotated), 7:65-8:52.

In the embodiment of Figures 3/3A, the fuel shutoff actuates by rotating actuator assembly 100 about pivot point 106:



*Id.*, Figs. 3-3A (annotated), 3:61-4:33, 5:34-6:16, 7:31-55.

## 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 the Challenged Claims. As detailed below, this Petition establishes a reasonable likelihood that Petitioners will prevail with respect to one or more of the Challenged Claims. *See* EX1003, ¶¶75-568.

### A. Ground 1: Claims 1, 3, 22, and 57 are anticipated by the Workshop Manual

Claims 1, 3, 22, and 57 are anticipated under §102, as detailed below and in the declaration of Dr. Morse. EX1003, ¶¶76-124.

**1. Claim 1**

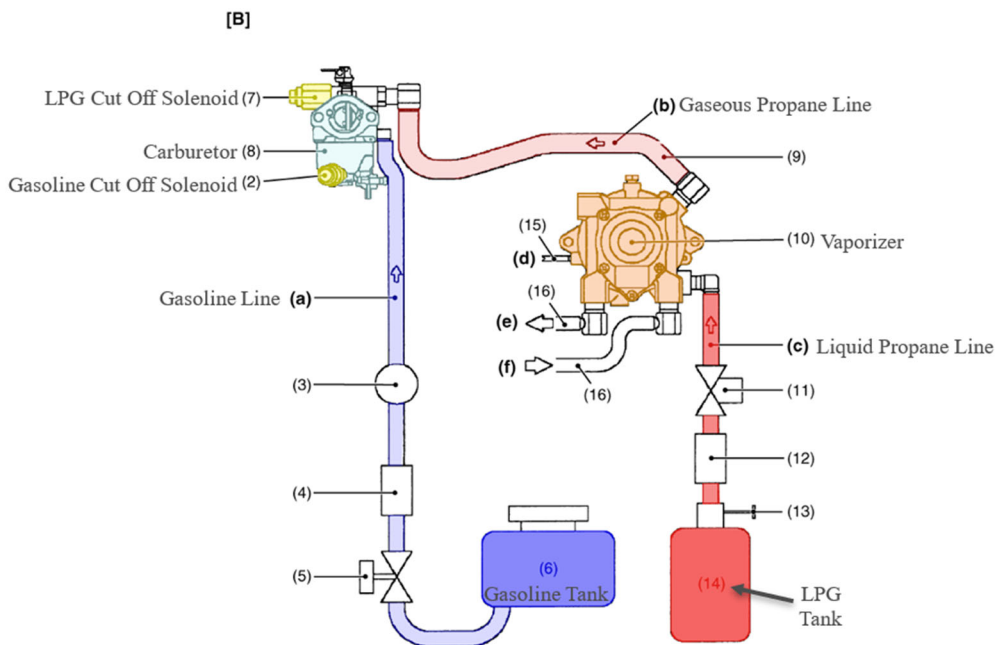
***a. Element [1.0]***

The Workshop Manual discloses a “Dual Fuel (Gasoline/LPG) Engine.”

EX1012, 8.

***b. Element [1.1]***

The Workshop Manual teaches that the DF972 engine uses both gasoline and LPG. EX1012, 8, 65. The figure below discloses the fuel system:



*Id.*, 65;<sup>2</sup> EX1003, ¶80. The Workshop Manual discloses operation on gaseous fuel, referred to as LPG or “LP Gas.” EX1012, 8, 68-69. 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

<sup>2</sup> All figures in the Grounds are annotated unless indicated otherwise.

fuel.” *Id.*, 65 (also denoting “Gaseous Propane Line” (b)), 69 (describing the vaporizer operation).

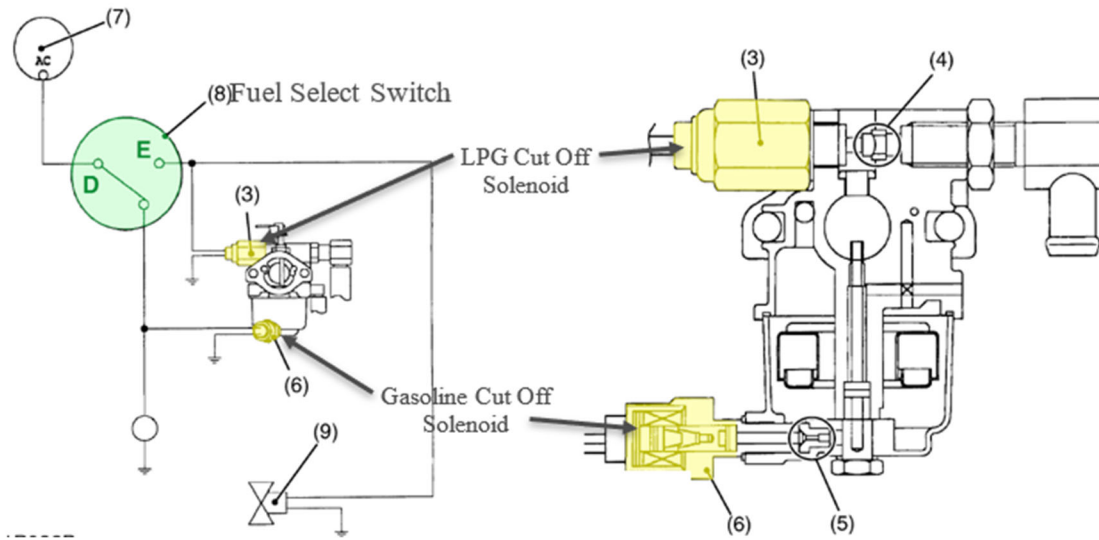
As confirmed by the ’398 Patent (EX1001, 4:9-10), gasoline is liquid fuel and LPG is a gaseous fuel. *See also* EX1001, 1:41-47; EX1003, ¶¶82-85.

*c. Element [1.2]*

The Workshop Manual discloses a switch (i.e., “Fuel Select Switch”) that changes operation of the engine between gaseous fuel and liquid fuel:

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.

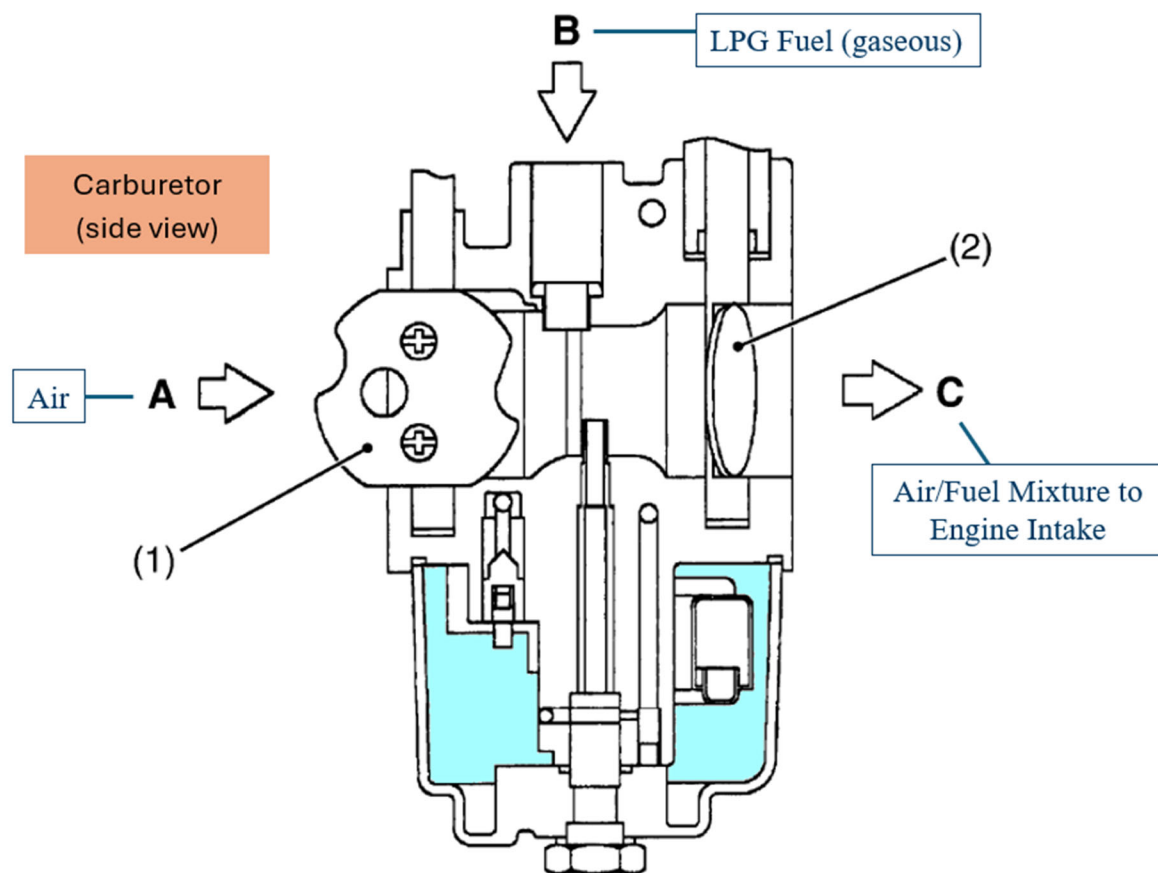
EX1012, 68. This switch is shown in the figures:

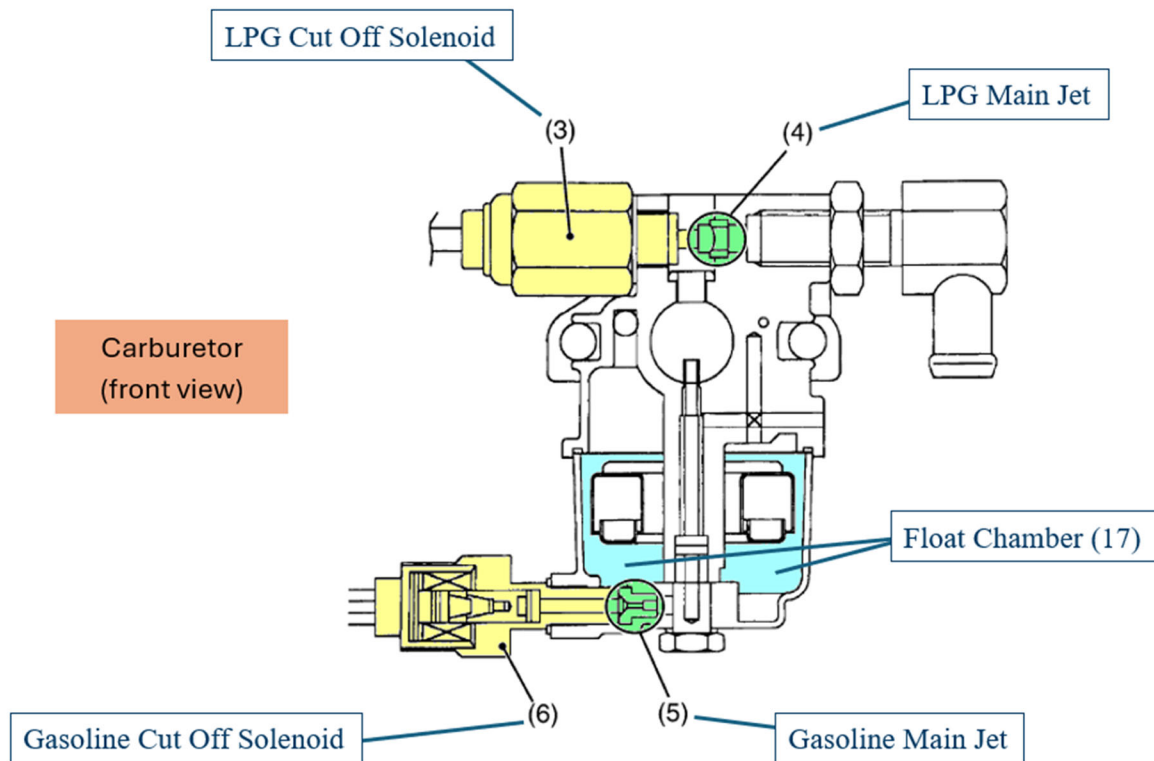


*Id.*; EX1003, ¶¶87-89.

***d. Element [1.3]***

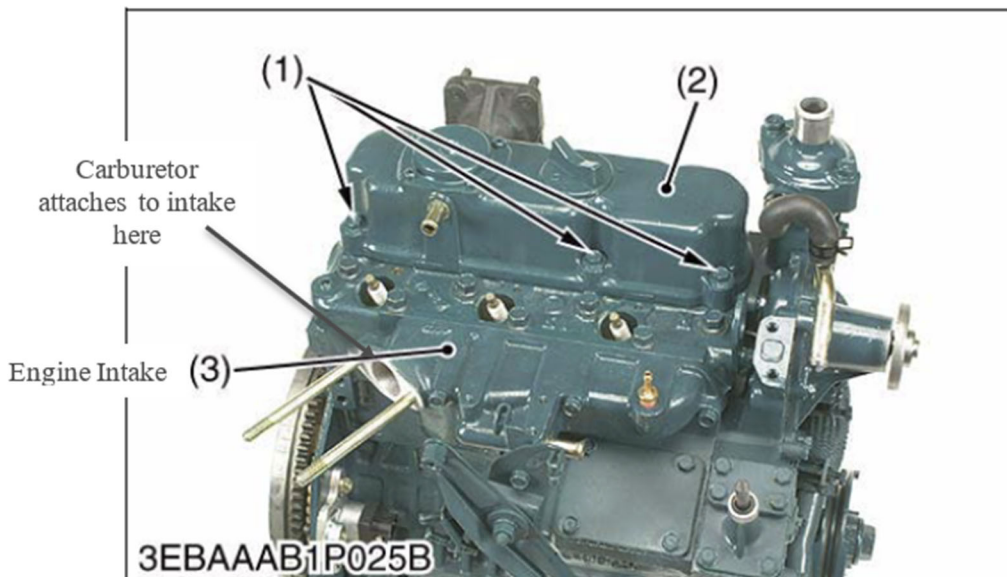
The Workshop Manual discloses a carburetor that mixes air and fuel: “The mixer meters both fuel and air, and procedures [sic: produces] an air/fuel mixture that has the proper ratio as required by the engine.” EX1012, 68. The figures illustrate the carburetor operation:

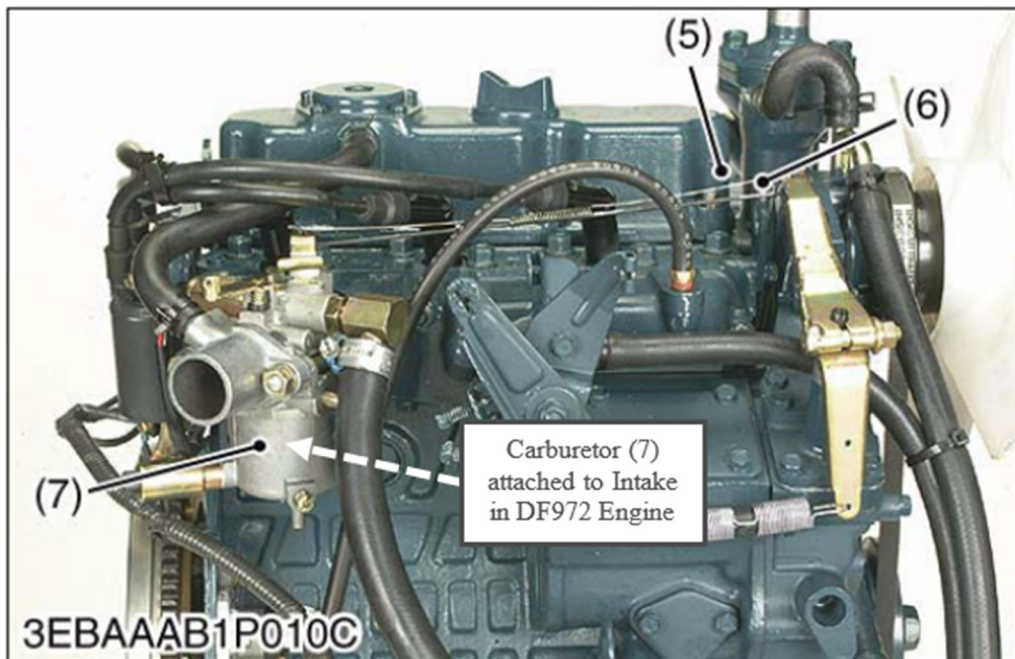
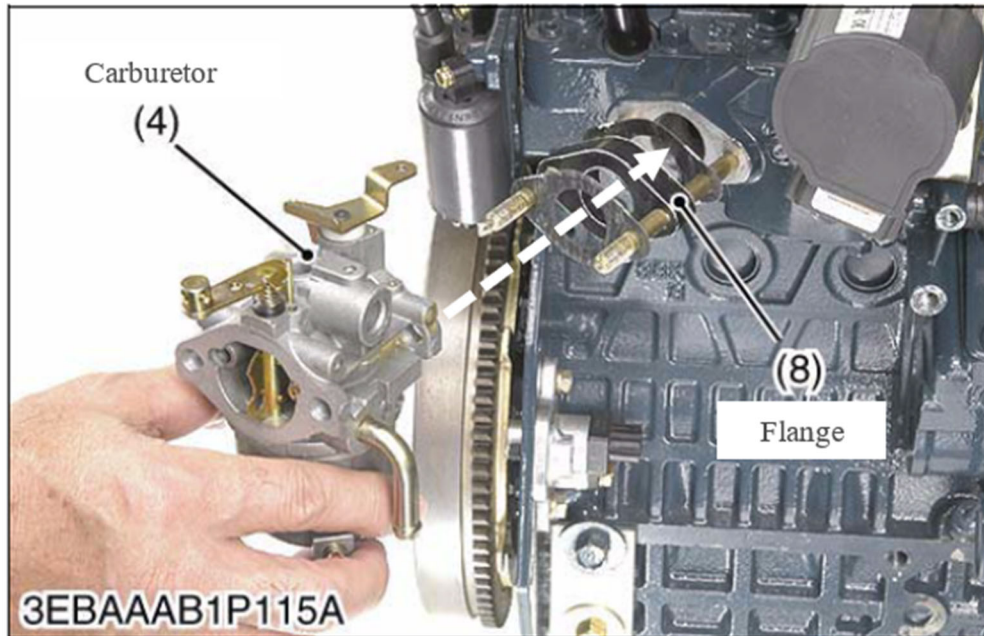




*Id.*; EX1003, ¶92.

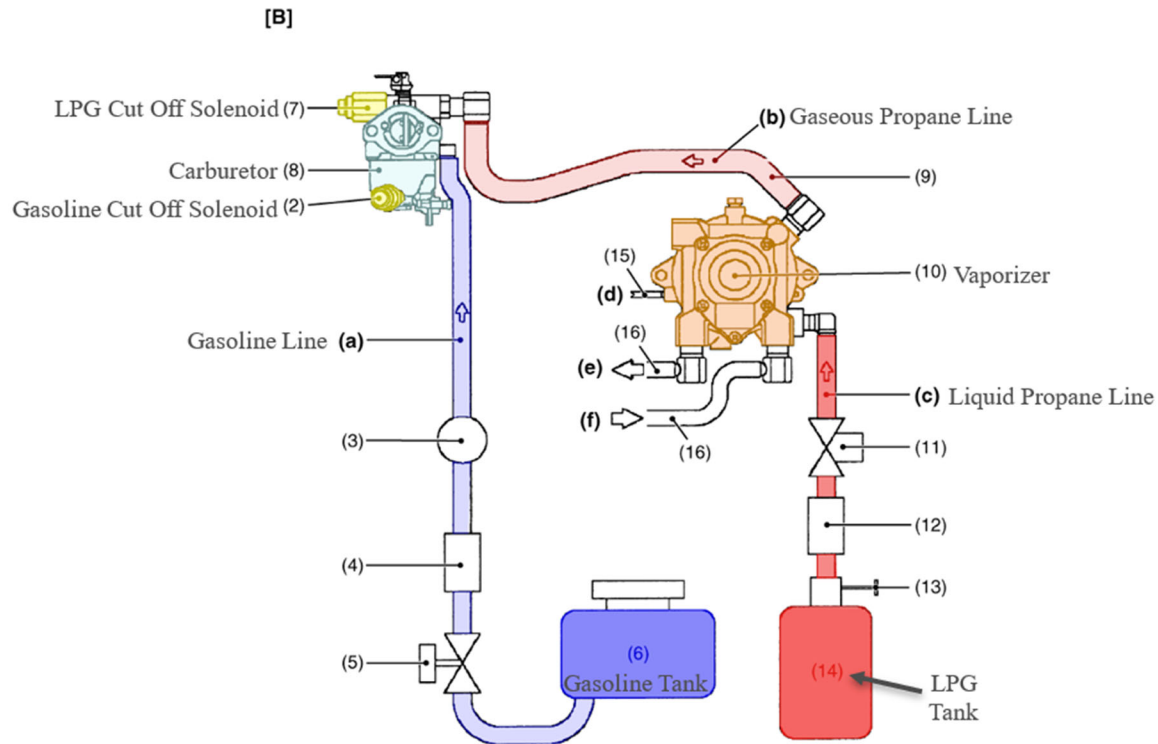
The Workshop Manual shows the carburetor attaching to the engine intake:





EX1012, 115, 119; EX1003, ¶93.

The Workshop Manual discloses that the carburetor connects to a LPG tank (gaseous fuel source) and a gasoline tank (liquid fuel source):



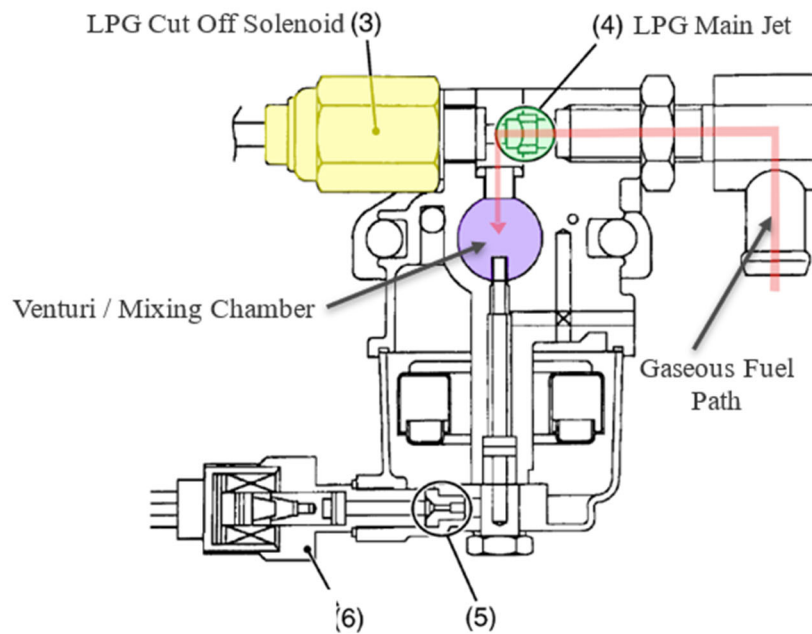
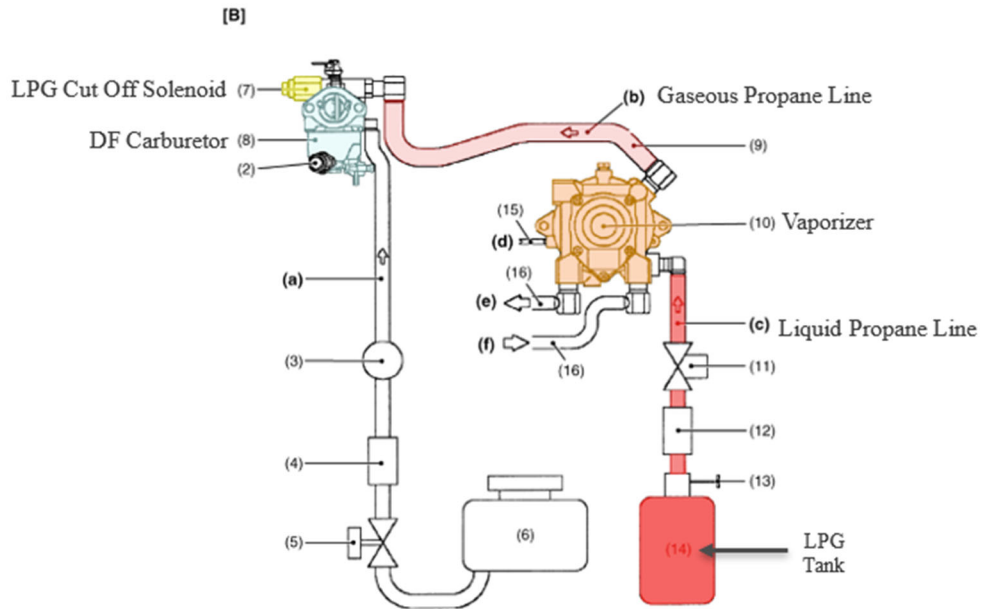
EX1012, 65; EX1003, ¶94.

*e. Element [1.4]*

The Workshop Manual discloses a liquid fuel valve (Gasoline Cock (5)) and liquid fuel line (Gasoline Line (a)). EX1012, 65. The Gasoline Cock is positioned on the Gasoline Line coupling the gasoline tank to the carburetor:



<sup>3</sup> Referred to as LPG Cut Off Solenoid (7) and LPG Cut Off Solenoid (3). EX1012, 65, 68.

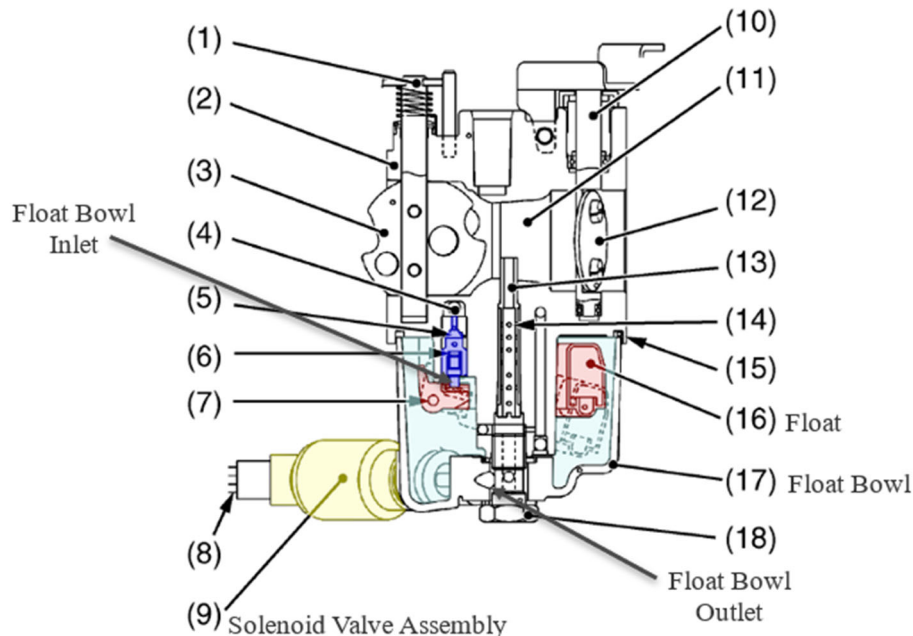


*Id.*, 65, 68; EX1003, ¶98.

***g. Element [1.6]***

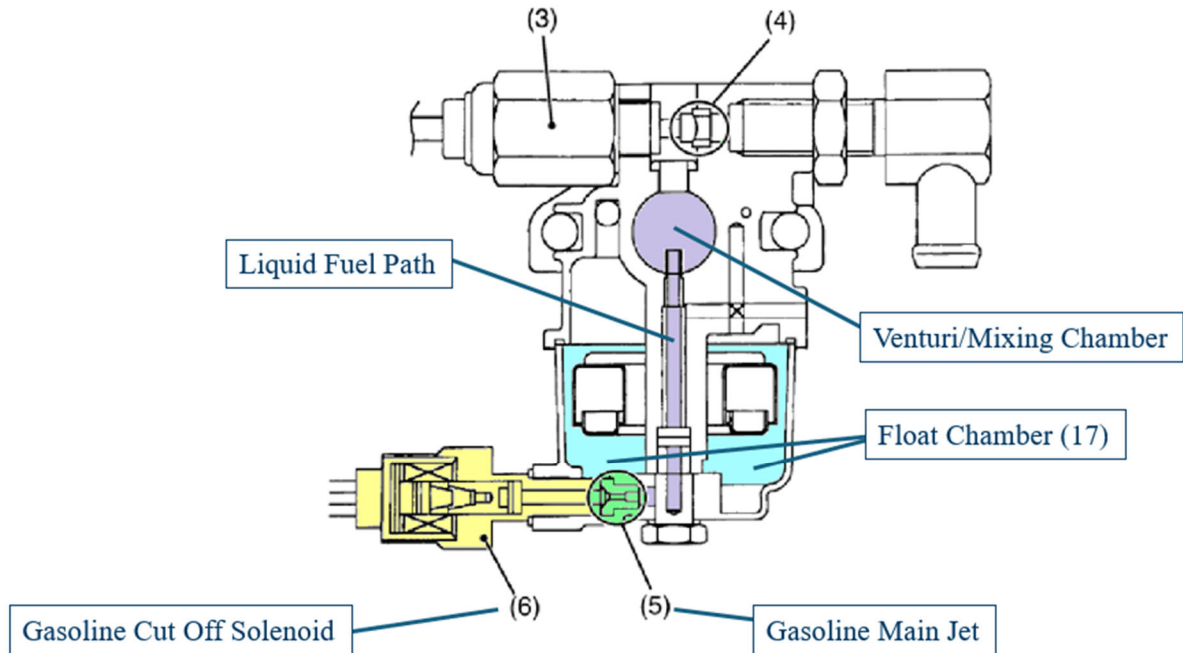
The Workshop Manual discloses Gasoline Cut Off Solenoid (EX1012, 65, 68), which is a “liquid fuel cut-off.” EX1003, ¶100. The fuel select switch changes

operation of the engine between LPG and gasoline, which results in interrupting gasoline. EX1012, 65, 68 (“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.**” (emphasis added)); *supra* §VII.A.1.c.



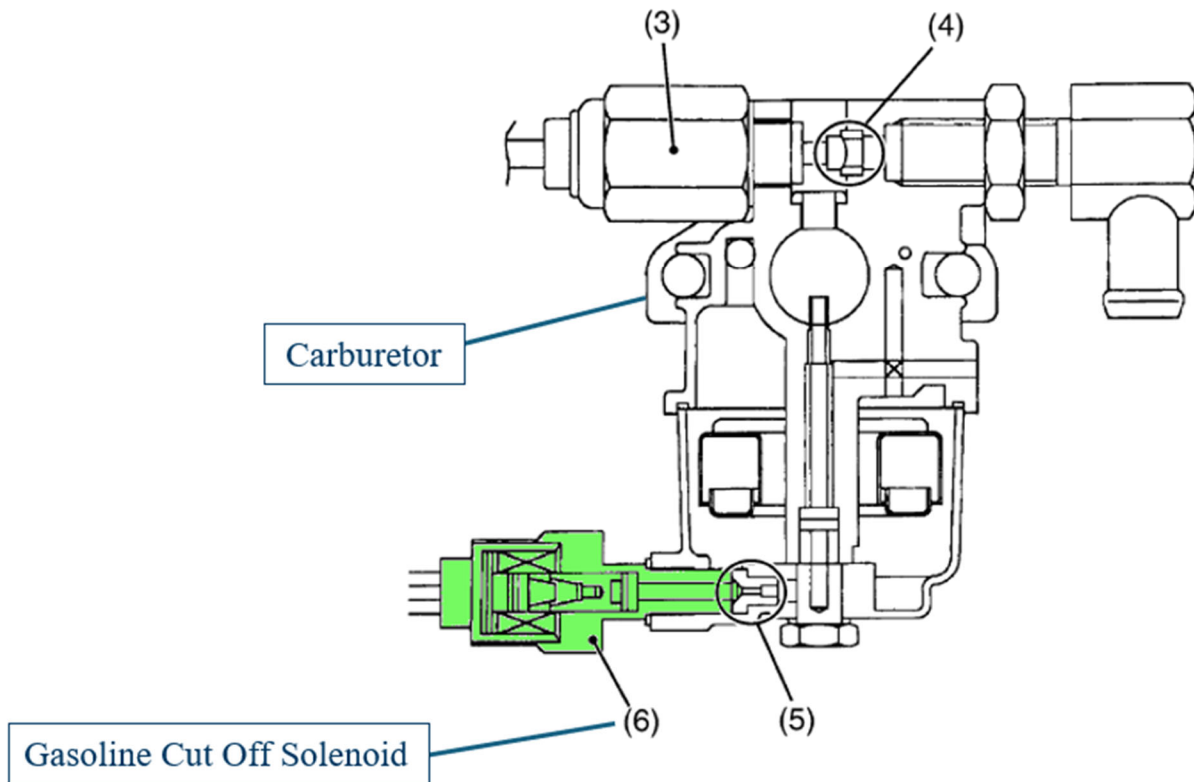
*Id.*, 67;<sup>4</sup> EX1003, ¶100.

<sup>4</sup> This figure is for the WG972 engine, but the Workshop Manual indicates that the “DF Carburetor operates the same as a gasoline carburetor in gasoline fuel.”



EX1012, 68; EX1003, ¶100.

The Gasoline Cut Off Solenoid is incorporated into the carburetor:



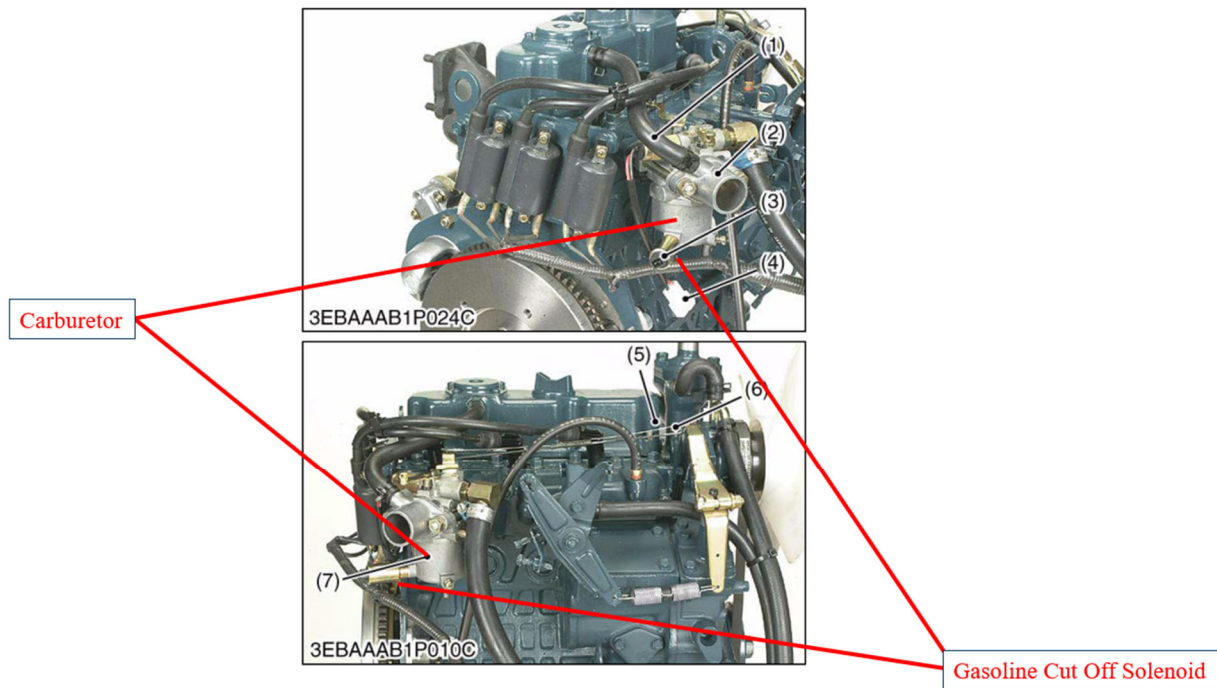
EX1012, 68; *id.*, 67; EX1003, ¶101.

**2. Claim 3**

The DF972 operates on gasoline and LPG. *Supra* §VII.A.1.b.

**3. Claim 22**

The Workshop Manual discloses the Gasoline Cut Off Solenoid is physically attached to an outer surface of the carburetor:



EX1012, 115; EX1003, ¶105.

#### 4. Claim 57

##### a. Element [57.0]

The Workshop Manual discloses a dual-fuel engine. *Supra* §§VII.A.1.a-VII.A.1.b.

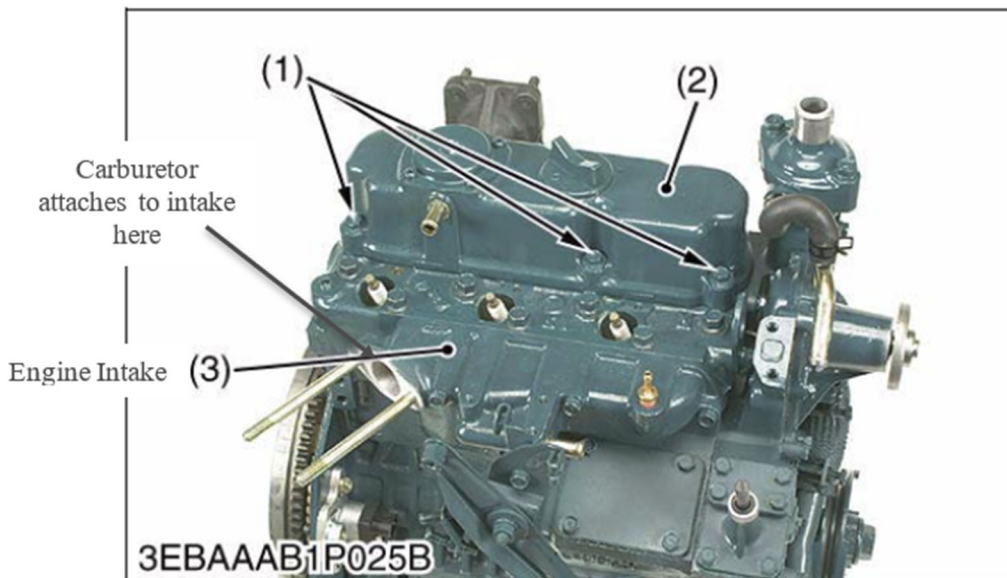
It is inherent that the components of the DF972 engine were assembled to form the engine, as their integration into a functional system necessitates assembly steps. EX1003, ¶107. A POSA would understand that the Workshop Manual's disclosure of the DF972 inherently includes the method of assembling its components. *Id.*

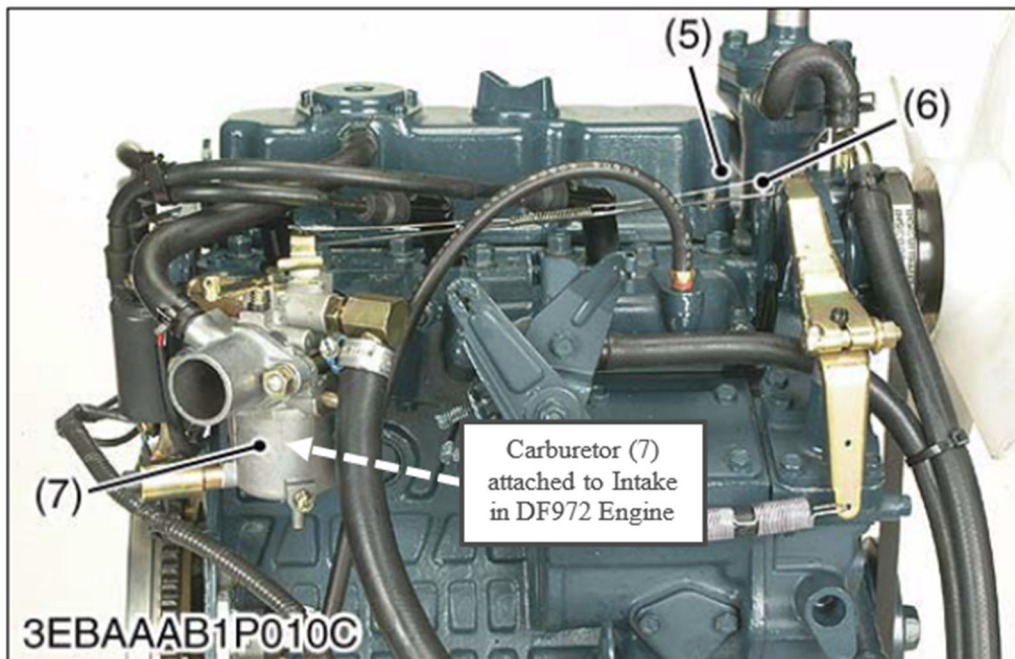
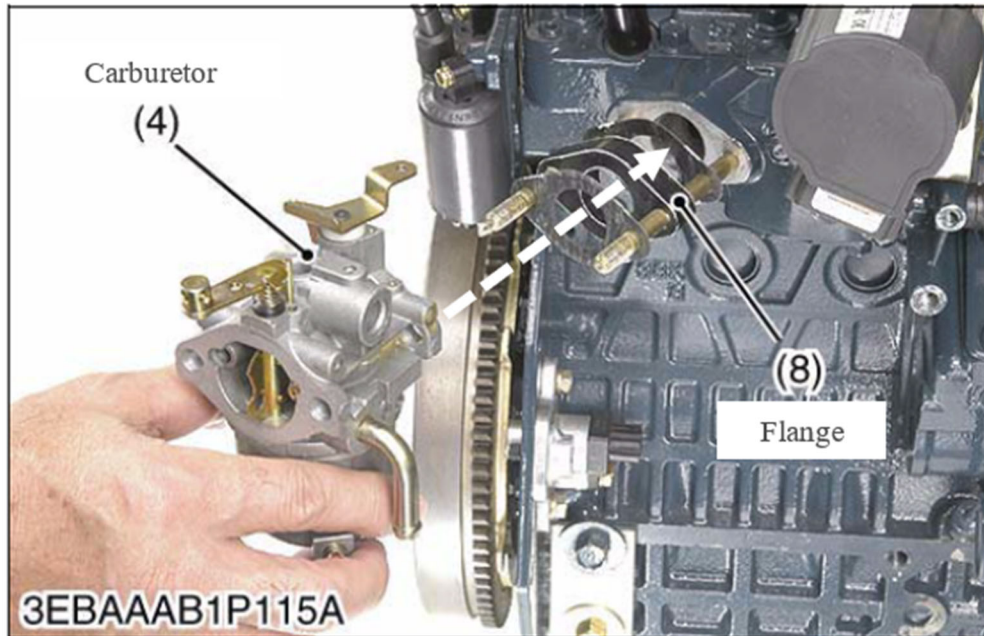
***b. Element [57.1]***

The Workshop Manual discloses this element. *Supra* §VII.A.1.b.

***c. Element [57.2]***

The Workshop Manual discloses attaching a carburetor to an intake of the engine:

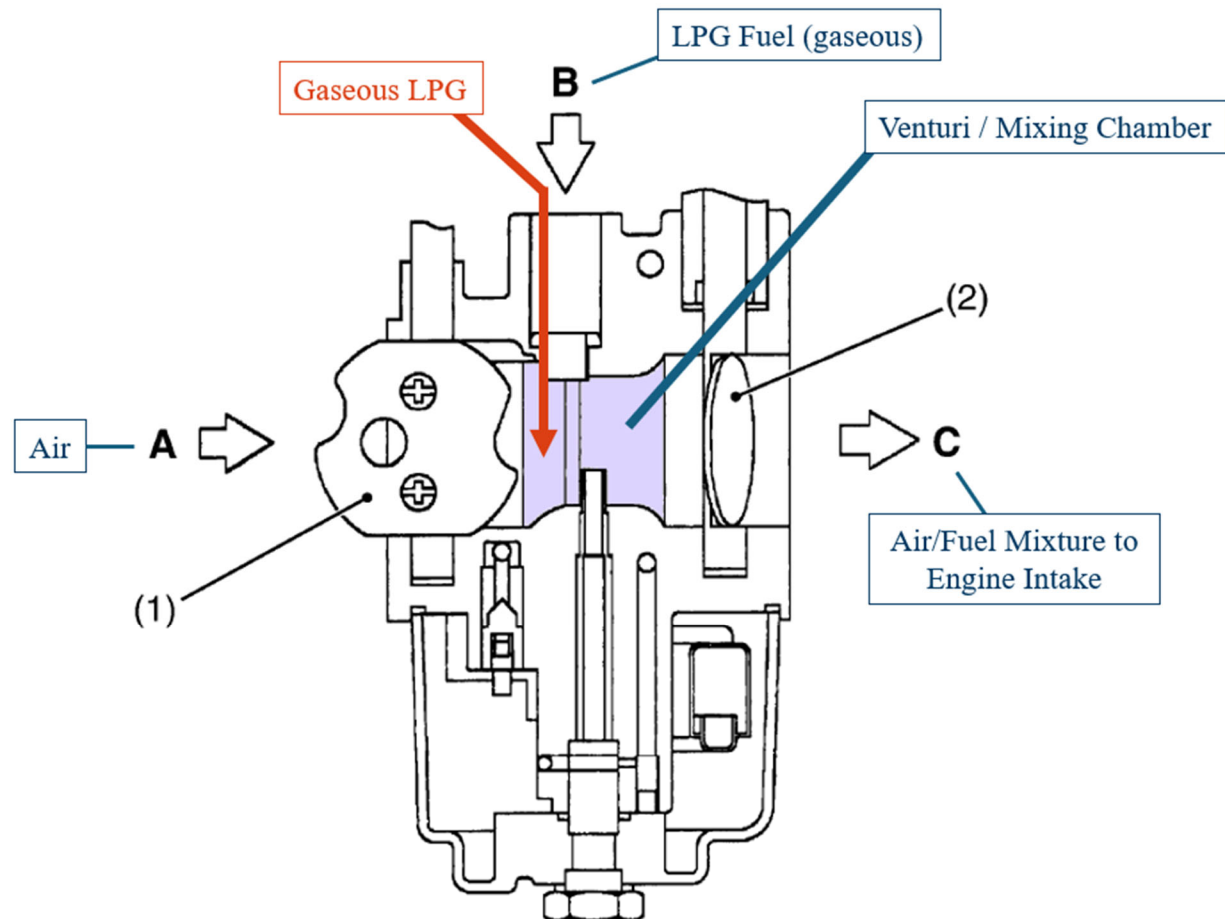


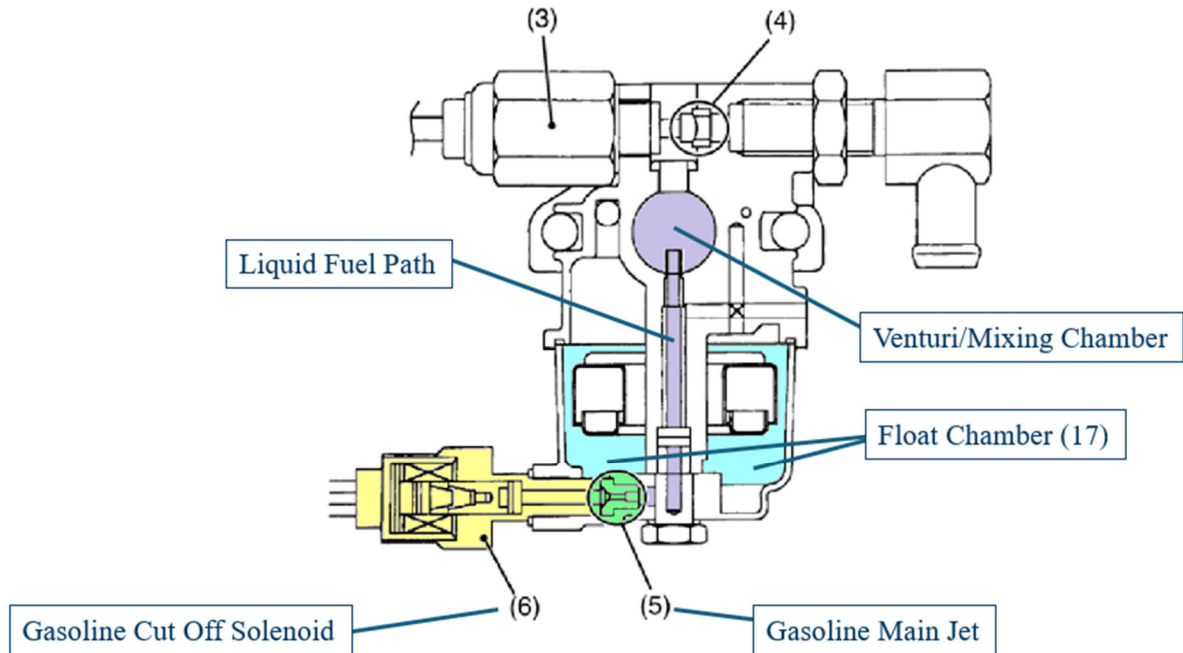


EX1012, 115, 119; *supra* §VII.A.1.d; EX1003, ¶¶111-112.

*d. Element [57.3]*

The Workshop Manual discloses a carburetor mixing chamber, which a POSA would understand to be a throat of the carburetor in which LPG and gasoline are mixed with air:

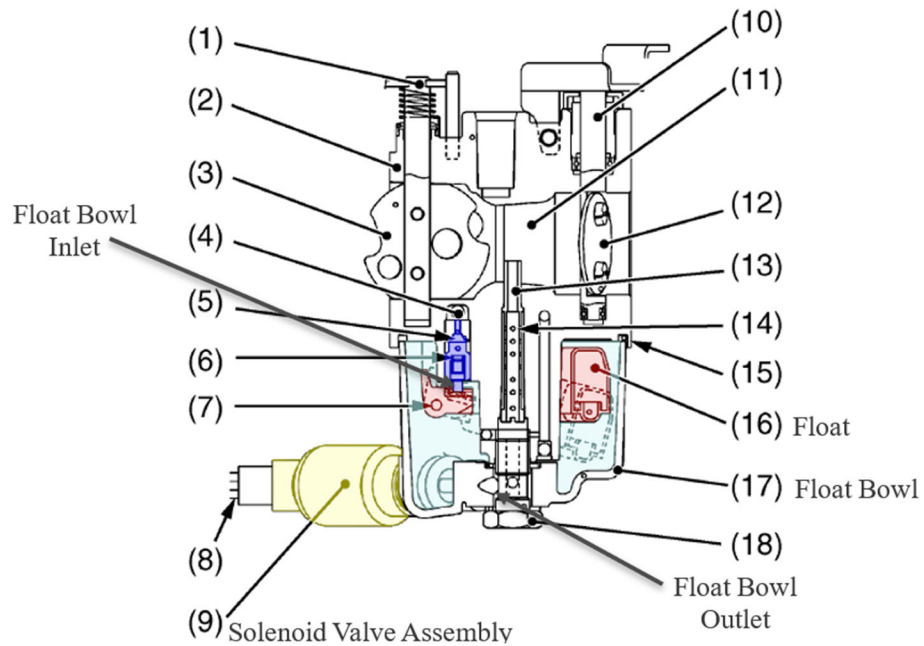


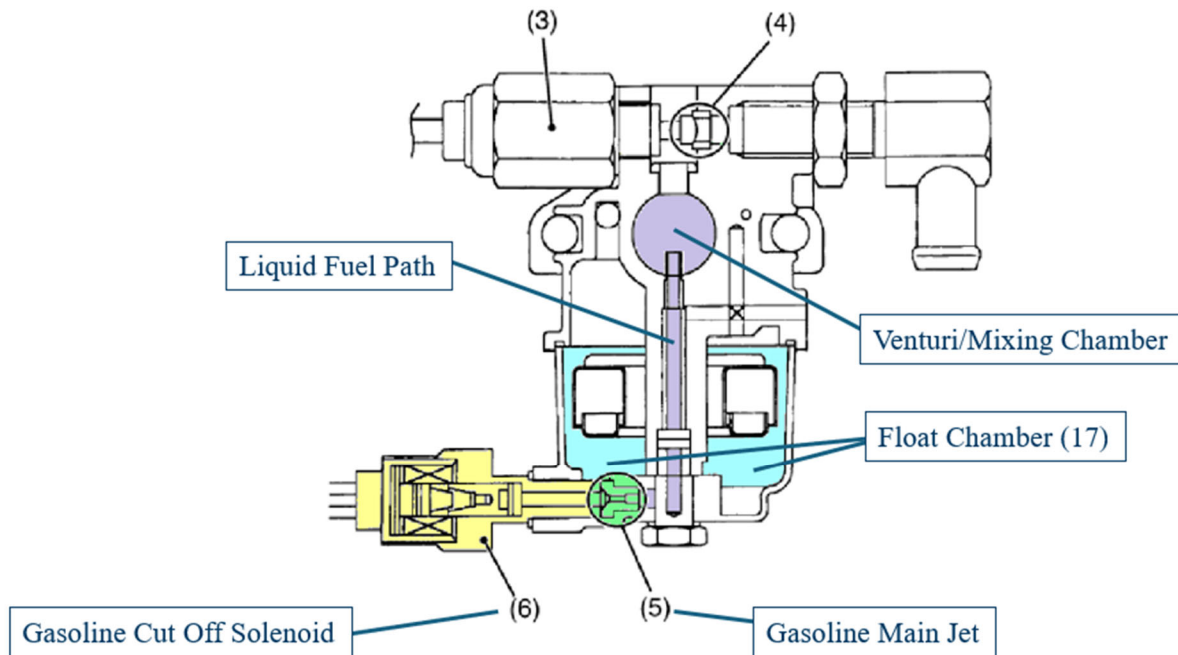


EX1012, 68; EX1003, ¶114.

*e. Element [57.4]*

The carburetor comprises a float chamber (17) (a float bowl):

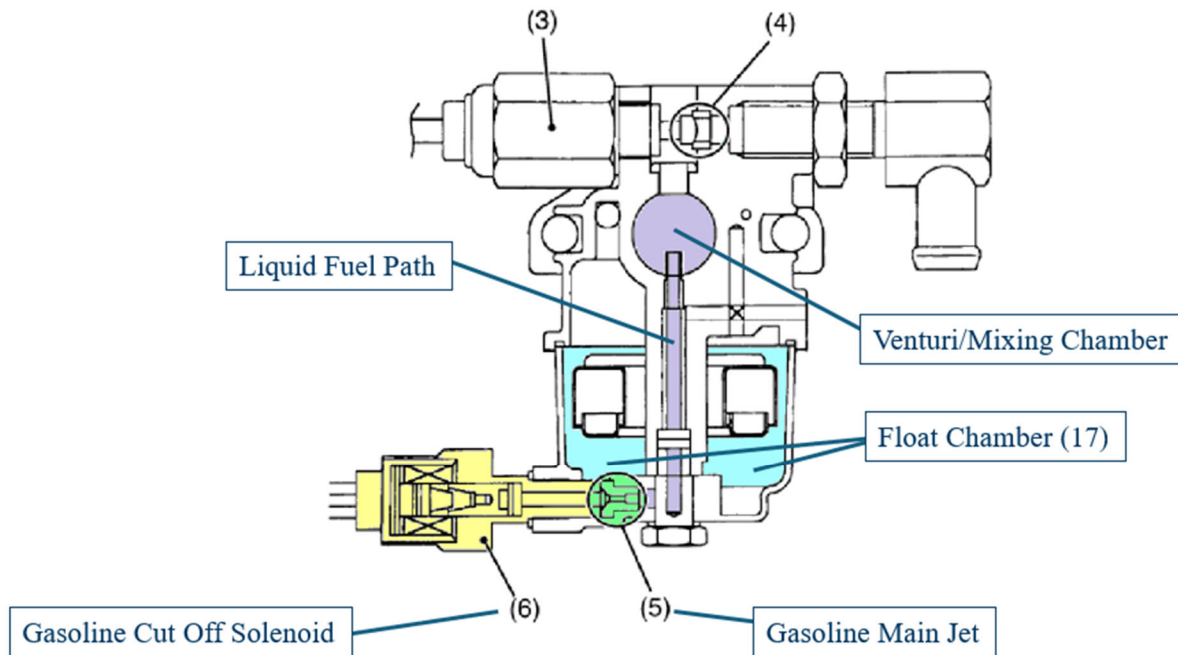




EX1012, 67-68; EX1003, ¶116.

*f. Element [57.5]*

The Workshop Manual discloses a fuel passage positioned downstream from the float chamber. EX1012, 68 (“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.***” (emphasis added)); EX1003, ¶118. A POSA would understand the carburetor mixing chamber to be the throat of the carburetor. EX1003, ¶118.



EX1012, 68; EX1003, ¶118. Therefore, the fuel passage (in purple) extends from the float chamber to the throat to provide gasoline. EX1012, 67-68; EX1003, ¶119.

***g. Element [57.6]***

The Workshop Manual discloses this element. *Supra* §VII.A.1.c.

***h. Element [57.7]***

The Workshop Manual discloses this element. *Supra* §VII.A.1.g.

**B. Ground 2: Claims 2, 4-14, 19-21, 23, 32-42, and 58 are obvious over the Workshop Manual in view of Matsushima, Yamamoto, and Olmr**

Claims 2, 4-14, 19-21, 23, 32-42, and 58 of the '398 Patent are obvious under §103, as detailed below and in the declaration of Dr. Morse. EX1003, ¶¶125-235.

**1. Claim 2**

It would have been obvious to a POSA to incorporate a pull-start to start the DF972 engine in place of the battery. EX1003, ¶127. Matsushima discloses a pull-start for an engine. EX1029, Abstract, 3:53-68, 4:63-66, 5:4-8, Fig. 1.

A POSA would have found it obvious to incorporate Matsushima's recoil-starter 40 with the DF972 engine. EX1003, ¶128.

***a. Motivation/Expectation of Success***

The Workshop Manual and Matsushima both relate to the same class of small, spark-ignition engines that are offered with either battery-dependent electric start or battery-independent recoil (pull) start. EX1003, ¶129. Incorporating a pull-start into the Workshop Manual's dual-fuel engine would improve reliability in cold or remote applications and reduce costs. Matsushima provides a blueprint for implementing a recoil starter on an engine of similar displacement and layout. *Id.*

A POSA would have reasonably expected success in adopting Matsushima's recoil mechanism for use with the DF972 engine. *Id.*, ¶130. Because the DF972 engine already incorporates a flywheel and fan shroud analogous to those in Matsushima, a POSA would have found it straightforward to mount Matsushima's recoil mechanism on the DF972 engine with only routine mechanical adaptation. *Id.* At the time of the invention, the use of recoil starters was ubiquitous on

engines, and their installation required only routine mechanical tasks—attaching the standard recoil housing. *Id.*

## **2. Claim 4**

The Workshop Manual’s dual-fuel 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.” EX1012, 77. The Workshop Manual specifies that the alternator outputs 150W at 12V. *Id.*, 8. Thus, Workshop Manual discloses an electrical power generator, powered by operation of the DF972 engine. EX1003, ¶132.

It would have been obvious to combine Matsushima’s recoil-starter assembly with the DF972 engine. *Supra* §VII.B.1.

## **3. Claim 5**

### ***a. Element [5.1]***

The DF972’s fuel select switch selectively connects gasoline or LPG to the carburetor. *Supra* §VII.A.1.c. The fuel select switch is connected to the DF972’s generator via the battery. *Id.*; *supra* §VII.B.2. The fuel select switch would also be connected to the generator in the absence of the battery (to power the solenoids), just as Matsushima’s components are connected to its generator (such as its fluid injection valve 10). EX1029, Fig. 1, 5:1-48; EX1003, ¶136.

The fuel select switch uses a mechanical part to control the flow of electrical current, thus making it an electro-mechanical switch. EX1003, ¶137.

***b. Element [5.2]***

The Gasoline Cut Off Solenoid (a solenoid) is connected to open and close the gasoline path to the engine (a pull-start when combined with Matushima) upon reception of electrical power from the fuel select switch. *Supra* §§VII.A.1.c, VII.A.1.g; EX1003, ¶140.

**4. Claim 6**

The Gasoline Cut Off Solenoid (a solenoid) is incorporated into the carburetor and controls gasoline flow to the engine and is powered by the DF972's electrical power generator. *Supra* §§VII.A.1.c, VII.A.1.g, VII.B.3; EX1003, ¶142.

**5. Claim 7**

The fuel select switch selectively powers the Gasoline Cut Off Solenoid by controlling electrical connection between the Gasoline Cut Off Solenoid and the electrical power generator. *Supra* §§VII.A.1.c, VII.A.1.g, VII.B.3; EX1003, ¶144.

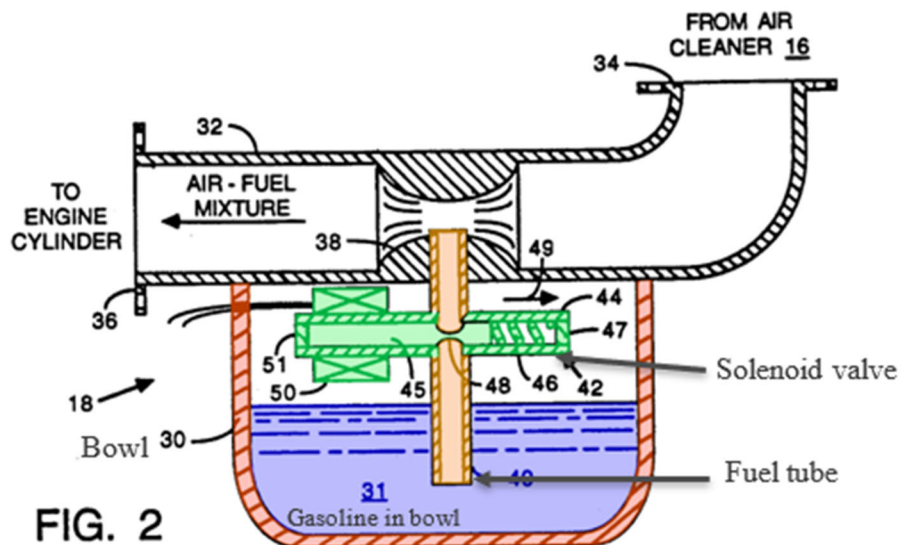
**6. Claim 8**

The Gasoline Cut Off Solenoid is normally closed. EX1012, 68; EX1003, ¶¶88, 146. It would have been obvious to a POSA to use a normally-open solenoid, instead. EX1003, ¶146. Olmr discloses a gasoline cut-off solenoid valve in a carburetor that is normally open. EX1007, 3:38-55, Fig. 2.

***a. Motivation/Expectation of Success***

The Workshop Manual 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. EX1003, ¶147. The DF972's Gasoline Cutoff Solenoid cuts the gasoline flow from the float bowl when the operation of the engine is switched from gasoline to LPG. *Id.* Olmr discloses a gasoline engine having solenoid 42 in a float bowl 30 that cuts off the flow of gasoline to the venturi 38 when the operator closes the kill switch. EX1007, 2:30-68, 4:11-27.



*Id.*, Fig. 2; EX1003, ¶147.

Thus, Olmr's valve 42 is a solenoid connected to open and close a fuel path to the [pull-start] engine via venturi 38. EX1003, ¶148. Olmr thus teaches a solenoid valve for accomplishing the same function taught by the Workshop Manual, i.e., cutting gasoline flow to the carburetor when needed. *Id.*

A POSA would have been motivated to use Olmr's normally-open solenoid rather than a normally-closed solenoid based on the express teachings of Olmr:

Electricity is not required to hold the valve in this position during engine starting and normal running. This is a key feature since many small gasoline engines do not utilize a battery or other source of power for starting. Thus upon commencement of engine operation, a source of electricity is not required as solenoid valve is in the normally open position. In addition, should the valve control circuit fail, the spool valve plunger 45 will fail in the normally open position allowing continued operation of the engine.

EX1007, 3:43-52; EX1003, ¶149. Although the DF972 engine has a battery, a POSA would have been nonetheless motivated to use this configuration to allow engine starting if the engine is modified to operate without a battery or if the battery is dead. EX1003, ¶149.

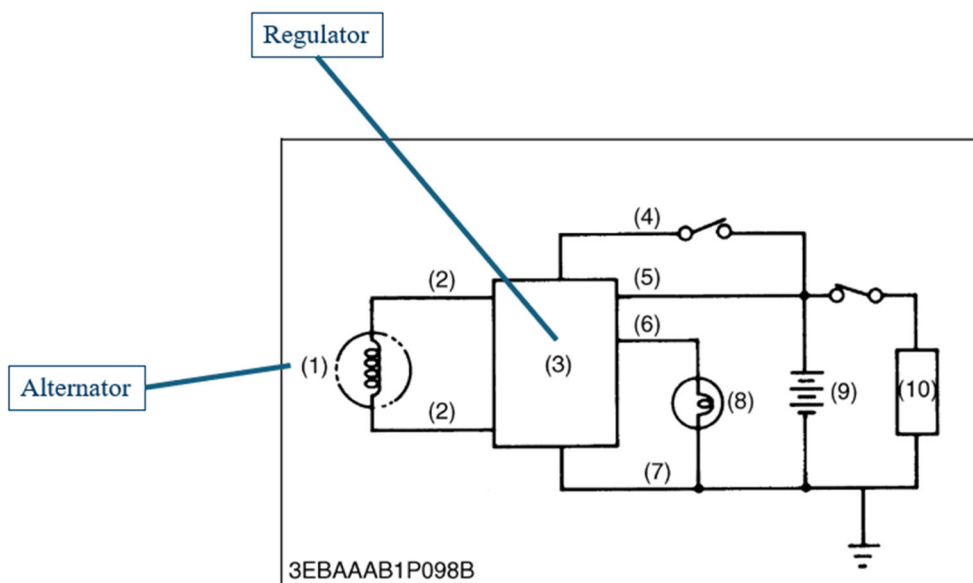
A POSA would have had a reasonable expectation of success in replacing the DF972's normally-closed solenoid with the normally-open solenoid of Olmr because it would have involved a simple substitution and a rewiring of the DF972's switch and both types were routinely used at the time of the invention. *Id.*, ¶150.

**7. Claim 9**

Matsushima's pull-starter drives an electrical power generator to power various components while starting its engine (including its fuel pump, spark plug and fuel injection valve). EX1029, Abstract, 5:1-48; EX1003, ¶152. Incorporating Matsushima's pull-starter assembly with the DF972 engine would similarly allow the pull-starter assembly to drive the DF972's generator to power and close the DF972's solenoid valve while starting the engine on gaseous fuel. *Id.*

**8. Claim 10**

The DF972's electrical power generator is an alternator. EX1012, 77; EX1003, ¶154. The alternator is coupled to a voltage regulator:



EX1012, 77; EX1003, ¶155.

The Workshop Manual states: “The regulator performs rectification and voltage regulation. The regulator converts AC into DC which flows through the power consuming circuits and the battery, and also charges the battery.” EX1012, 77. The voltage regulator provides a regulated voltage to the Gasoline Cut Off Solenoid because it is one of the power consuming circuits. *Supra* §§VII.A.1.c, VII.A.1.g.; *see also* EX1003, ¶156.

**9. Claim 11**

The Workshop Manual discloses that when the main switch is “on,” current flows to the Gasoline Cut Off Solenoid, and gasoline in the float chamber flows to the mixing chamber. EX1012, 68; EX1003, ¶158.

**10. Claim 12**

Matsushima’s pull-starter drives an electrical power generator to power various components while starting its engine. EX1029, Abstract, 5:1-48; EX1003, ¶160. Incorporating Matsushima’s pull-starter assembly with the DF972 engine would similarly allow the pull-starter assembly to drive the DF972’s generator to power and open the DF972’s Gasoline Cut Off Solenoid while starting the engine on gasoline. EX1003, ¶160.

**11. Claim 13**

It would have been obvious to use a microcontroller to close the DF972’s solenoid when operating on LPG and open the solenoid when operating on gasoline because such microcontrollers were well-known to a POSA at the time of

the invention, as shown by Matsushima. EX1029, 4:58-62; EX1003, ¶162.

Matsushima discloses an electronic control unit (ECU 30) that controls the timing for opening its fuel injection valve and the duration over which the fuel injection valve 10 is opened. EX1029, 4:58-62; EX1003, ¶162. A POSA would understand Matsushima's ECU to be a microcontroller. EX1003, ¶162.

*a. Motivation/Expectation of Success*

A POSA would have been motivated to use a microcontroller to help prevent the engine from stalling when switching from gasoline to LPG. EX1003, ¶163. A POSA would have been motivated to slightly delay shutting the Gasoline Cut Off Solenoid upon opening the gaseous fuel valve to continue providing gasoline fuel for the short period of time required for LPG fuel to enter 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 would have appreciated the benefits of achieving a balanced fuel-air ratio, including when switching between fuels on the fly. *Id.*, ¶164. Control circuitry for providing short delays of this nature were well-known, and would have been easily incorporated into the Workshop Manual's Gasoline Cut Off Solenoid and valves; a POSA 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.*

**12. Claim 14**

The obvious modification to use a microcontroller to control the DF972's solenoid valves would also involve using the microcontroller to close the Gasoline Cut Off Solenoid during engine shutdown to stop the flow of gasoline at the desired time. EX1012, 68; *supra* §VII.B.11; EX1003, ¶166.

**13. Claim 19**

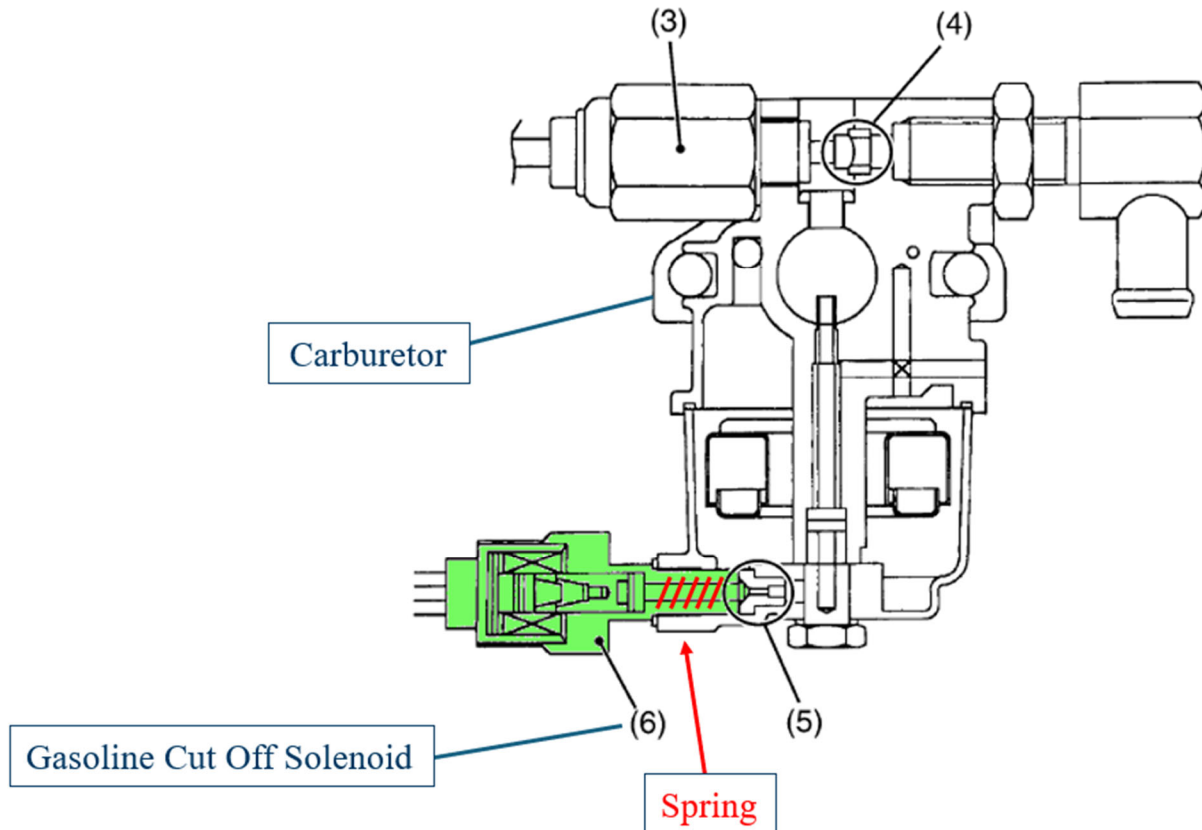
The Gasoline Cut Off Solenoid selectively interrupts gasoline and, by definition, a solenoid is a magnetically actuated valve. *Supra* §VII.A.1.g; EX1003, ¶168.

**14. Claim 20**

***a. Element [20.1]***

Linear solenoids and solenoid valves (like the Gasoline Cut Off Solenoid) typically consist of a spring-plunger design, wherein the spring is used to bias the plunger to its “normal” position. The DF972's Gasoline Cut Off Solenoid is normally closed, meaning that the solenoid spring will return the plunger to this position, cutting off the supply of fuel, when current is no longer applied. EX1012, 68 (“with the fuel select switch (8) in the “GASOLINE” position...the battery current flows to the gasoline cut off solenoid (6). Therefore gasoline fuel in the float chamber flows to the mixing chamber.”); EX1003, ¶171.

Although the Workshop Manual does not depict a spring in the Gasoline Cut Off Solenoid, a POSA would understand the Gasoline Cut Off Solenoid has a spring that biases the plunger to close the valve, such as in the configuration shown below:

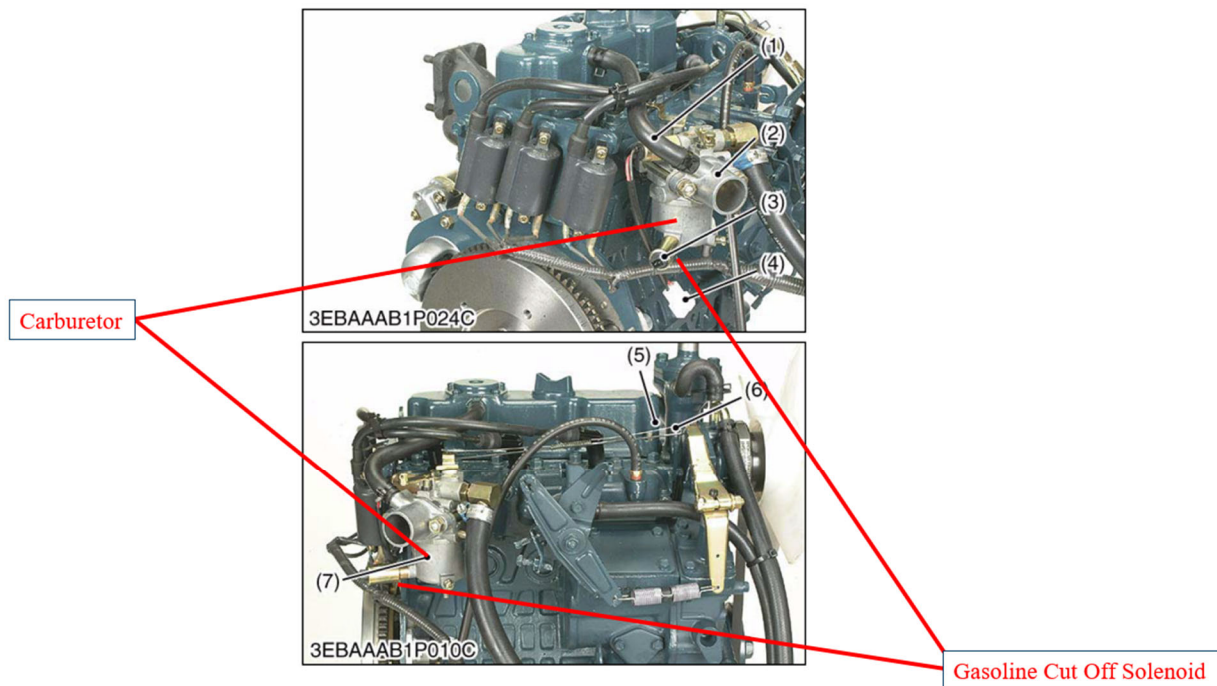


EX1003, ¶172. Alternatively, it would have been obvious to use a solenoid with a spring that biases the plunger given the starter solenoid for the DF972 engine works in this manner, as does as Olmr's cutoff solenoid. EX1003, ¶173; EX1012, 76; EX1007, 2:43-68, Fig. 2; *see also* EX1038, 3 (Fig. 4.1x). In addition, solenoids with springs to bias a plunger were common, off-the-shelf valves at the time of the invention. EX1003, ¶173.

***b. Element [20.2]***

A solenoid, by definition, utilizes a magnetic field to induce plunger movement to open or close a flow path. EX1003, ¶175. The DF972's Gasoline Cut Off Solenoid, normally closed, opens when the solenoid is energized and the electromagnetic coil (i.e., "actuating magnet") attracts the plunger away from its normally closed position (i.e., "away from a position interrupting liquid fuel"). *Id.* In this open position, the plunger would be pressed against the spring used to bias the plunger to its normally closed position. *Id.*

The Gasoline Cut Off Solenoid (and its contents, including its actuating magnet) is coupled to the carburetor:

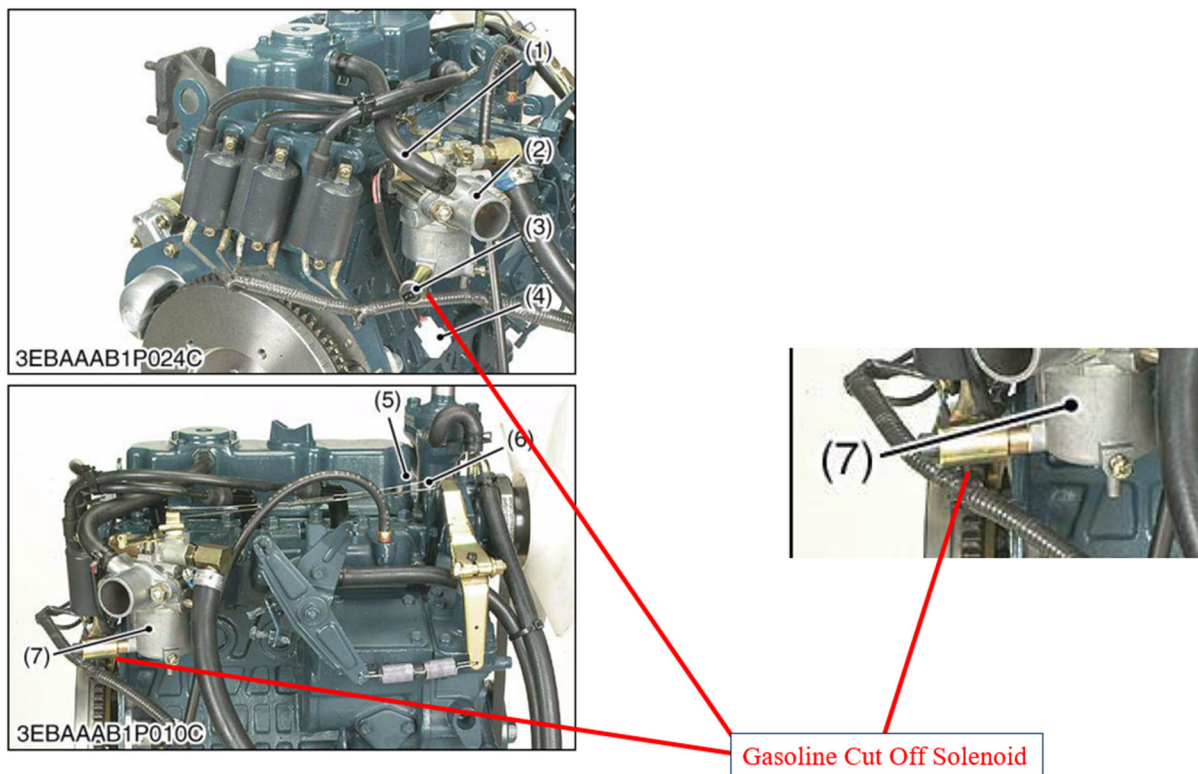


EX1012, 115; *see also id.*, 67-68; EX1003, ¶176.

**15. Claim 21**

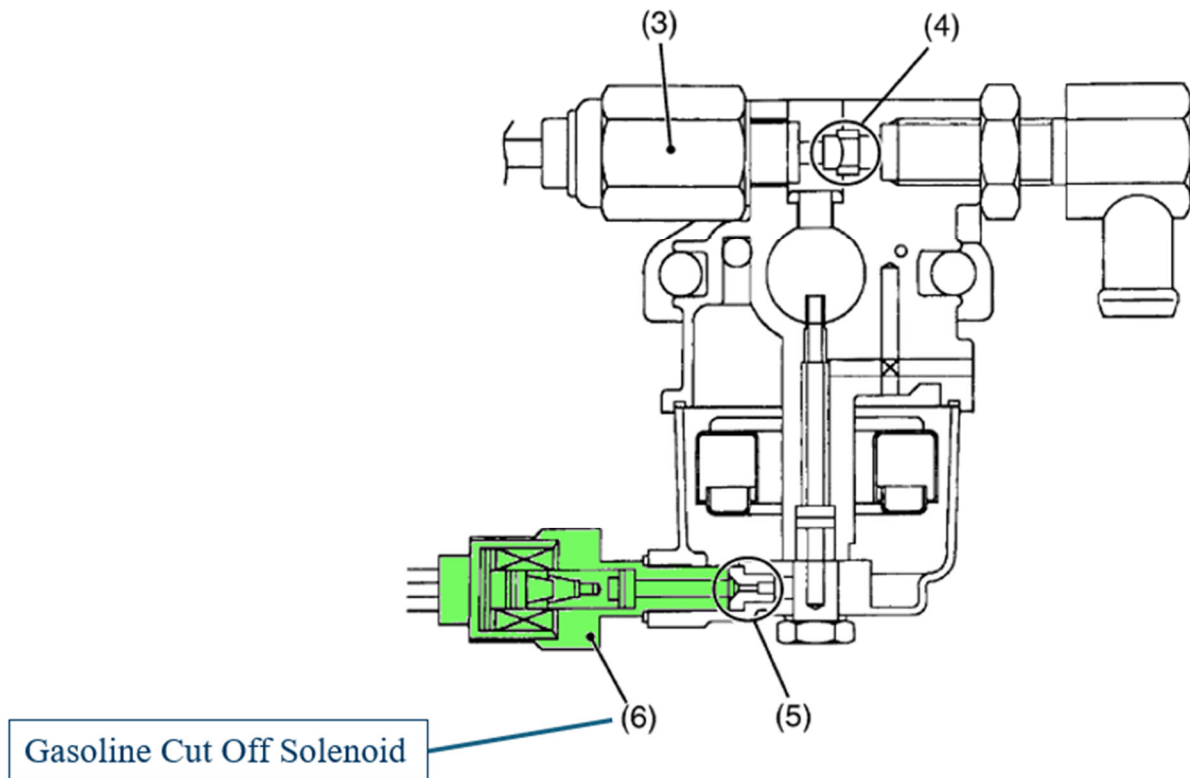
***a. Element [21.1]***

The Gasoline Cut Off Solenoid has a housing, as shown below:



EX1012, 115; *see also id.*, 67-68; EX1003, ¶179.

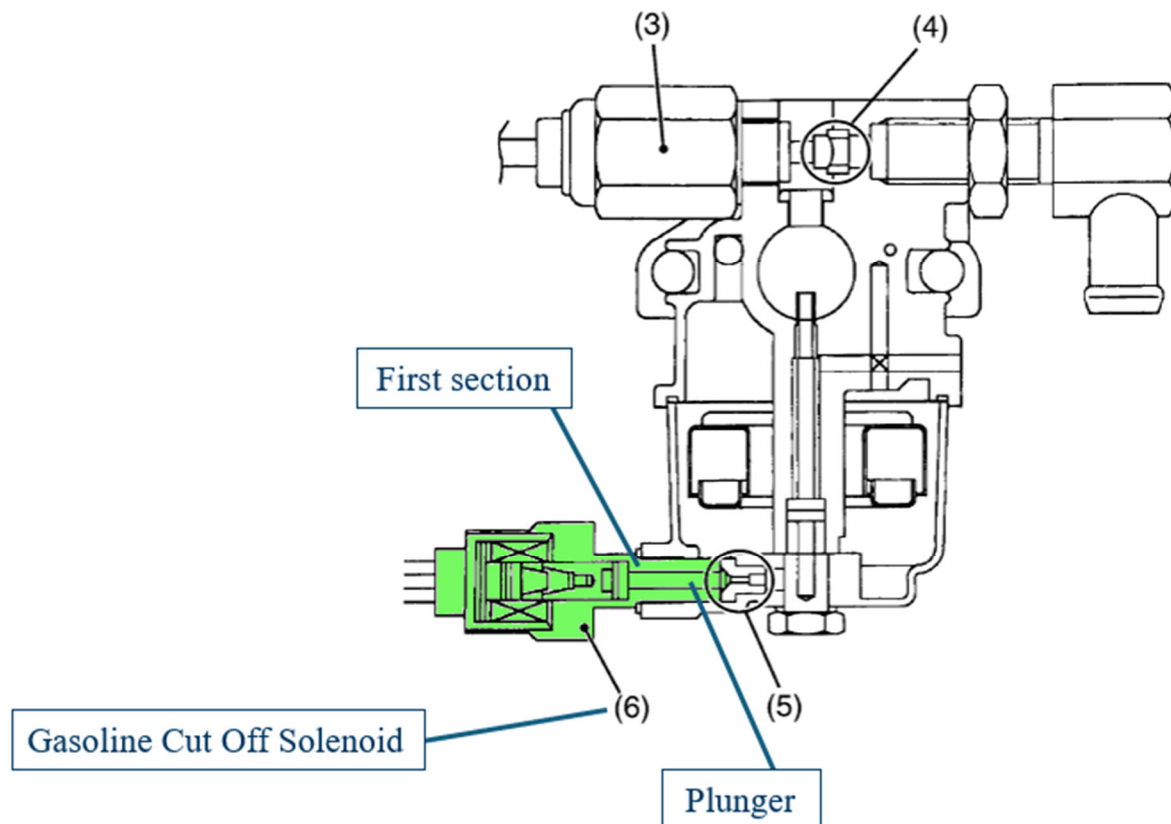
Without the housing, the components of the solenoid would be visible, as depicted below:



EX1012, 68; EX1003, ¶180.

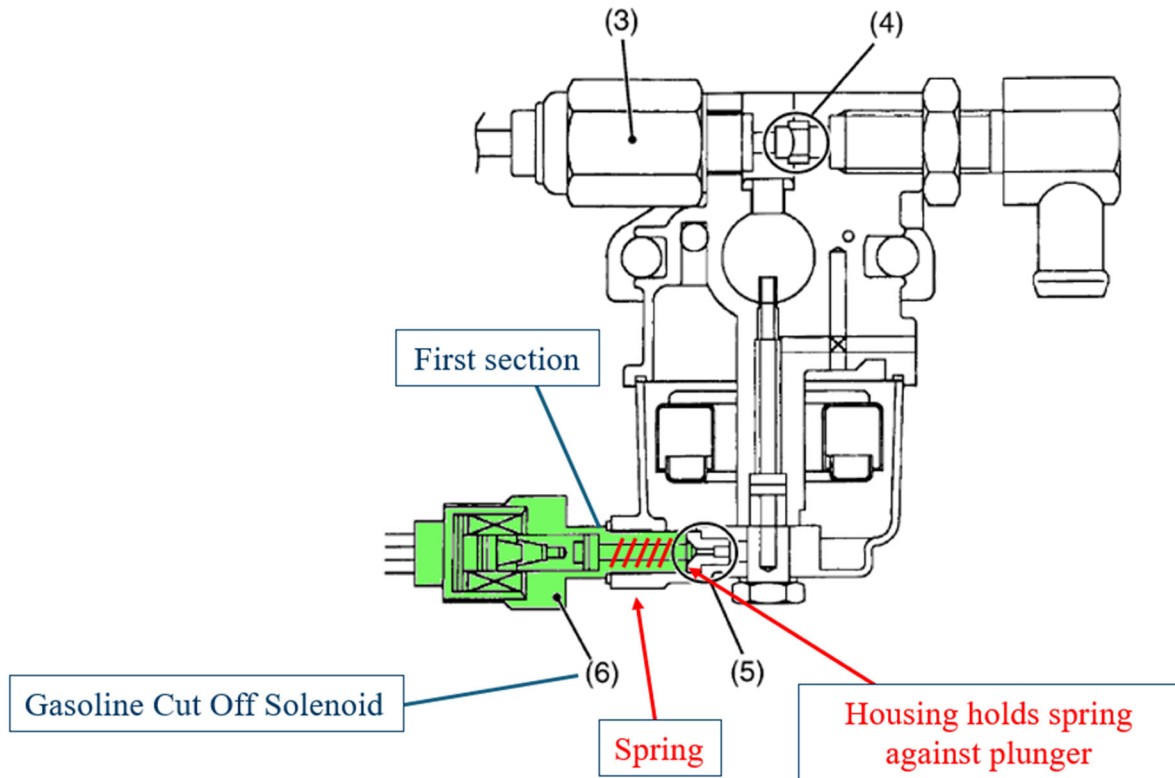
***b. Element [21.2]***

The housing of the Gasoline Cut Off Solenoid has a first section that encloses the plunger:



EX1012, 68; EX1003, ¶182.

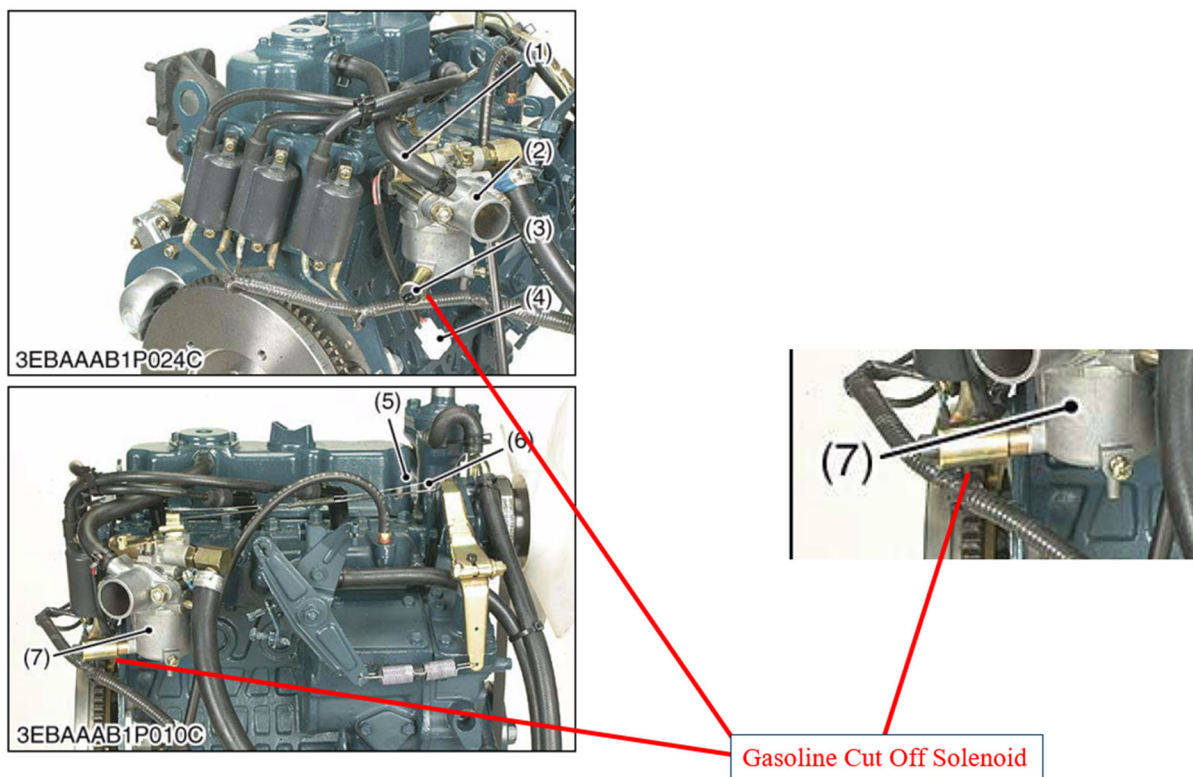
In an obvious configuration discussed (*supra* §VII.B.14.a), the first section of the housing would also hold the spring against the plunger, as shown below:



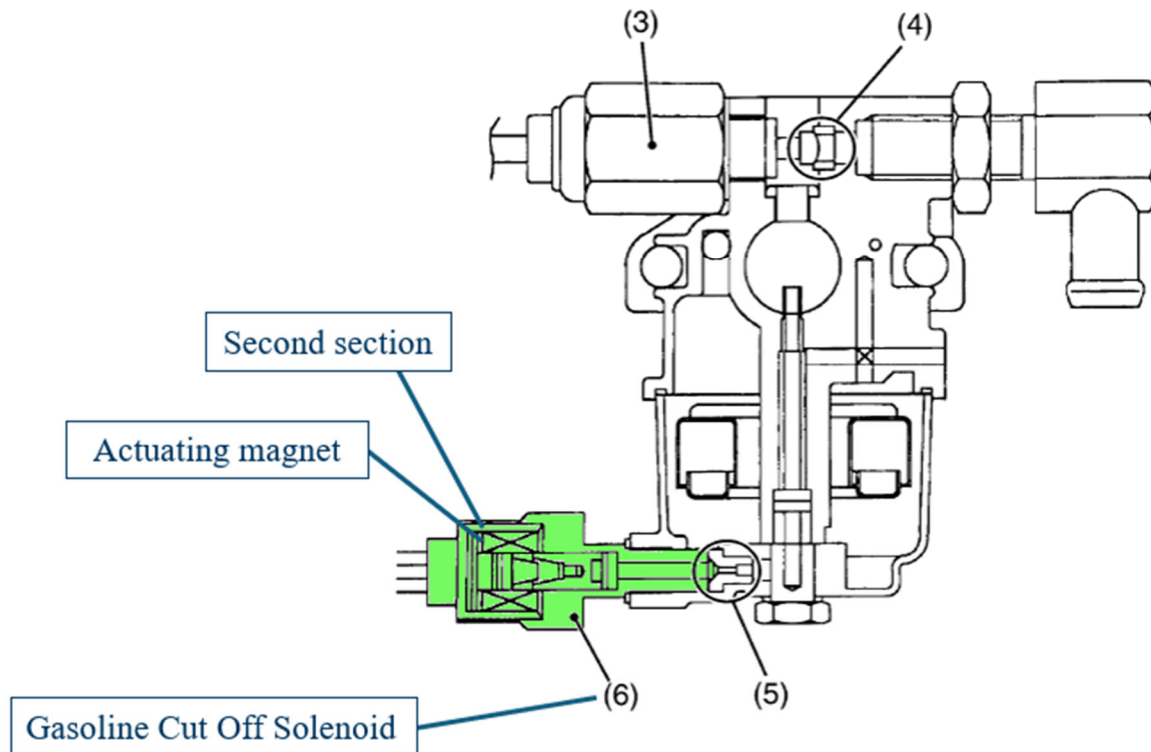
EX1003, ¶183.

*c. Element [21.3]*

The housing of the Gasoline Cut Off Solenoid has an outer cylindrical shell that fully contains the electromagnetic coil (the actuating magnet):



EX1012, 115; EX1003, ¶185.



*Id.*, 68.

This outer shell is structurally coupled to the first section and encloses the electromagnetic coil (the actuating magnet). *Id.*, 68, 115; EX1003, ¶186.

## 16. Claim 23

### *a. Element [23.0]*

The DF972 is a dual-fuel engine with an electrical power generator. *Supra* §§VII.A.1.a-VII.A.1.b, VII.B.2.

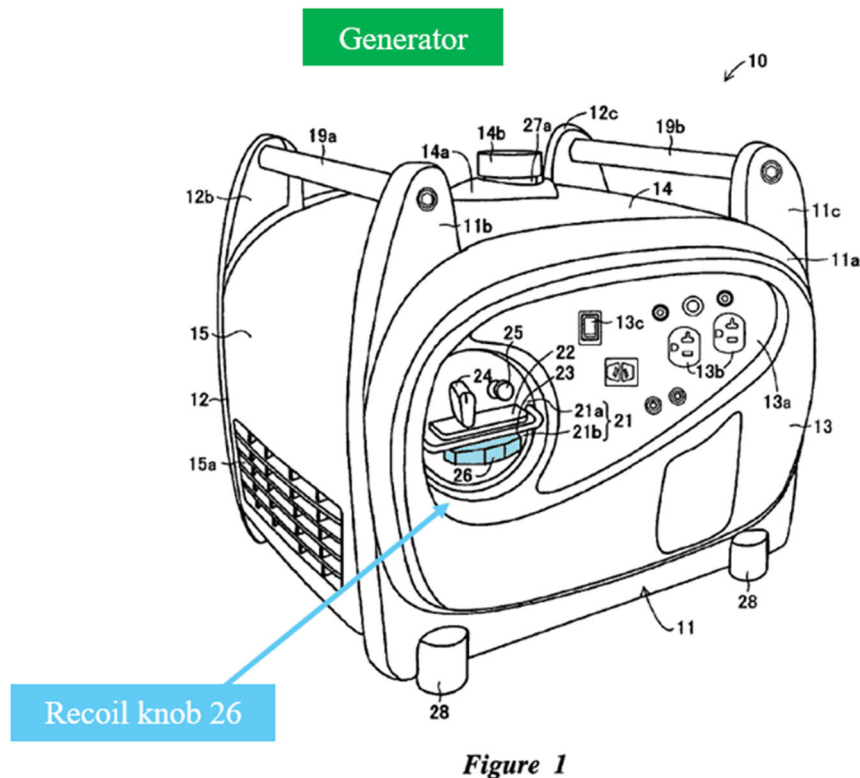
It would have been obvious to replace the battery of the DF972's engine with Matsushima's recoil-starter assembly, thus resulting in a batteryless dual-fuel generator. *Supra* §VII.B.1.

***b. Element [23.1]***

The DF972 engine is coupled to drive an alternator and is operable on LPG and gasoline. *Supra* §§VII.A.1.a-VII.A.1.b, VII.B.2. It would have been obvious to a POSA enclose the DF972 engine, modified with Matsushima's recoil starter, in a housing, such as the housing disclosed in Yamamoto. EX1030, Fig. 1; EX1003, ¶190.

***i. Motivation/Expectation of Success***

A POSA would have been motivated to enclose the engine/generator in a housing because it was standard at the time of the invention to enclose engines and engine/generator combinations in housings to protect the engine/generator and other components from damage, and to prevent injury by making the engine components inaccessible while running. EX1003, ¶192. Yamamoto discloses one example of the type of housing that could be used for an engine with a pull start (recoil knob 26):



**17. Claim 32**

The combination of the Workshop Manual, Matsushima, and Yamamoto discloses the elements of this claim or, alternatively, they would have been obvious in further view of Olmr. *Supra* §VII.B.14.

**18. Claim 33**

The combination of the Workshop Manual, Matsushima, and Yamamoto discloses the elements of this claim or, alternatively, they would have been obvious in further view of Olmr. *Supra* §VII.B.15.

**19. Claim 34**

***a. Element [34.1]***

The Gasoline Cut Off Solenoid is a “carburetor cutoff solenoid.” *Supra* §VII.A.1.g.

***b. Element [34.2]***

The DF972 engine has an alternator to supply electrical power. *Supra* §VII.B.2. The alternator includes a stator and rotor made up of eight permanent magnet pole pieces assembled on a shaft that rotate, which is a “charge winding.” EX1012, 77; EX1003, ¶214. The charge winding powers the Gasoline Cut Off Solenoid. *Supra* §VII.B.4; EX1003, ¶142.

***c. Element [34.3]***

The Workshop Manual discloses a fuel select switch that selectively powers the Gasoline Cut Off Solenoid by controlling electrical connection between the

Gasoline Cut Off Solenoid and the charge winding (i.e., the alternator). *Supra* §§VII.B.5, VII.B.19.b.

**20. Claim 35**

The combination of the Workshop Manual, Matsushima, Yamamoto, and Olmr discloses the elements of this claim. *Supra* §VII.B.6.

**21. Claim 36**

The combination of the Workshop Manual, Matsushima, and Yamamoto discloses the elements of this claim. *Supra* §VII.B.7.

**22. Claim 37**

The combination of the Workshop Manual, Matsushima, and Yamamoto discloses the elements of this claim. *Supra* §§VII.A.1.c, VII.B.3.a, VII.B.19.b.

**23. Claim 38**

The combination of the Workshop Manual, Matsushima, and Yamamoto discloses the elements of this claim. *Supra* §VII.B.8.

**24. Claim 39**

The combination of the Workshop Manual, Matsushima, and Yamamoto discloses the elements of this claim. *Supra* §VII.B.9.

**25. Claim 40**

The combination of the Workshop Manual, Matsushima, and Yamamoto discloses the elements of this claim. *Supra* §VII.B.10.

**26. Claim 41**

The combination of the Workshop Manual, Matsushima, and Yamamoto discloses the elements of this claim or renders them obvious. *Supra* §VII.B.11.

**27. Claim 42**

The combination of the Workshop Manual, Matsushima, and Yamamoto discloses the elements of this claim or renders them obvious. *Supra* §VII.B.12.

**28. Claim 58**

The Workshop Manual discloses a fuel-select switch to operatively control the Gasoline Cut Off Solenoid. *Supra* §§VII.A.1.c, VII.A.1.g, VII.A.4.g.

A POSA would have understood that fuel select switch is manually operated and, as such, would have a manually operated control, such as a control knob. EX1003, ¶236. Alternatively, it would have been obvious to couple a manually operated control to the DF972's fuel select switch to provide a way for the user to switch fuels. *Id.* Yamamoto provides one example of such a control for “on” and “off” of the generator, and a similar control could be used for “gasoline” and “LPG” for the DF972 engine. EX1030, Fig. 2. The control would provide the electrical connection between the gasoline position “D” and the LPG position “E” of the Workshop Manual. EX1012, 68; EX1003, ¶236. A POSA would have had a reasonable expectation of success because such controls providing a switching between two contacts were well-understood and commonly used at the time of the invention. EX1003, ¶236.

**C. Ground 3: Claims 1, 3, 22, and 57 are anticipated by Nakafushi**

Claims 1, 3, 22, and 57-58 are anticipated under §102, as detailed below and in the declaration of Dr. Morse. EX1003, ¶¶237-284.

**1. Claim 1**

***a. Element [1.0]***

Nakafushi discloses a “dual-fuel engine”: a “gasoline/LPG combined engine configured to selectively use gasoline or LPG as a fuel.” EX1005, ¶[0001].

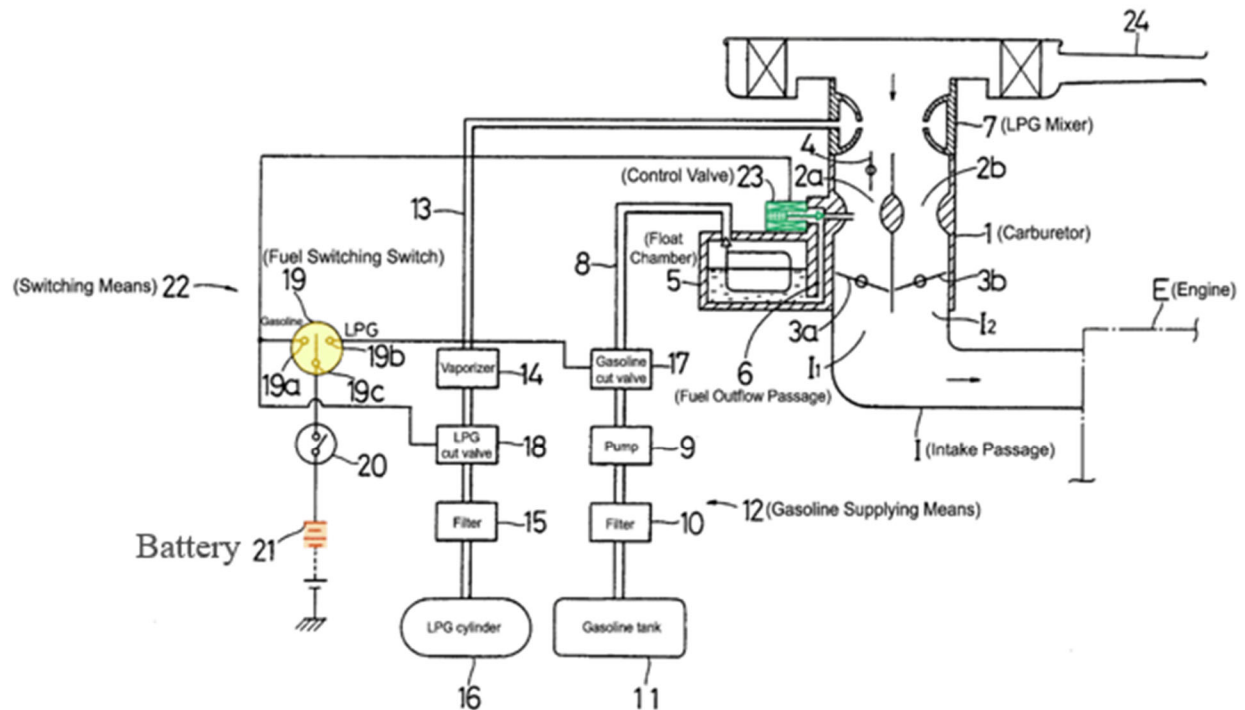
***b. Element [1.1]***

Nakafushi’s engine selectively uses gasoline or LPG as fuel. *Id.*

***c. Element [1.2]***

Nakafushi discloses a “fuel switching switch 19” that changes operation of the engine between LPG and gasoline. EX1005, ¶¶[0013]-[0014]; EX1003, ¶243. The switch 19 has a “gasoline-side contact point 19a and an LPG side contact point 19b,” and “the control valve 23 is connected to the gasoline contact point 19a of the fuel switching switch 19” and that gasoline cut valve 17 and LPG cut valve 18 are “connected to a gasoline-side contact point 19a and an LPG side contact point 19b of [switch 19], respectively.” *Id.*

These elements are highlighted in Figure 1 below:

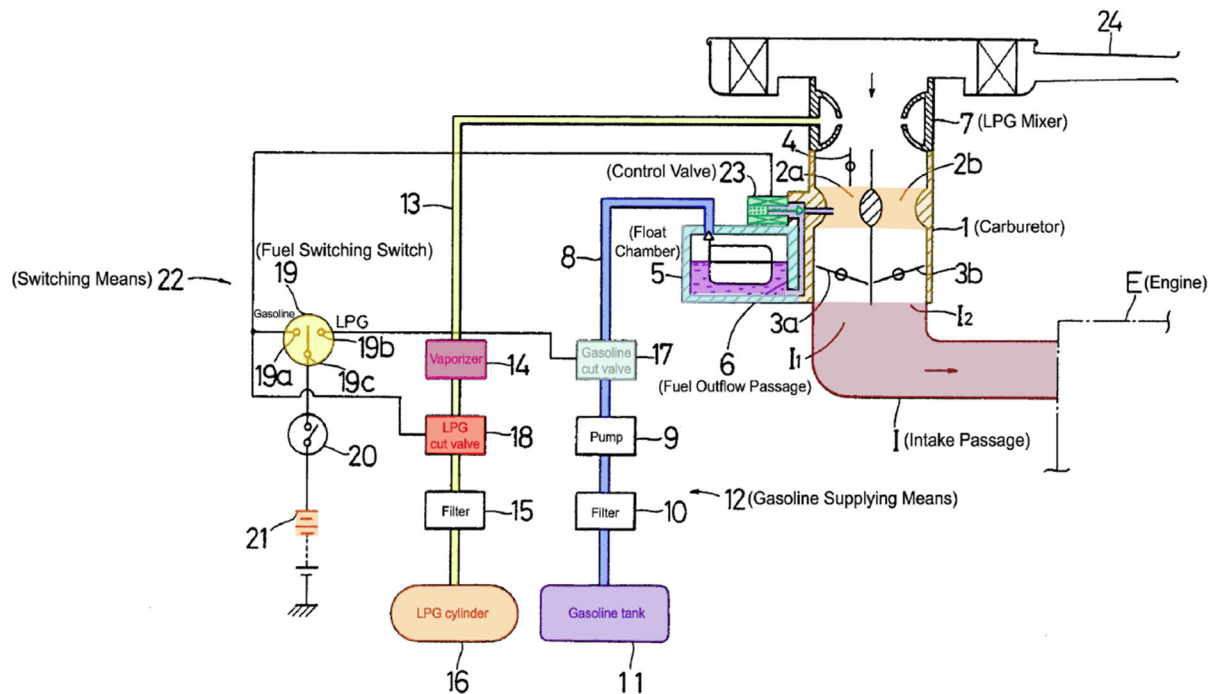
**FIG. 1**

EX1005, Fig. 1; EX1003, ¶243.

Nakafushi discloses that when switch 19 is switched to the gasoline contact point 19a side, a cut signal is sent to the LPG cut valve 18 and simultaneously, control valve 23 receives a signal to open. EX1005, ¶¶[0013]-[0014]; EX1003, ¶244. 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.* Thus, movement of switch 19 allows for simultaneous operation of control valves 17, 18, and 23, which in turn changes operation of the engine between gaseous fuel and liquid fuel. *Id.*

*d. Element [1.3]*

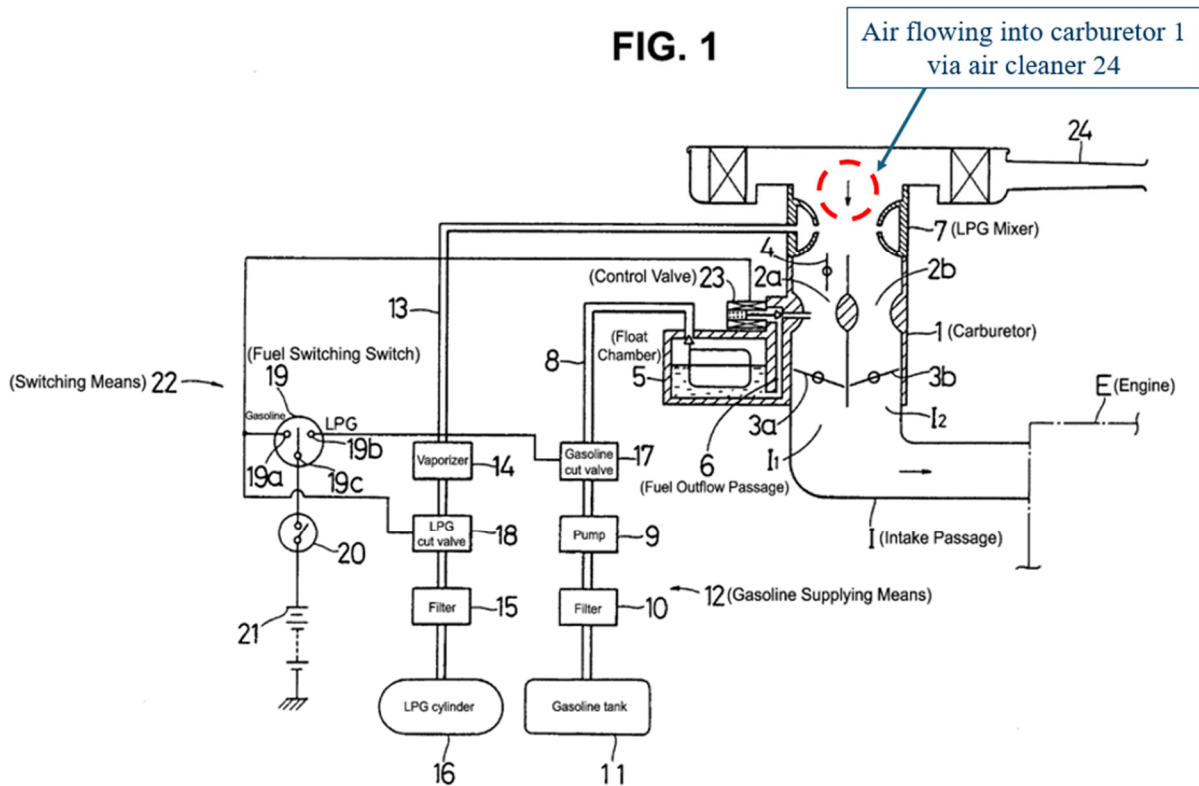
Nakafushi discloses a carburetor 1 attached to the intake of the engine E, and the carburetor connects the LPG cylinder and gasoline tank to the intake:

**FIG. 1**

EX1005, Fig. 1; EX1003, ¶246.

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 type carburetor 1 is disposed in the intake passage I.” EX1005, ¶[0010]. The intake passage I of Nakafushi’s carburetor 1 has venturi portions 2a and 2b. *Id.*

Nakafushi discloses air flowing into carburetor 1 through air cleaner 24 to mix with gasoline or LPG in venturi portions 2a and 2b, as seen in Figure 1:

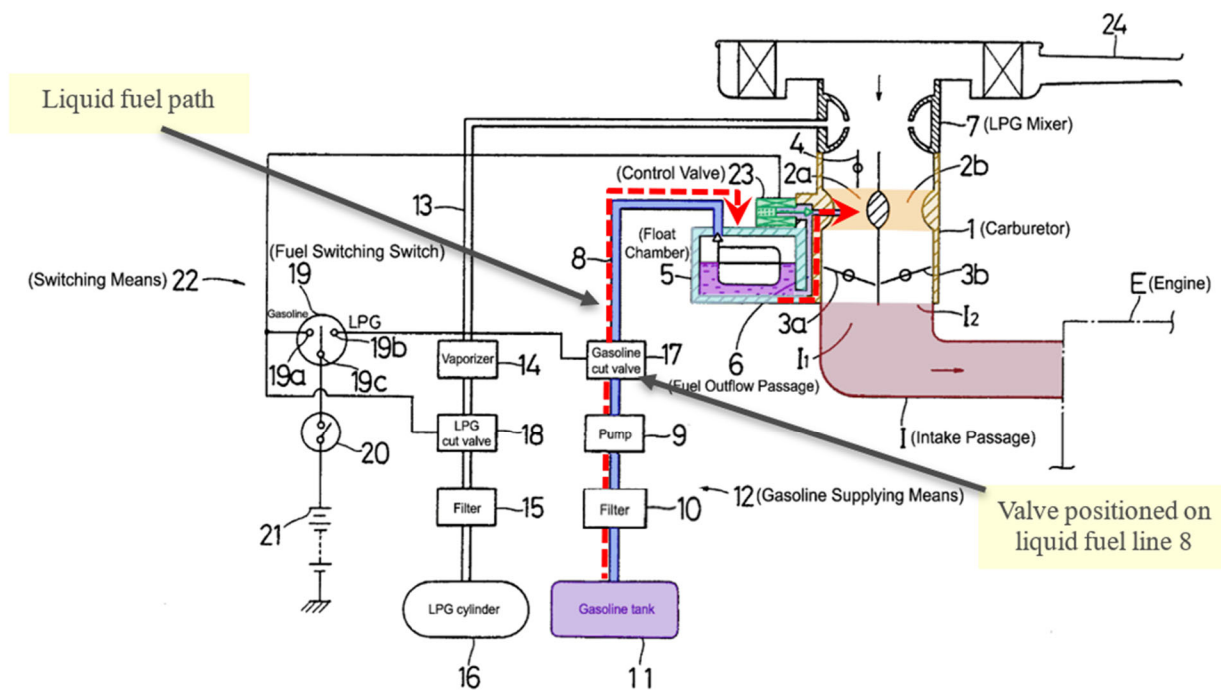


*Id.*, Fig. 1, ¶[0015]; EX1003, ¶248.

A POSA would have understood that engines such as those disclosed in Nakafushi operated by mixing fuel (gasoline or LPG) with air prior to combustion in the engine, as confirmed by Nakafushi's numerous references to the "air-fuel ratio" and "air-fuel mixture." ¶¶[0004]-[0005], [0008], [0016], [0019]; EX1003, ¶249. A POSA would have recognized Nakafushi's disclosure of a dual-fuel engine that mixed air with the gaseous fuel (LPG) or liquid fuel (gasoline) in the carburetor, which is attached to the intake for delivery to the engine. EX1003, ¶249.

***e. Element [1.4]***

Nakafushi discloses a liquid fuel valve (gasoline cut valve 17) “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.” EX1005, ¶[0013]. Gasoline cut valve 17 is positioned on the gasoline supply passage 8, which begins at the gasoline tank 11, leading to float chamber 5, which in turn is connected to carburetor 1 through fuel outflow passage 6:

**FIG. 1**

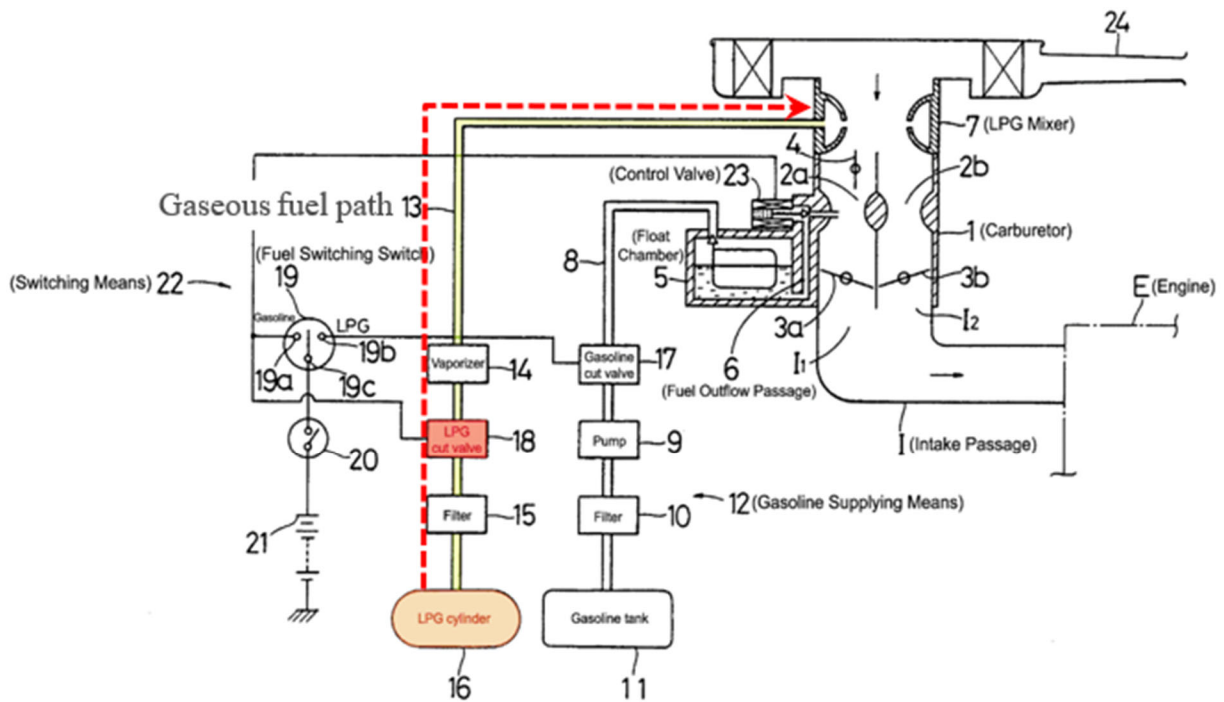
*Id.*, Fig. 1; EX1003, ¶252.

***f. Element [1.5]***

Nakafushi discloses a gaseous fuel valve (LPG cut valve 18) “configured to close the LPG supplying passage 13 in response to a cut signal...to intervene

between the vaporizer 14 and the filter 15.” EX1005, ¶[0013]. LPG cut valve 18 is positioned on the LPG supplying passage 13, which begins at the LPG cylinder 16, leading to vaporizer 14, which in turn is connected to carburetor 1:

**FIG. 1**



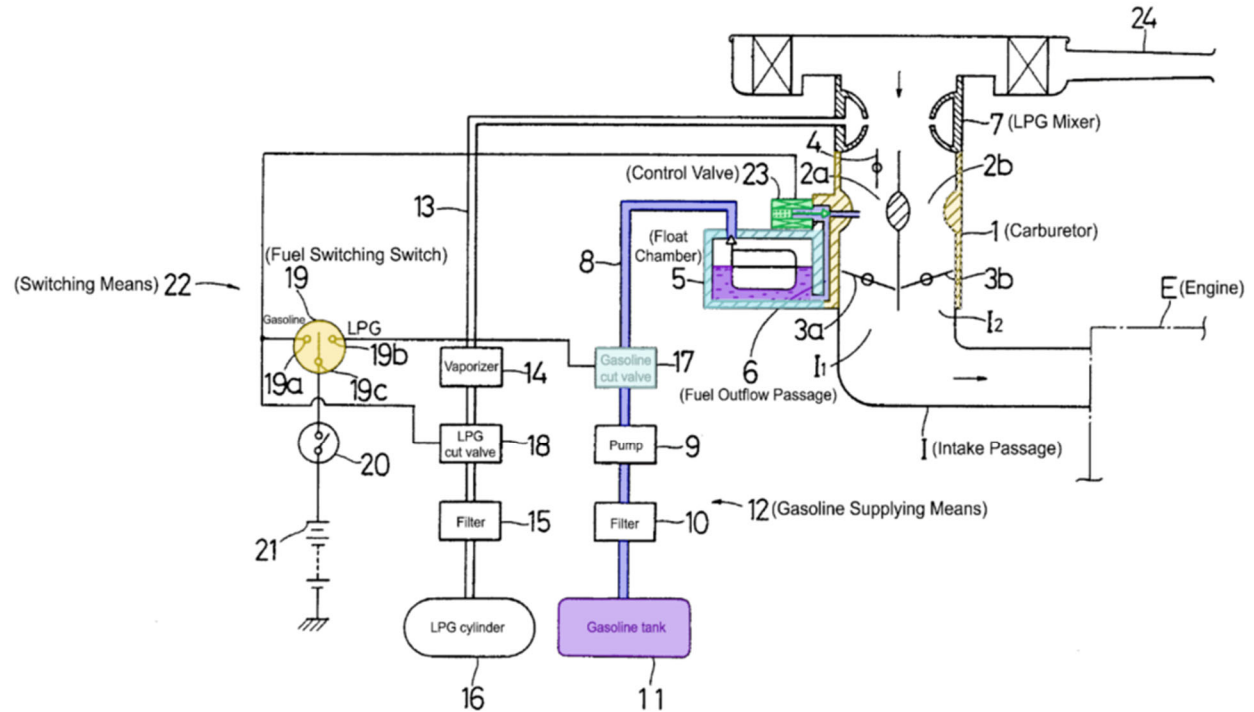
*Id.*, Fig. 1; EX1003, ¶254.

***g. Element [1.6]***

Nakafushi discloses control valve 23 (EX1005, ¶[0014], Fig. 1), which is a “liquid fuel cut-off.” EX1003, ¶256. Nakafushi explains that “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.” EX1005, ¶[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:

**FIG. 1**



*Id.*, Fig. 1, ¶[0010]; EX1003, ¶256.

Figure 1 shows that control valve 23 is “incorporated into the carburetor.” EX1003, ¶257.

The switch 19 changes operation of the engine between LPG and gasoline by selectively powering control valve 23 and LPG cut valve 18, or gasoline cut valve 17. *Supra* §VII.C.1.c. The switch opens control valve 23 and gasoline cut valve 17, and closes LPG valve 18 during gasoline operation, and vice versa for LPG operation. EX1005, ¶¶[0013]-[0014]; EX1003, ¶258. Thus, upon actuation of

the switch from liquid fuel to gaseous fuel, control valve 23 closes to interrupt gasoline. EX1003, ¶258.

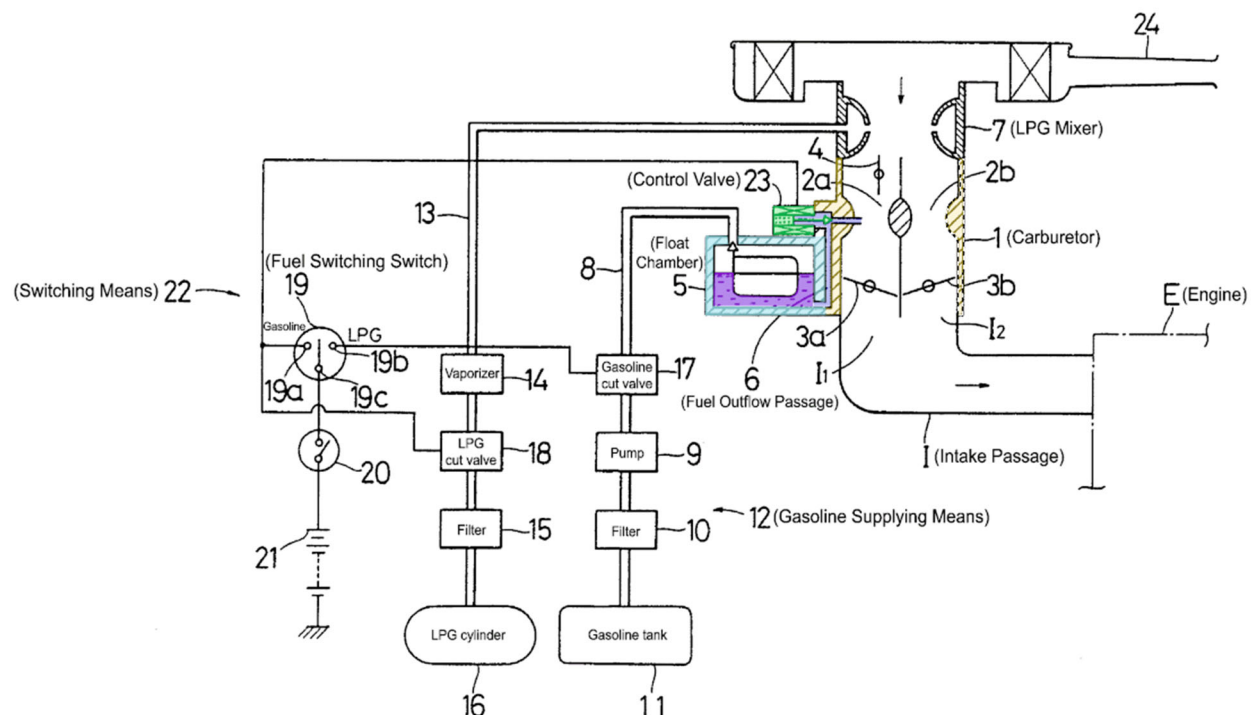
## 2. Claim 3

Nakafushi discloses “[t]he present invention relates to a gasoline-LPG combined engine configured to selectively use gasoline or LPG as a fuel.” EX1005, ¶[0001].

## 3. Claim 22

Nakafushi’s Figure 1 discloses a liquid fuel cut-off (i.e., control valve 23) that is physically attached to an outer surface of the carburetor:

**FIG. 1**



EX1005, Fig. 1; EX1003, ¶262.

**4. Claim 57**

***a. Element [57.0]***

Nakafushi discloses a dual-fuel engine. *Supra* §§VII.C.1.a-VII.C.1.b. It is inherent in Nakafushi that these components were assembled to form the dual-fuel engine, as their described integration into a functional system necessitates assembly steps. EX1003, ¶265. A POSA would have understood that Nakafushi's disclosure of a fully configured engine system inherently included the method of assembling these components. *Id.*

***b. Element [57.1]***

Nakafushi discloses this element. *Supra* §VII.C.1.b.

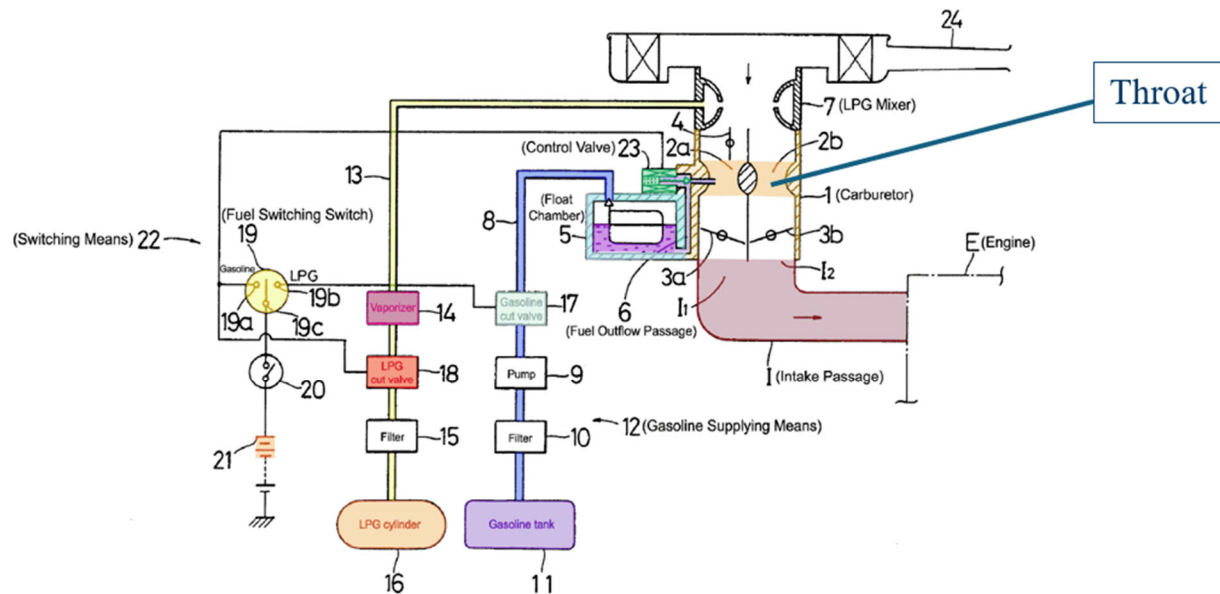
***c. Element [57.2]***

Nakafushi discloses a carburetor attached to an intake of the engine. *Supra* §VII.C.1.d.

***d. Element [57.3]***

Nakafushi discloses a throat of the carburetor 1 to mix gaseous fuel with air and liquid fuel with air:

**FIG. 1**

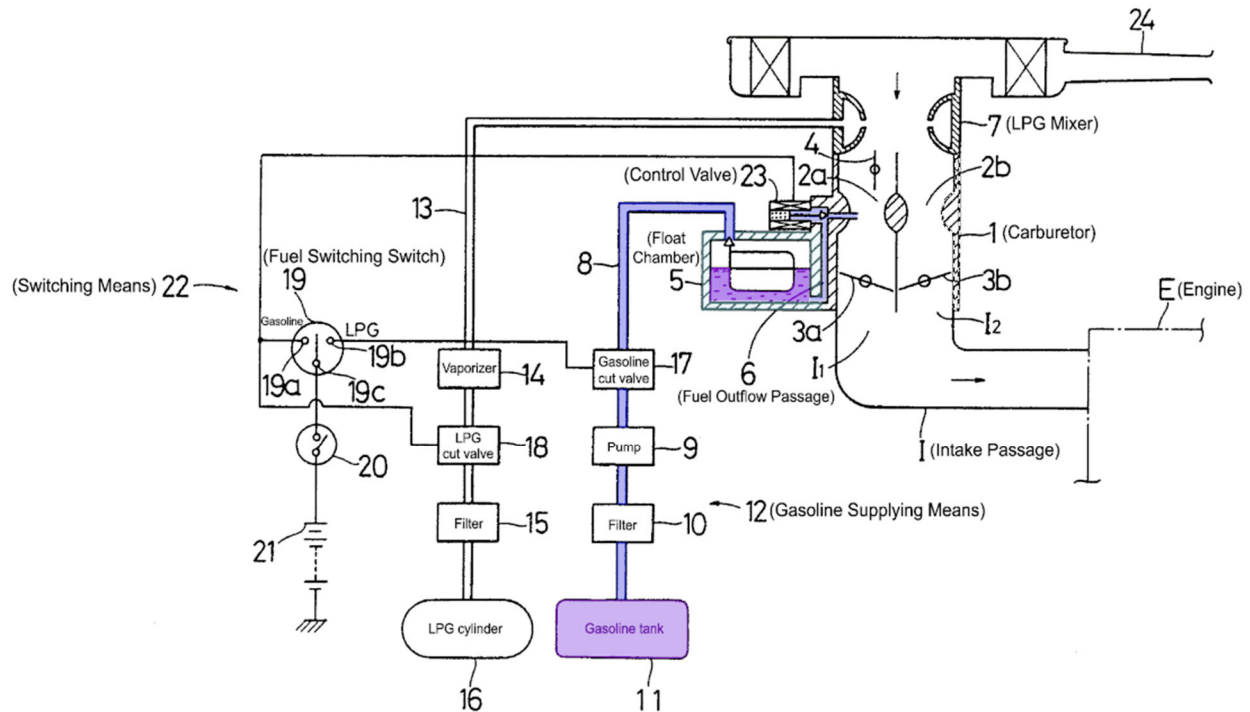


EX1005, Fig. 1; *supra* §VII.C.1.d; EX1003, ¶271.

*e. Element [57.4]*

Nakafushi discloses “the float chamber 5 is communicated with the Venturi portions 2a and 2b of the carburetor 1 via a fuel outflow passage 6 having a small diameter, so that the gasoline in the float chamber 5 is sucked into the Venturi portions 2a and 2b and atomized and supplied during the operation of the engine E.” EX1005, ¶[0010].

**FIG. 1**



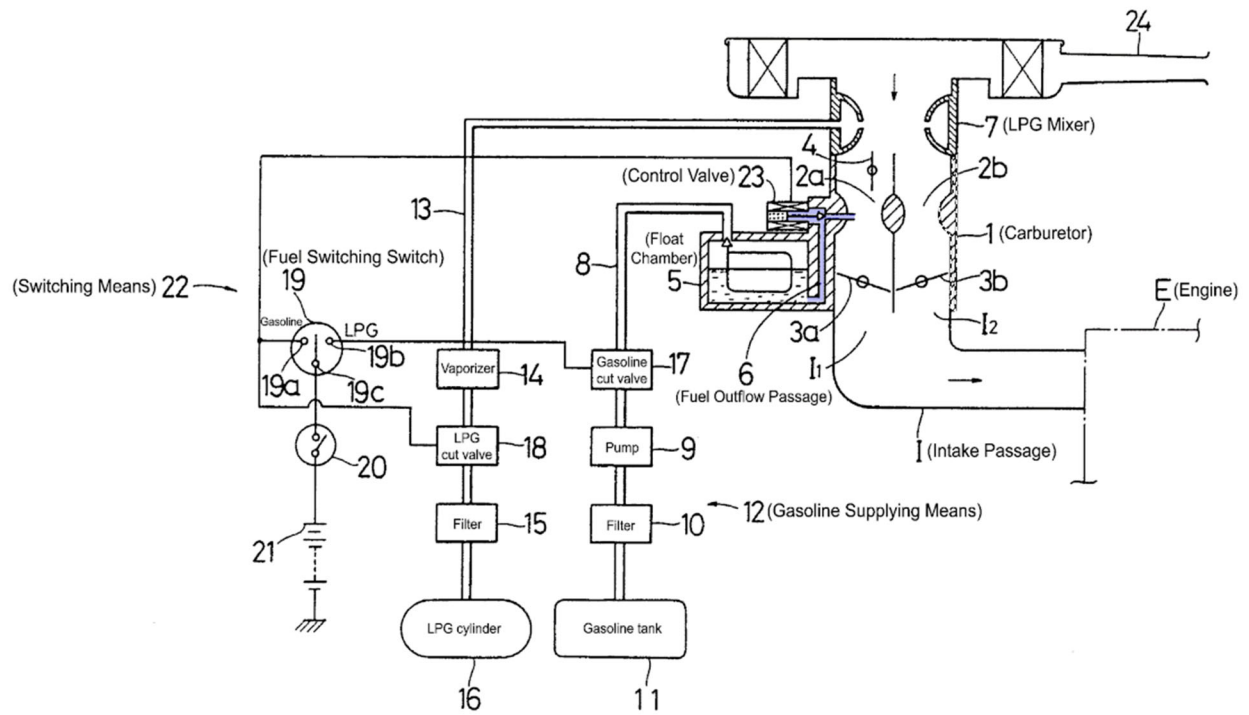
EX1005, Fig. 1.

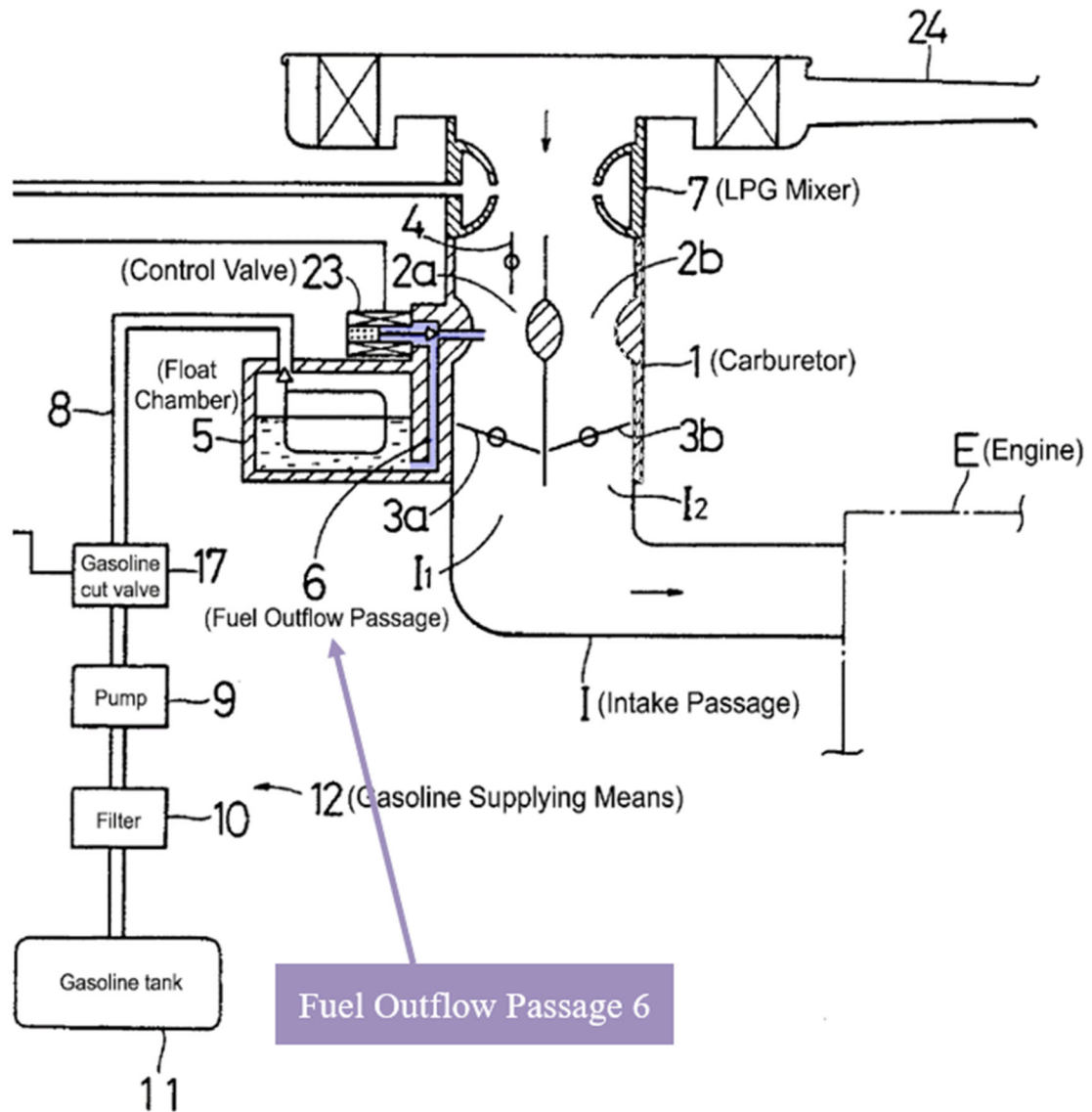
Nakafushi's float chamber 5 is a float bowl. EX1003, ¶277.

*f. Element [57.5]*

Nakafushi discloses fuel outflow passage 6 positioned downstream from the float chamber 5 to the throat of the carburetor. EX1005, ¶[0010], Fig. 1; EX1003, ¶279.

FIG. 1





EX1005, Fig. 1.

The fuel outflow passage 6 is a “fuel passage” because it is positioned downstream from the float bowl and extends from the float bowl to the throat. *Id.*, ¶[0010], Fig. 1; EX1003, ¶280.

***g. Element [57.6]***

Nakafushi discloses this element. *Supra* §VII.C.1.c.

***h. Element [57.7]***

Nakafushi discloses this element. *Supra* §VII.C.1.g.

**D. Ground 4: Claims 2, 4-14, 19-21, 23, 32-42, and 58 are obvious over Nakafushi in view of Matsushima, Yamamoto, and Olmr**

Claims 2, 4-14, 19-21, 23, 32-42, and 58 of the '398 Patent are obvious under §103, as detailed below and in the declaration of Dr. Morse. EX1003, ¶¶285-388.

**1. Claim 2**

It would have been obvious to a POSA to incorporate a pull-start and an electrical power generator to supply electrical power in place of Nakafushi's battery. EX1003, ¶287. Matsushima discloses a pull-start and generator for an engine. EX1029, Abstract, 3:53-68, 4:63-66, Fig. 1.

A POSA would have been motivated to incorporate Matsushima's pull-start and would have had a reasonable expectation of success for the same reasons discussed above with respect to incorporating Matsushima's pull-start assembly for use with the DF972 engine. *Supra* §VII.B.1.

**2. Claim 4**

It would have been obvious to incorporate Matsushima's recoil-starter assembly and electrical power generator with Nakafushi's engine. *Supra* §VII.D.1.

**3. Claim 5**

***a. Element [5.1]***

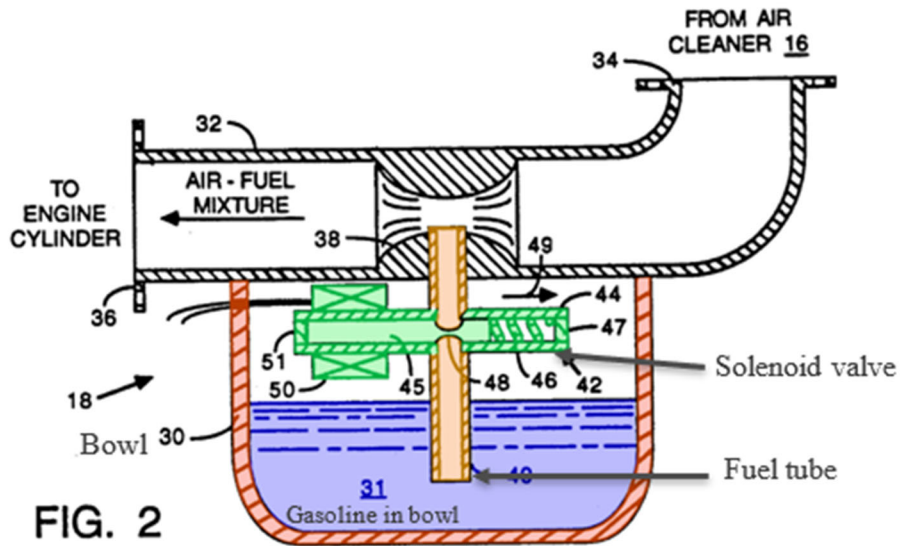
Nakafushi's switch 19 alternatively connects gasoline or LPG to the carburetor. *Supra* §VII.C.1.c. The switch 19 moves mechanically between the contacts and operates by altering cut signals (i.e., electrical currents), thus making it an electro-mechanical switch. EX1005, ¶¶[0013]-[0014], Fig. 1; EX1003, ¶293.

Matsushima's generator would be connected to and supply electrical current to valves 17, 18, or 23 via switch 19 in the same way as Nakafushi's battery. EX1005, ¶¶[0013]-[0014], Fig. 1; EX1003, ¶294.

***b. Element [5.2]***

Nakafushi's control valve 23 is connected to open and close the fuel outflow passage 6 (for gasoline) to the engine (a pull-start engine when combined with Matsushima) in response to reception of electrical power from switch 19. *Supra* §§VII.C.1.c, VII.C.1.g.

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. EX1003, ¶298. Olmr discloses a gasoline engine having solenoid 42 in a float bowl 30 that cuts off the flow of gasoline to the venturi 38 when the operator closes the kill switch. EX1007, 2:30-68, 4:11-27.



*Id.*, Fig. 2; EX1003, ¶298. Thus, Olmr's valve 42 is a solenoid connected to open and close a fuel path to the [pull-start] engine via venturi 38. EX1003, ¶299.

A POSA would have found it obvious to use a solenoid, such as that disclosed by Olmr, for Nakafushi's control valve 23. EX1003, ¶300.

### *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. EX1003, ¶301. 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. *Id.* Nakafushi does not expressly label the type of valve is used, but Olmr expressly teaches using a solenoid (valve 42) for this same purpose. *Id.*; EX1007, 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. EX1003, ¶301.

***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. EX1003, ¶302.

Furthermore, Nakafushi discloses a simple electrical circuit to open and close its control valve 23 (EX1005, ¶¶[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. EX1003, ¶303. Indeed, Olmr teaches an essentially identical electrical circuit for operating its solenoid valve. EX1007, 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. EX1003, ¶303.

**4. Claim 6**

Nakafushi's control valve 23 is incorporated into the carburetor and interrupts gasoline flow to the engine. *Supra* §VII.C.1.g.

Nakafushi's control valve 23 (a solenoid valve when combined with Olmr) would be powered by Matsushima's generator as an alternative to being powered by Nakafushi's battery. EX1005, ¶¶[0013]-[0014], Fig. 1; EX1003, ¶305.

**5. Claim 7**

Nakafushi's switch 19 selectively powers control valve 23 (a solenoid when combined with Olmr) by controlling electrical connection between control valve 23 and Nakafushi's battery. *Supra* §VII.C.1.c.

Nakafushi's switch 19 would selectively power control valve 23 by controlling the electrical current between control valve 23 and Matsushima's generator in the same way switch 19 controls current between control valve 23 and Nakafushi's battery. EX1005, ¶¶[0013]-[0014], Fig. 1; EX1003, ¶307.

**6. Claim 8**

The control valve 23 of Nakafushi is normally closed. EX1005, ¶[0014], Fig. 1.

Olmr's solenoid valve is normally open (EX1007, 3:47-49), and the decision to configure a solenoid as normally open or normally closed is mere design choice. EX1003, ¶309. It would have been obvious to a POSA to configure it as normally

open for the same reasons discussed above with respect to the DF972 engine.

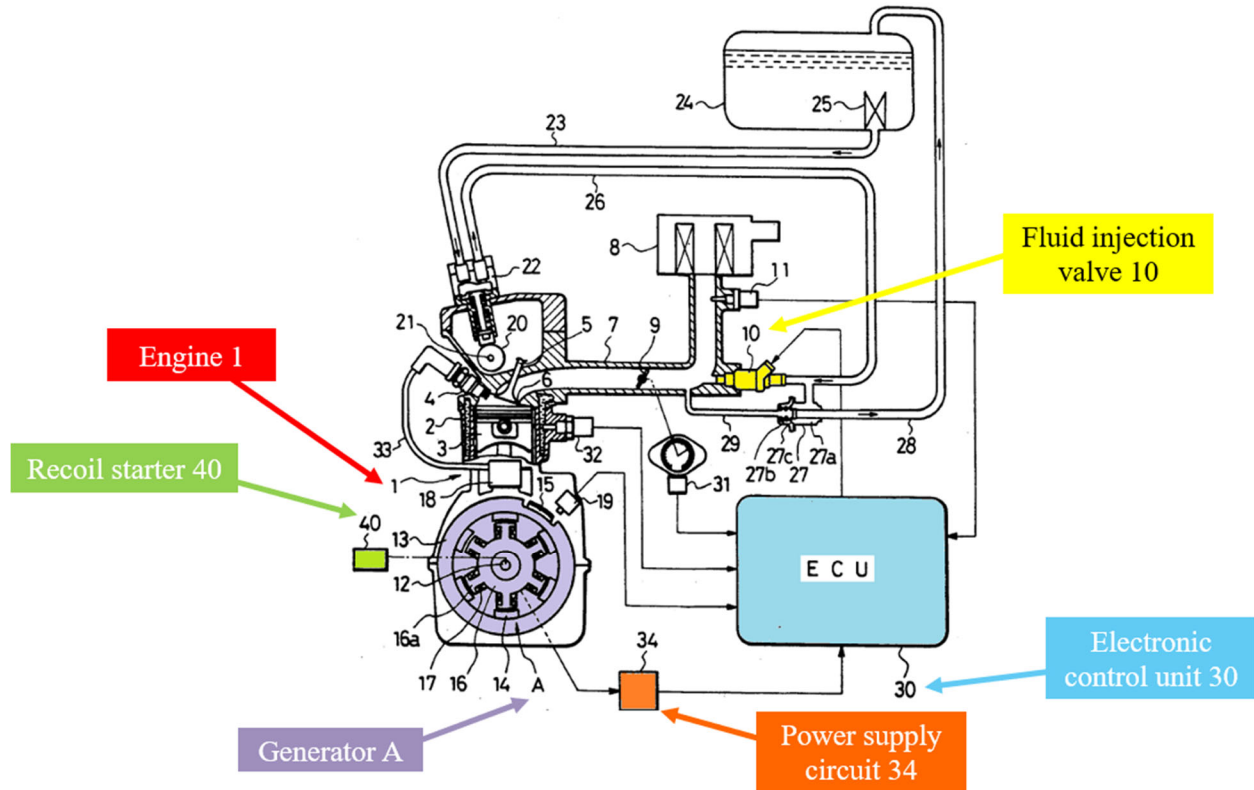
*Supra* §VII.B.6.

**7. Claim 9**

Matsushima's pull-starter drives an electrical power generator to power various components while starting its engine. EX1029, Abstract, 5:1-48; EX1003, ¶311. Incorporating Matsushima's pull-starter assembly and generator with Nakafushi's engine would similarly power and close Nakafushi's control valve 23 (a normally-open solenoid when combined with Olmr) while starting the engine on gaseous fuel. EX1003, ¶311.

**8. Claim 10**

Matsushima's generator includes magnets mounted on the flywheel, a stator core, and a plurality of windings wound on the stator core and disposed to face the magnets during rotation of the flywheel, making Matsushima's generator an alternator. EX1029, 2:35-40, EX1003, ¶313. Matsushima discloses its generator is connected to "a power supply circuit 34 for rectifying, smoothing and stabilizing output voltage" from the generator, including the voltage for the fuel injection valve 10. EX1029, 43-62; Fig. 1.



EX1029, Fig. 1.

Because the power supply stabilizes the output voltage from the alternator, it is a voltage regulator. EX1003, ¶314. Combined with Nakafushi's engine, Matsushima's alternator and power supply circuit 34 would provide a regulated voltage to Nakafushi's control valve 23 (a solenoid when combined with Olmr). *Id.*

## 9. Claim 11

Nakafushi's control valve 23 (a solenoid when combined with Olmr) is normally closed and, as such, is open to provide gasoline to the engine when it is powered. EX1005, ¶[0014], Fig. 1; EX1003, ¶316.

**10. Claim 12**

Matsushima's pull-starter drives an electrical power generator to power various components while starting its engine (including its fuel pump, spark plug and fuel injection valve). EX1029, Abstract, 5:1-48; EX1003, ¶318. Incorporating Matsushima's pull-starter assembly with Nakafushi's engine would similarly allow the pull-starter assembly to drive the generator to power and open Nakafushi's control valve 23 (a solenoid when combined with Olmr) while starting the engine on gasoline. EX1003, ¶318.

**11. Claim 13**

It would have been obvious to use a microcontroller to close Nakafushi's control valve 23 (a solenoid when combined with Olmr) when operating on LPG and open the solenoid when operating on gasoline for the same reasons discussed above with respect to the DF972 engine. *Supra* §VII.B.11.

**12. Claim 14**

The obvious modification to use a microcontroller to control Nakafushi's valves would also involve using the microcontroller to close the Nakafushi's control valve 23 (a solenoid when combined with Olmr) during engine shutdown to stop the flow of gasoline at the desired time. *Supra* §VII.D.11; EX1003, ¶323.

**13. Claim 19**

Nakafushi's control valve 23 (a solenoid when combined with Olmr) would be magnetically actuated because a solenoid valve is magnetically actuated and

Olmr discloses electromagnetic coil 50 to actuate solenoid valve 42. EX1003, ¶325; EX1007, 2:43-68.

**14. Claim 20**

***a. Element [20.1]***

Spring 46 of Olmr's solenoid valve 42 operates within the solenoid to push the valve plunger 45 to allow liquid fuel to flow. EX1007, 3:39-41. Because the solenoid of Olmr is normally open (EX1007, 3:47-49), a normally-closed solenoid (based on the teaching of Nakafushi, i.e., the opposite of Olmr), would operate by the spring pushing the valve plunger 45 to interrupt liquid fuel. EX1003, ¶328.

***b. Element [20.2]***

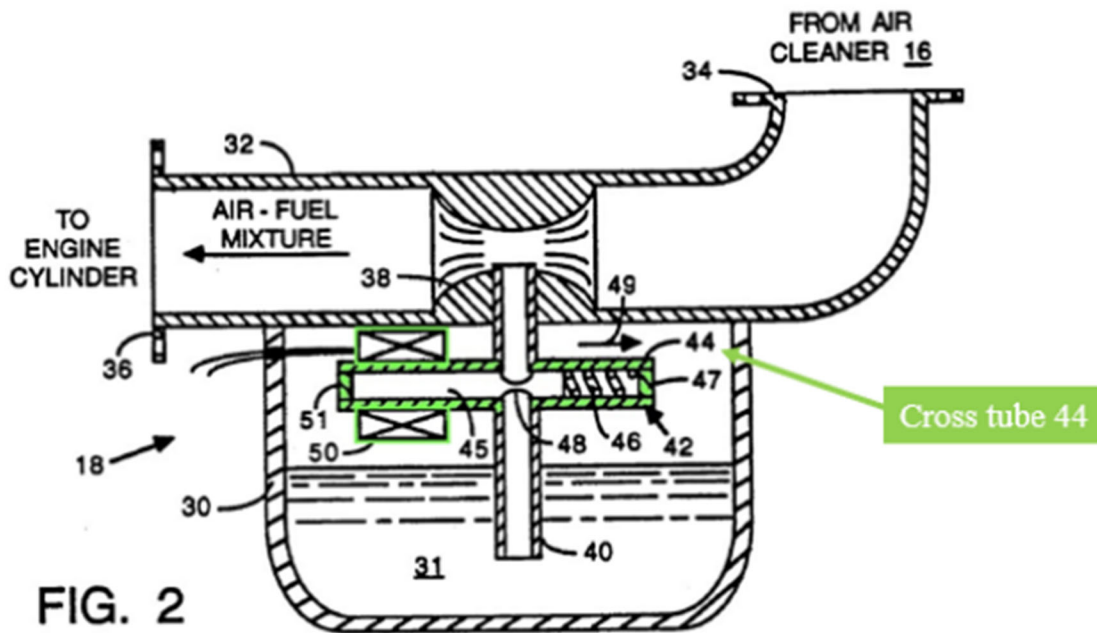
Current flow produces a magnetic field in Olmr's solenoid, which pushes the valve plunger 45 against spring 46 such that the valve plunger blocks gasoline from flowing. EX1007, 4:18-23. Because the solenoid of Olmr is normally open (EX1007, 3:47-49), a normally-closed solenoid (the opposite of Olmr) would operate by the magnetic field pushing the valve plunger against the spring away from a position interrupting liquid fuel. EX1003, ¶330.

Nakafushi's control valve 23 is physically attached to an outer surface of the carburetor. *Supra* §VII.C.3. When using a solenoid as Nakafushi's control valve 23, the actuating magnet would also be coupled to the carburetor. EX1003, ¶331.

**15. Claim 21**

***a. Element [21.1]***

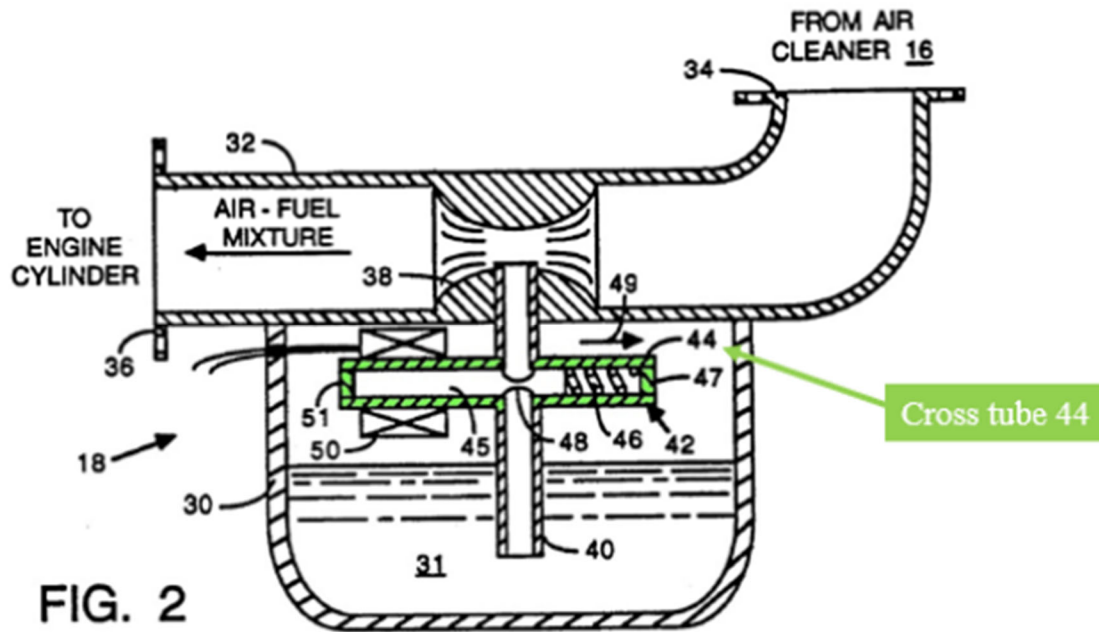
Olmr's solenoid valve 42 has a housing, including cross tube 44:



EX1007, Fig. 2, 2:43-44; EX1003, ¶334.

***b. Element [21.2]***

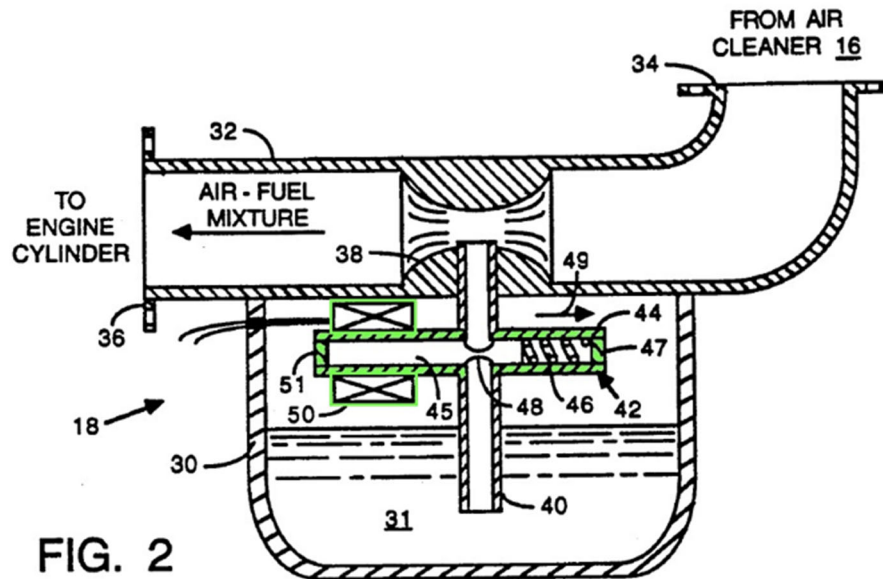
The housing of Olmr's solenoid valve 42 has a first section enclosing a plunger (cross tube 44), which holds the spring against the plunger:



EX1007, Fig. 2, 2:43-44; EX1003, ¶336.

*c. Element [21.3]*

The housing of Olmr's solenoid valve 42 has a second section enclosing the actuating magnet (the electromagnetic coil 50):



EX1007, Fig. 2; EX1003, ¶338. This second section is coupled to the first section.

*Supra* §VII.D.15.b.

To the extent Olmr does not sufficiently disclose a housing for this second section, it would have been obvious to have a housing for this second section based on Olmr's own teaching to use a housing for the first section (cross tube 44) and because it was routine at the time of the invention to enclose the entirety of a solenoid valve in a housing (as taught by the Workshop Manual). EX1003, ¶340. A POSA would have been motivated to use a solenoid valve with a housing to protect the components of the valve. *Id.*, ¶341. A POSA would have had a reasonable expectation of success because solenoids with housings, including housings for the first and second sections recited in this claim, were readily available at the time of

the invention and would have operated the same as a solenoid without a housing.

*Id.*

**16. Claim 23**

***a. Element [23.0]***

It would have been obvious to replace Nakafushi's battery with Matsushima's recoil-starter assembly and generator, thus resulting in a batteryless dual-fuel generator. *Supra* §§VII.D.1, VII.D.2.

***b. Element [23.1]***

Nakafushi's engine is operable on LPG and gasoline. *Supra* §VII.C.1.b.

Nakafushi's engine, using Matsushima's pull start, would drive Matsushima's generator. EX1003, ¶345.

It would have been obvious to a POSA to enclose the Nakafushi engine, modified with Matsushima's recoil starter and generator, in a housing, such as the housing disclosed in Yamamoto for the same reasons discussed with respect to the DF972 engine. *Supra* §VII.B.14; EX1003, ¶346.

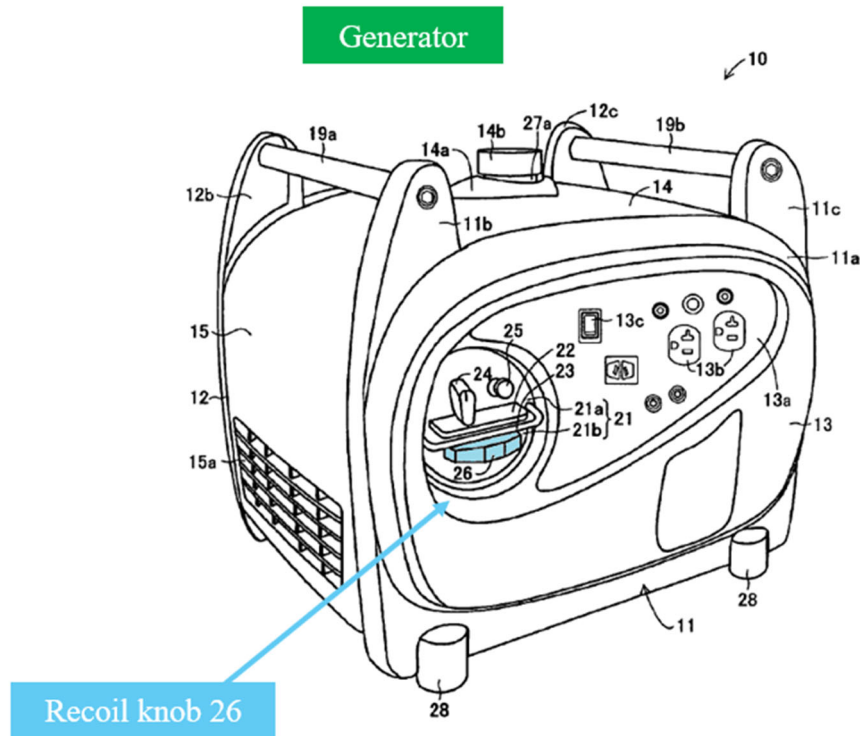


Figure 1

EX1030, Fig. 1.

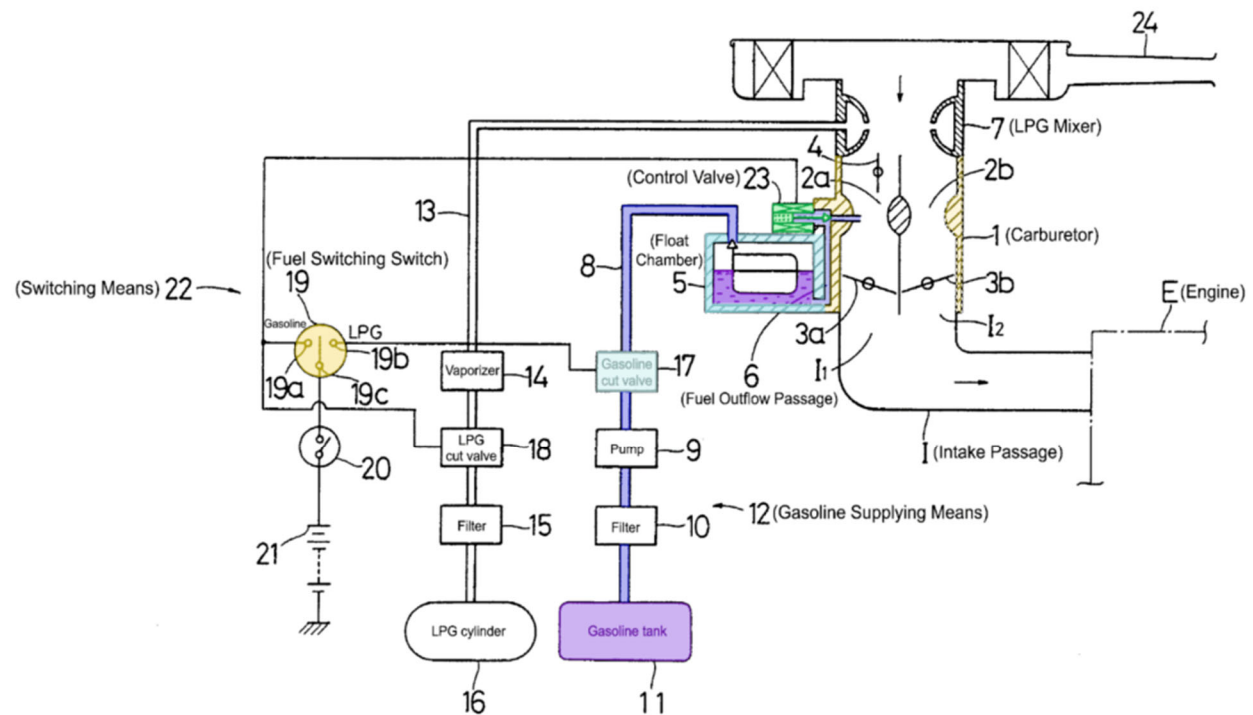
**c. Element [23.2]**

Nakafushi discloses a carburetor attached to an intake of the engine which includes a throat to mix fuel with air, a float bowl, and a fuel passage extending from the float bowl to the throat to provide liquid fuel. *Supra* §§VII.C.1.d, VII.C.4.d-VII.C.4.f.

**d. Element [23.3]**

Nakafushi's control valve 23 is attached to the carburetor to interrupt liquid fuel upon selection of engine operation to gaseous fuel. *Supra* §VII.C.1.g. Control valve 23 interrupts liquid fuel by closing fuel outflow passage 6, which is part of the fuel passage:

**FIG. 1**



EX1005, ¶[0014], Fig. 1; EX1003, ¶350.

### 17. Claim 32

The combination of the Nakafushi, Matsushima, Yamamoto, and Olmr discloses the elements of this claim. *Supra* §VII.D.14.

### 18. Claim 33

The combination of the Nakafushi, Matsushima, Yamamoto, and Olmr discloses the elements of this claim or, alternatively, they would have been obvious. *Supra* §VII.D.15.

**19. Claim 34**

***a. Element [34.1]***

Nakafushi's control valve 23 (a solenoid when combined with Olmr) is a "carburetor cutoff solenoid." *Supra* §§VII.D.3.b, VII.D.16.d.

***b. Element [34.2]***

Matsushima's generator is an alternator that includes a plurality of windings wound on the stator core and disposed to face the first magnet during rotation of the flywheel, which is a "charge winding." *Supra* §VII.D.16.b. EX1003, ¶367.

Nakafushi's control valve 23 (a solenoid when combined with Olmr) would be powered by Matsushima's charge winding. *Supra* §VII.D.4.

***c. Element [34.3]***

Nakafushi's switch 19 selectively powers control valve 23 (a solenoid when combined with Olmr) by controlling electrical connection between the solenoid valve and the charge winding (when combined with Matsushima). *Supra* §§VII.D.5, VII.D.19.b.

**20. Claim 35**

The combination of the Nakafushi, Matsushima, Yamamoto, and Olmr discloses the elements of this claim. *Supra* §VII.D.6.

**21. Claim 36**

The combination of the Nakafushi, Matsushima, Yamamoto, and Olmr discloses the elements of this claim. *Supra* §VII.D.7.

**22. Claim 37**

The combination of the Nakafushi, Matsushima, Yamamoto, and Olmr discloses the elements of this claim. *Supra* §§VII.C.1.c, VII.D.3.a, VII.D.19.b.

**23. Claim 38**

The combination of the Nakafushi, Matsushima, Yamamoto, and Olmr discloses the elements of this claim. *Supra* §VII.D.8.

**24. Claim 39**

The combination of the Nakafushi, Matsushima, Yamamoto, and Olmr discloses the elements of this claim. *Supra* §VII.D.8.

**25. Claim 40**

The combination of the Nakafushi, Matsushima, Yamamoto, and Olmr discloses the elements of this claim. *Supra* §VII.D.10.

**26. Claim 41**

The combination of the Nakafushi, Matsushima, Yamamoto, and Olmr the elements of this claim or renders them obvious. *Supra* §VII.D.11.

**27. Claim 42**

The combination of the Nakafushi, Matsushima, Yamamoto, and Olmr the elements of this claim or renders them obvious. *Supra* §VII.D.12.

**28. Claim 58**

Nakafushi discloses switch 19 to operatively control valve 23. *Supra* §§VII.C.1.c, VII.C.1.g, VII.C.4.g. A POSA would understand that Nakafushi's

switch 19 is manually operated and, as such, would have a manually operated control, such as a control knob. EX1003, ¶388. Alternatively, it would have been obvious to couple a manually operated control to Nakafushi's switch 19 (based on the teachings of Yamamoto) for the same reasons discussed with respect to the DF972 engine. *Supra* §VII.B.28.

**E. Ground 5: Claims 1, 15-16, and 43-44 are anticipated by Holzapfel**

Claims 1, 15-16, and 43-44 are anticipated under §102, as detailed below and in the declaration of Dr. Morse. EX1003, ¶¶389-429.

**1. Claim 1**

***a. Element [1.0]***

Holzapfel discloses a “fuel system embodying the supplying of liquid fuel and gaseous fuel to an engine.” EX1009, 1:1-5.

***b. Element [1.1]***

Holzapfel's engine is configured to operate on a gaseous fuel and on a liquid fuel. EX1009, 1:1-5.

***c. Element [1.2]***

Holzapfel discloses a “rod or wire 47” that changes operation of the engine between gaseous fuel and liquid fuel. EX1009, 2:100-107, 2:116-123. Rod/wire 47 simultaneously controls valves 14 and 39 by control of operating levers 45 and 46:

*Fig. 1*

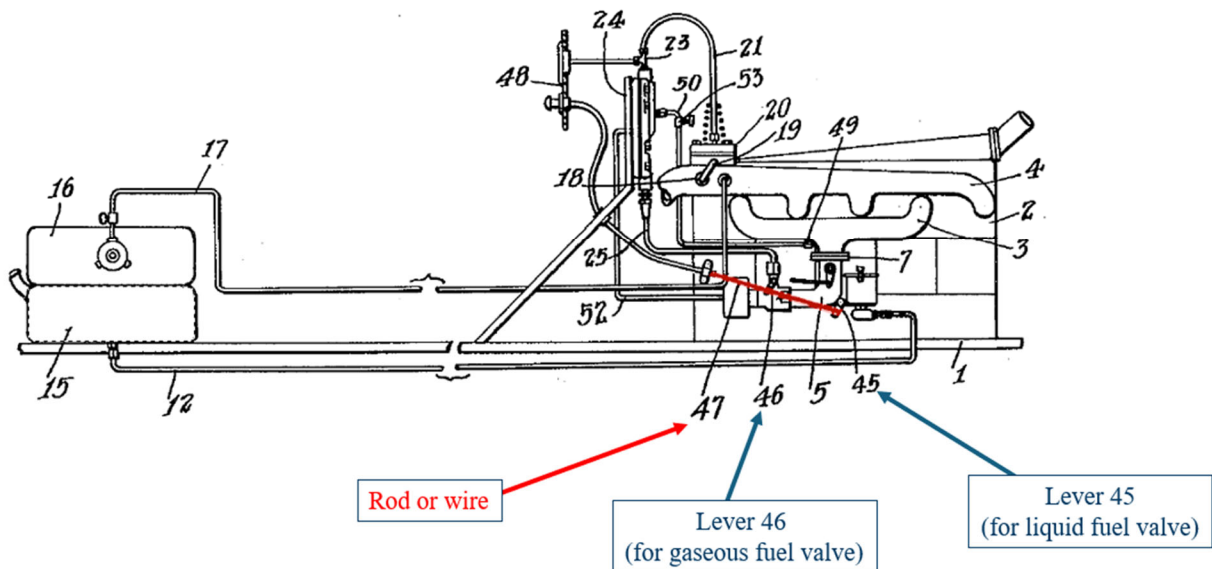
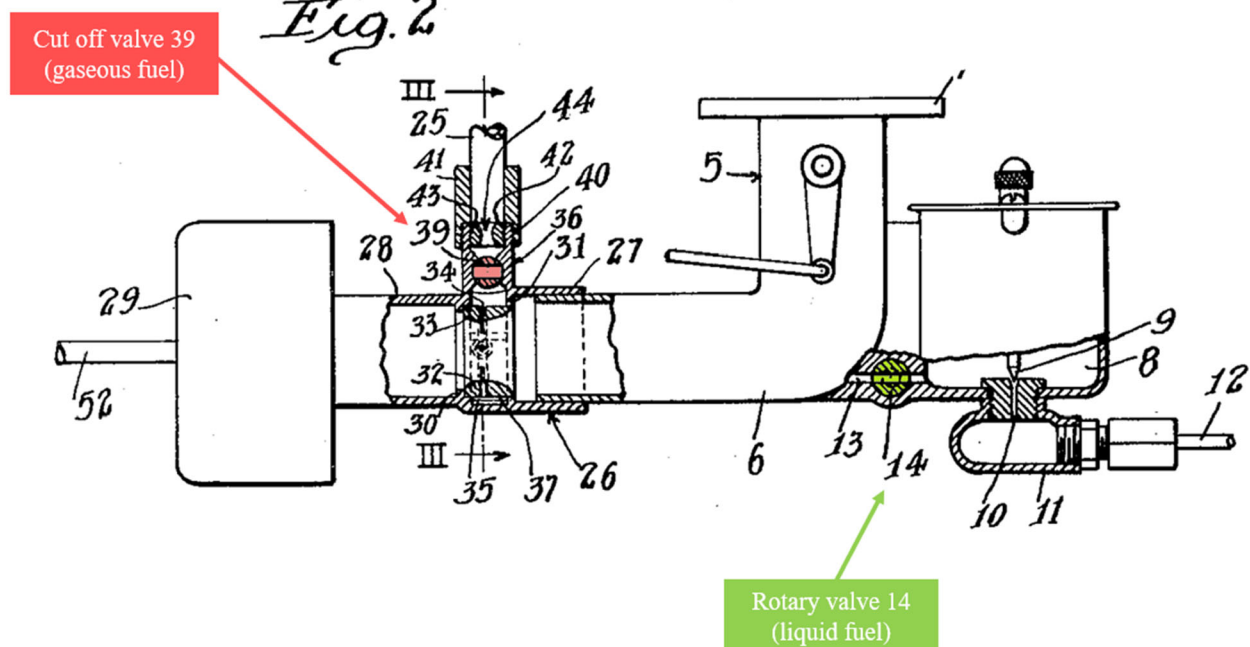


*Fig. 2*



EX1009, Figs. 1-2, 2:100-123; EX1003, ¶¶395-397.

*d. Element [1.3]*

Holzapfel discloses carburetor 5 that is attached to intake manifold 3 and that connects gaseous supply tank 16 and liquid supply tank 15:

*Fig. 1*

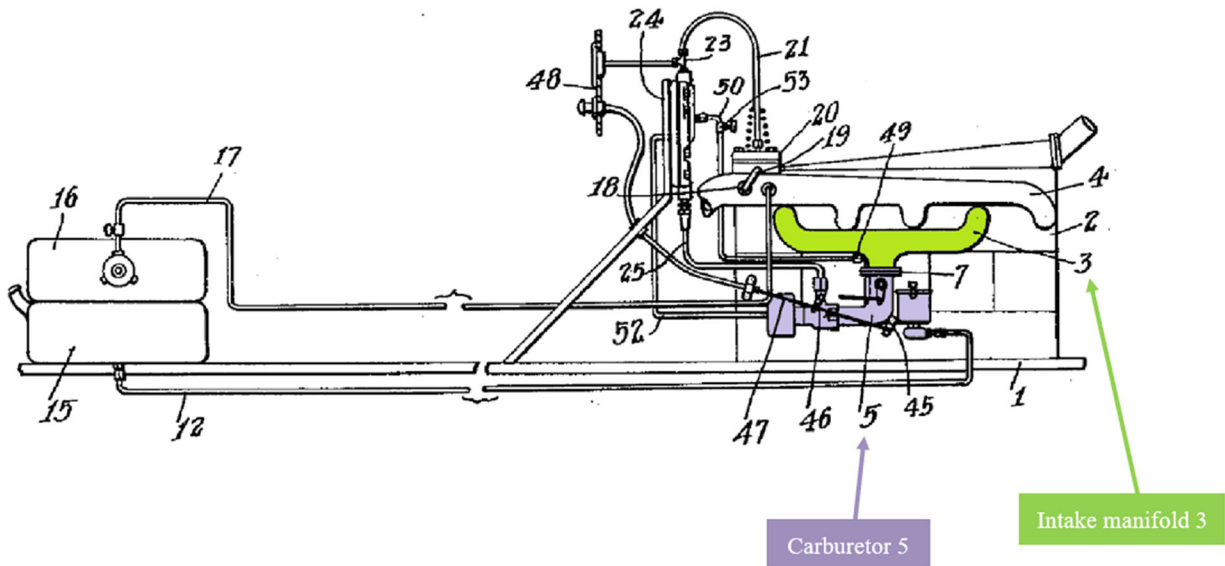
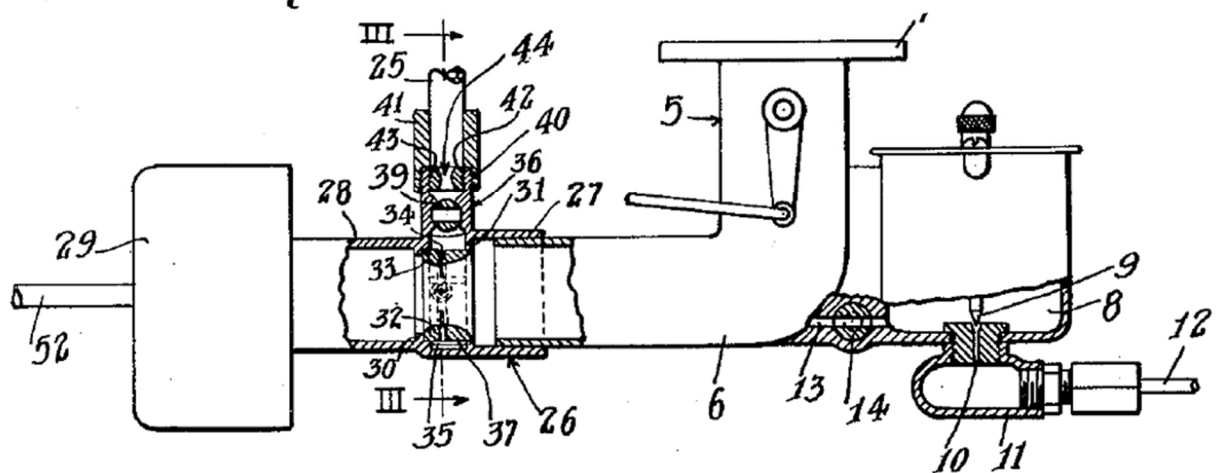


*Fig. 2*



EX1009, Fig. 2, 1:84-86; EX1003, ¶399.

Holzpfel states the other end of the carburetor constitutes an “inlet opening through which air may be sucked for mixing with the fuel injected into the carburetor.” EX1009, 1:87-89. The carburetor is “equipped with a float chamber or

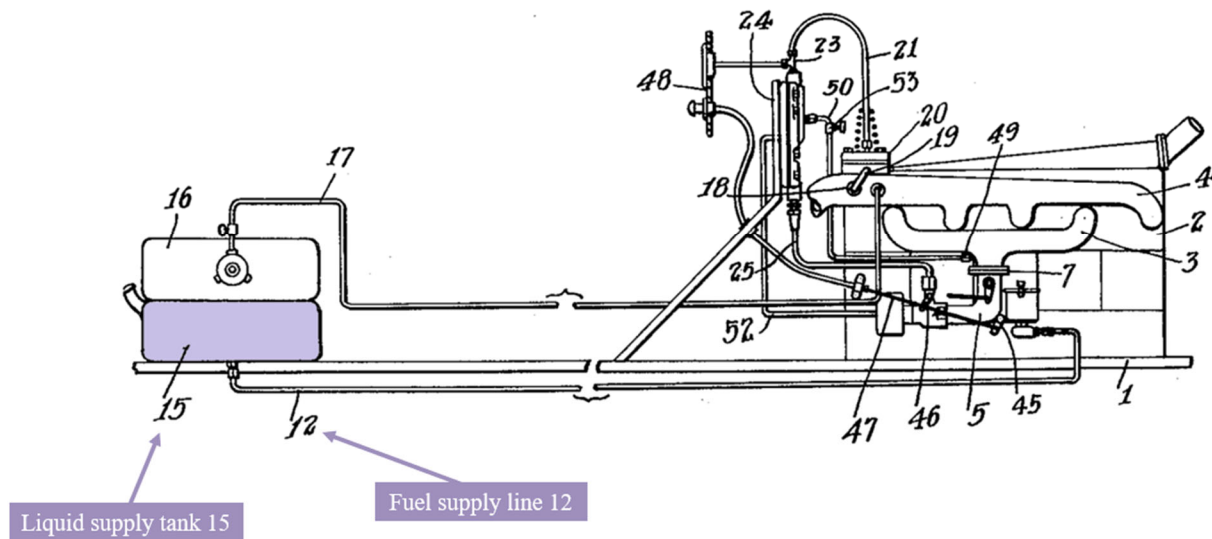
fuel reservoir 8 which may be of any suitable construction to provide a supply of [liquid] fuel at atmospheric pressure ready for injection into the tube 6 of the carburetor 5.” EX1009, 1:89-94. The float chamber 8 communicates with the carburetor by means of passage 13. EX1009, 1:100-104. Holzapfel further discloses “the gaseous fuel supply through outlet tube 25 may be mixed with air and passed into the tube 6 of the carburetor 5 so that such air and gas mixture may pass into the intake manifold 3 of the engine 2.” EX1009, 2:39-44.

*e. Element [1.4]*

Holzapfel discloses “needle valve 9 which obstructs the entrance of fuel into the [float] chamber 8 by closing off the passage 10.” EX1009, 1:95-99.

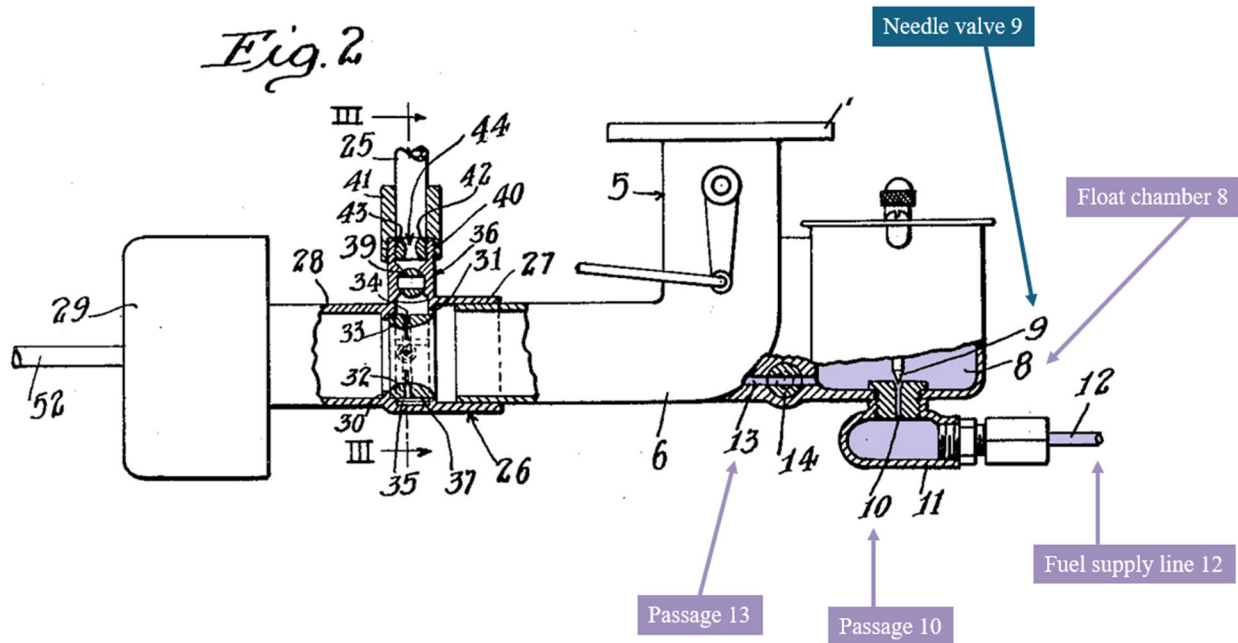
Fuel supply line 12 is attached to liquid supply tank 15 through which fuel from the tank 15 flows to float chamber 8 of the carburetor via inlet connection:

*Fig.1*



EX1009, Fig. 1., 1:108-2:2; EX1003, ¶403.

Fuel supply line 12 connects to float chamber 8 by way of passage 10, where needle valve 9 operates by closing passage 10:

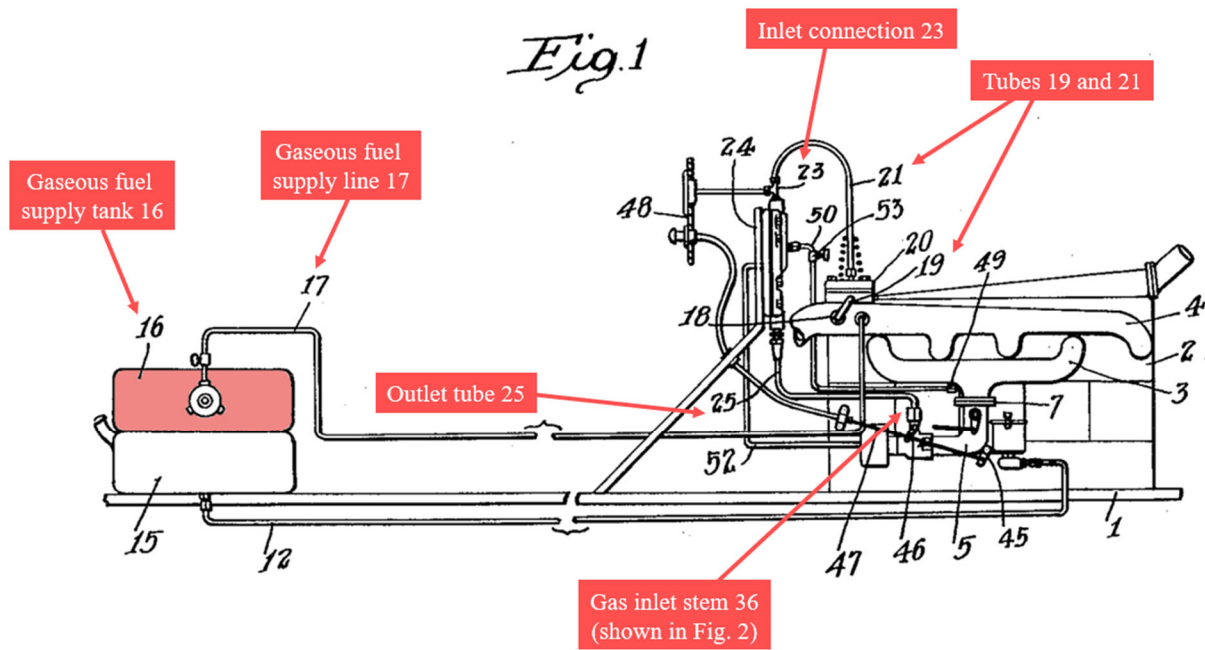


EX1009, Fig. 2, 1:84-99; EX1003, ¶404.

*f. Element [1.5]*

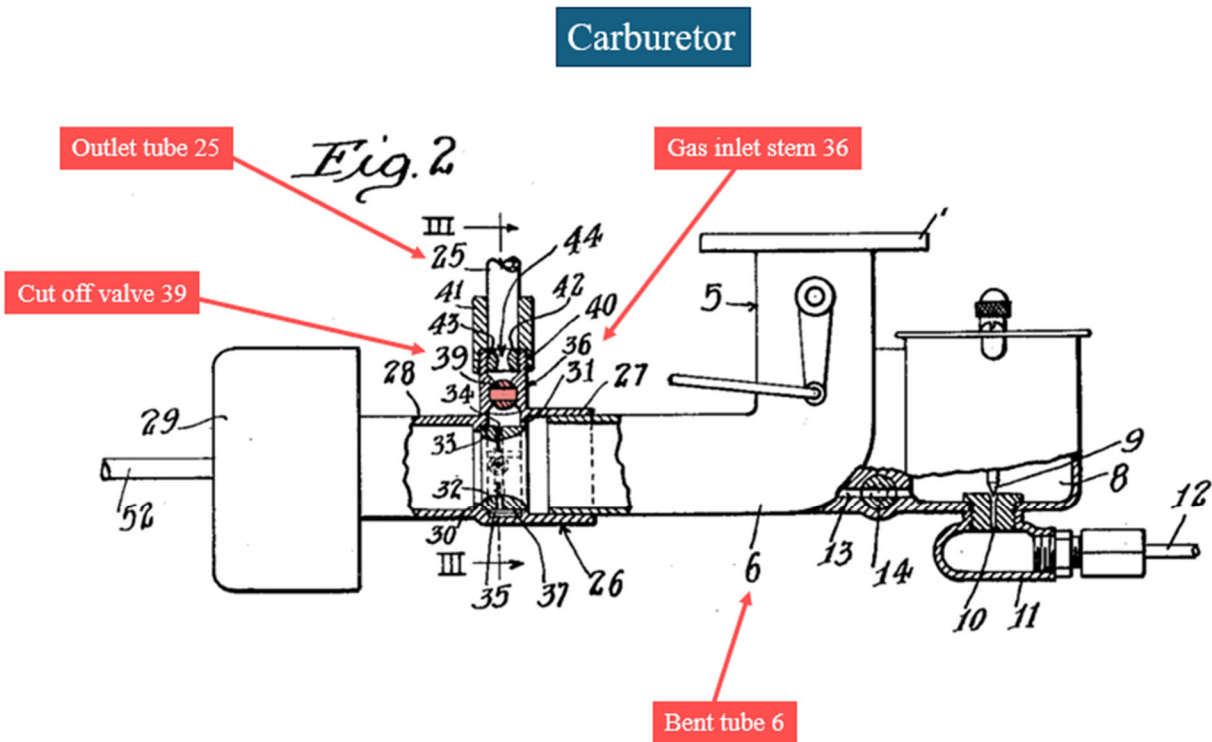
Holzapfel discloses “cut off valve 39 which may be operated to either open the inlet passage 36 to the passage of gas therethrough, or to close the same so that gas cannot pass therethrough.” EX1009, 2:86-90.

Gaseous fuel supply line 17 is attached to gaseous fuel supply tank 16 through which fuel from the tank 16 flows through tubes 19 and 21 to the inlet connection 23 and then through outlet tube 25 to the gas inlet stem 36:



EX1009, Fig. 1., 2:8-27, 2:85-90; EX1003, ¶407.

Gas inlet stem 36 connects to tube 6 of carburetor 5, where cut off valve 39 operates by closing inlet passage 36:



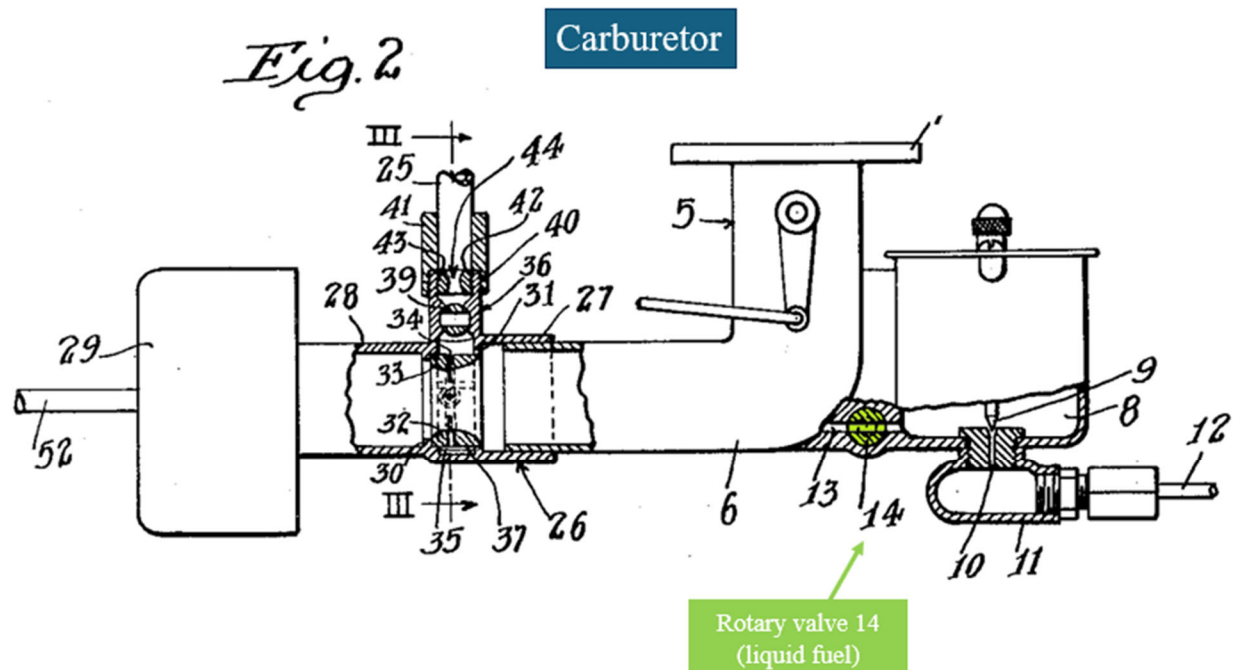
EX1009, Fig. 2, 2:39-44, 2:62-90; ¶¶407-408.

**g. Element [1.6]**

Holzapel discloses rotary valve 14, lever 45, and rod/wire 47 (EX1009, 1:104-107, 2:100-123, Fig. 2), which is a “liquid fuel cut-off.” EX1003, ¶411. The rod/wire 47 controls valve 14 via lever 45 such that the switching from gaseous fuel to liquid fuel results in the opening of valve 14. *Supra* §VII.E.1.c.

Holzapel discloses that when rod/wire 47 and valves 14 and 39 are in the position opposite that shown in Figure 2, valve 14 is closed (interrupting liquid fuel flow to the engine) and valve 39 is open (permitting the gaseous fuel source to couple to the engine). EX1009, 2:100-123, Fig. 2.

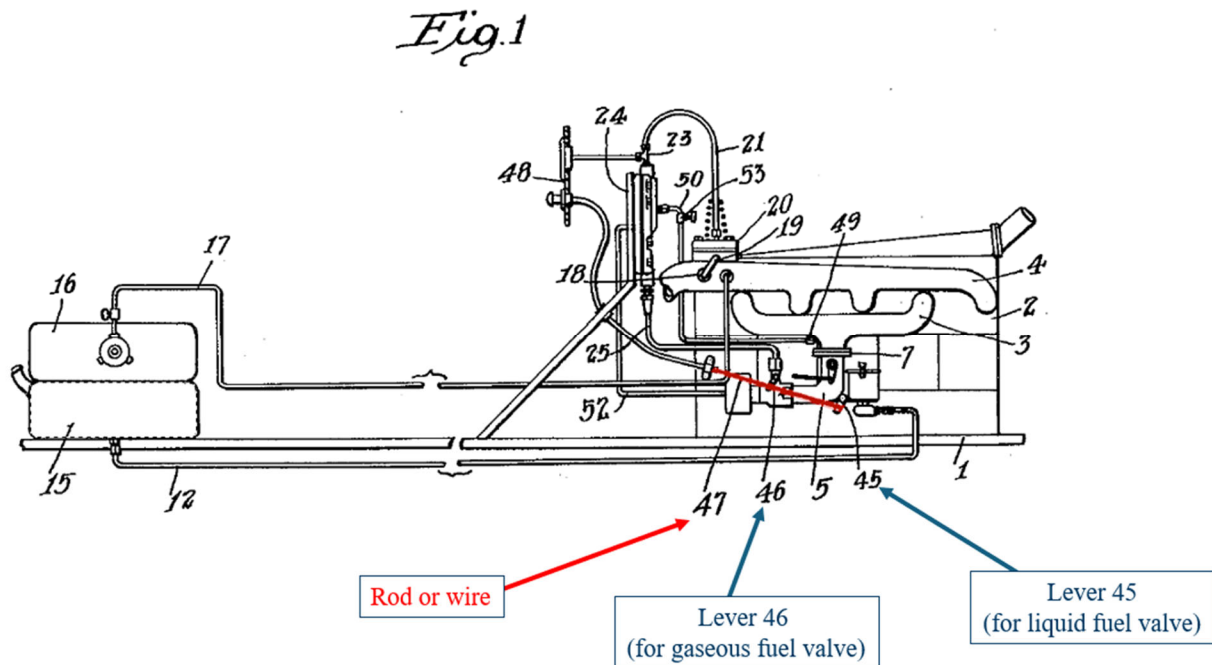
Valve 14 is incorporated into the carburetor:



EX1009, Fig. 2, 1:58; EX1003, ¶¶412-413.

## 2. Claim 15

Holzapfel's rotary valve 14 is manually actuated because the operator manipulates rod/wire 47 to control valve 14 via lever 45:



EX1009, Fig. 1, 2:100-123; EX1003, ¶415.

### 3. Claim 16

Holzapfel's rotary valve 14 actuates free from linear motion because, by definition, a rotary valve uses a rotating component free from linear motion to open and close a flow path. EX1003, ¶417.

### 4. Claim 43

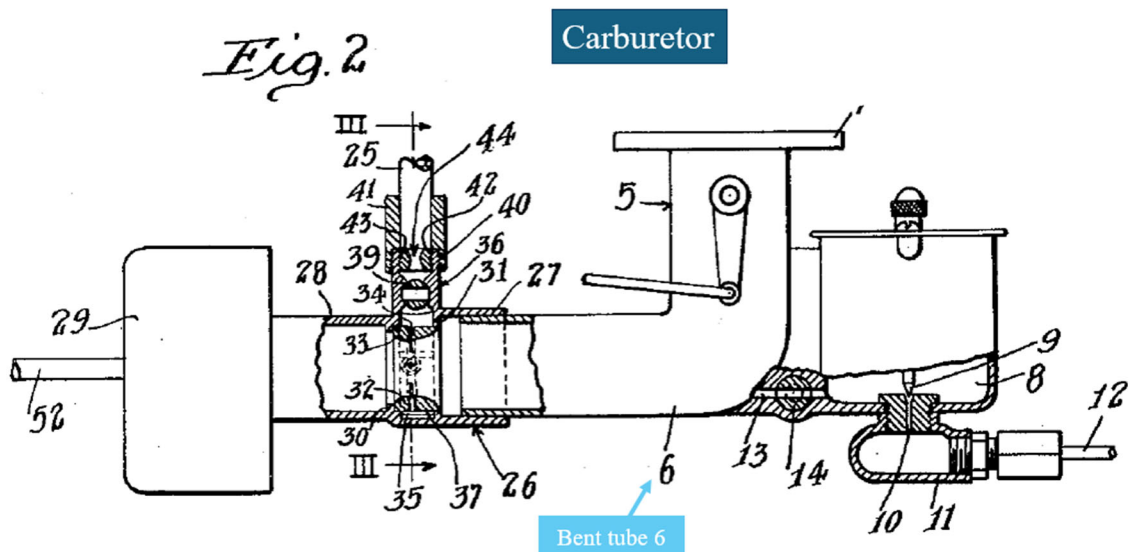
#### a. Element [43.0]

Holzapfel discloses a carburetor with a fuel shutoff (rotary valve 14, lever 45, and rod/wire 47). *Supra* §§VII.E.1.d, VII.E.1.g.

**b. Element [43.1]**

Holzapfel's carburetor includes float chamber or fuel reservoir 8 (i.e., float bowl) that communicates with the carburetor by means of passage 13. *Supra* §VII.E.1.d.

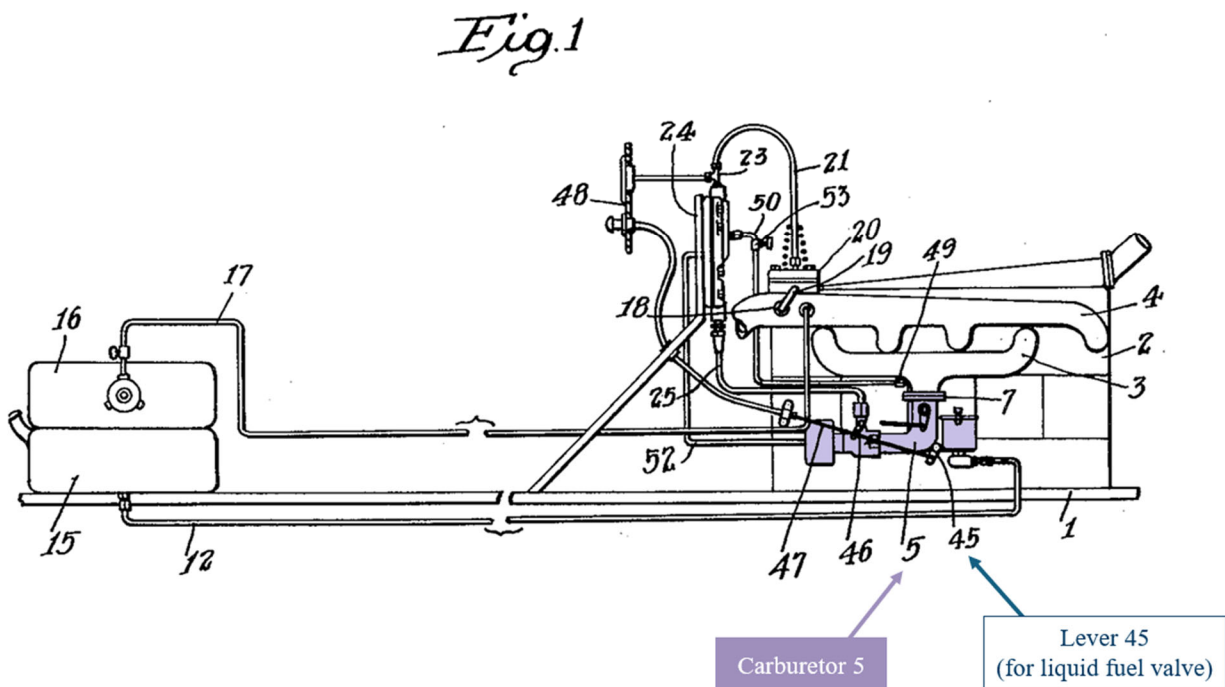
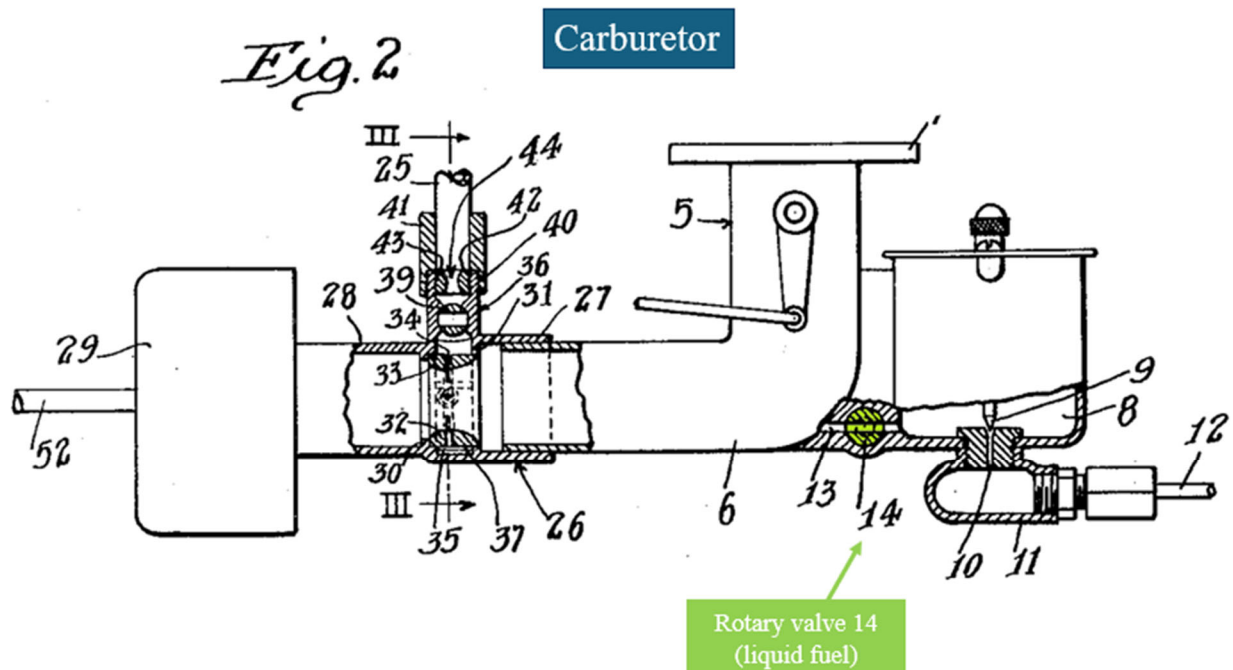
The fuel passage extends from the float bowl to the throat, which includes bent tube 6:



EX1009, Fig. 2; EX1003, ¶422; EX1001, 11:31-34 (describing throat).

**c. Element [43.2]**

Holzapfel's fuel shutoff (rotary valve 14, lever 45, and rod/wire 47) are coupled to carburetor 5:



EX1009, Figs. 1-2; EX1003, ¶424.

Rotary valve 14 defines the first end of the fuel shutoff, which operates in carburetor 5 to open and close passage 13, and lever 45 (in combination with

rod/wire 47) defines the second end of the fuel shutoff, which operates external to carburetor 5. EX1009, 2:100-107, 2:116-123, Figs. 1-2; EX1003, ¶425.

***d. Element [43.3]***

Holzapfel discloses this element. *Supra* §VII.E.3.

**5. Claim 44**

Holzapfel discloses this element. *Supra* §VII.E.2.

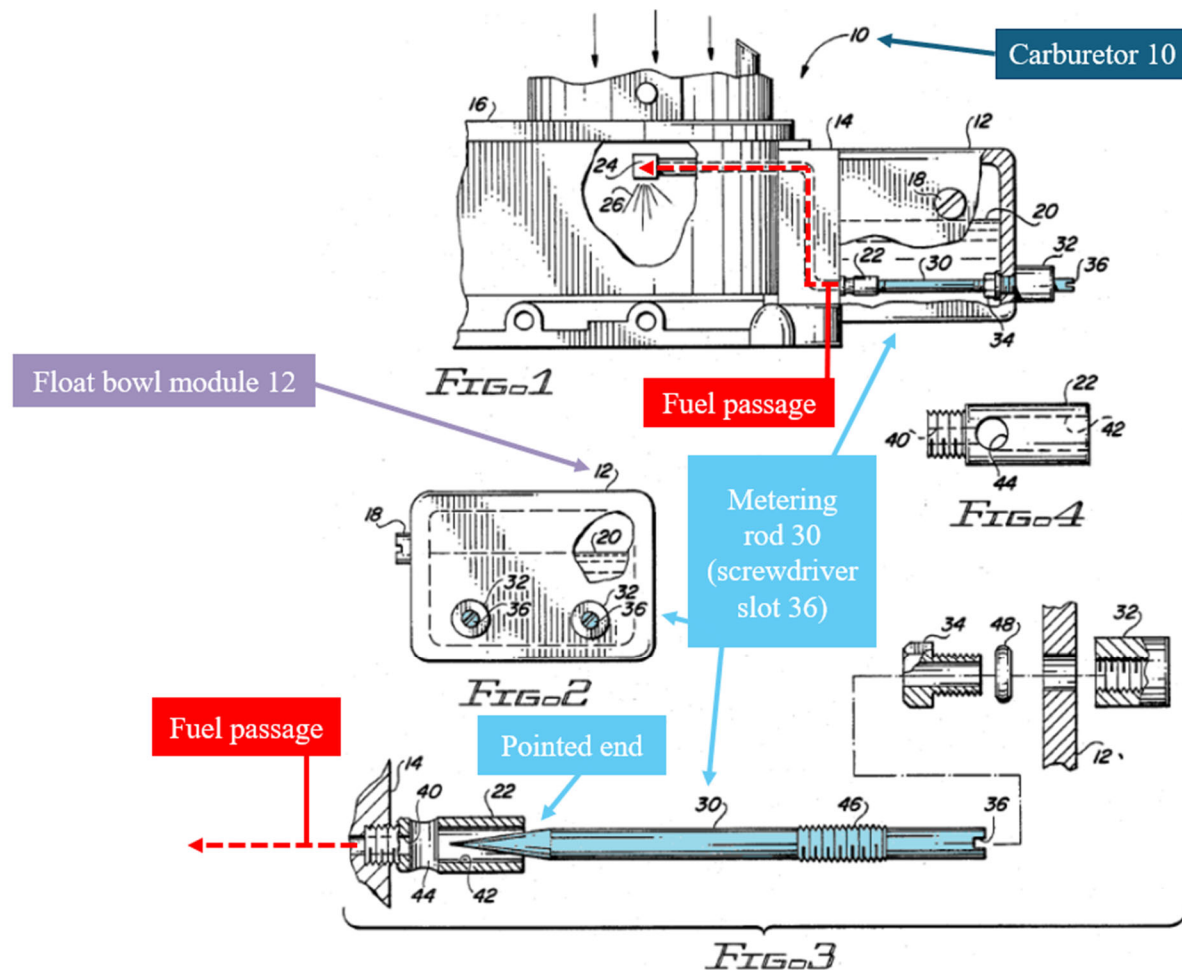
**F. Ground 6: Claims 43-46 and 56 are anticipated by Neal**

Claims 43-46 and 56 of the '398 Patent are anticipated under §102, as detailed below and in the declaration of Dr. Morse. EX1003, ¶¶430-454.

**1. Claim 43**

***a. Element [43.0]***

Neal discloses carburetor 10 with metering rod 30 in float bowl module 12:

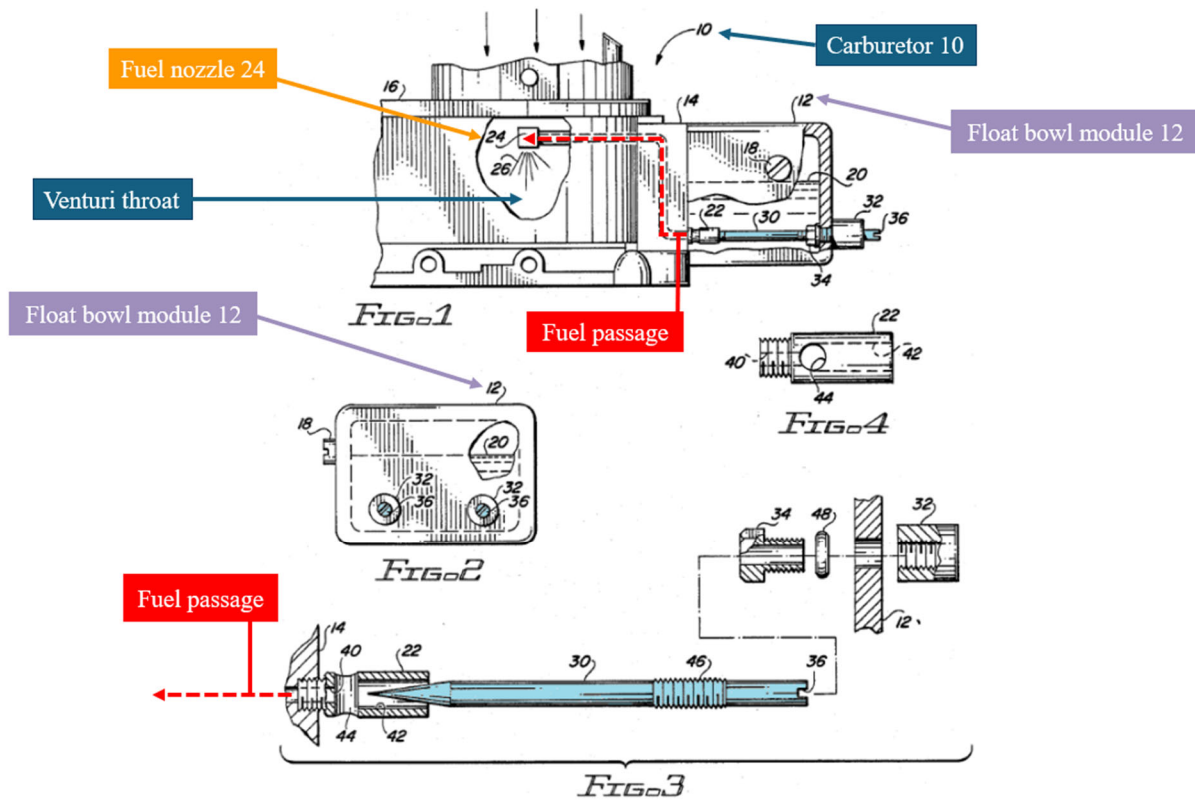


EX1031, Figs. 1-4, 2:59-3:24, 4:25-51, 6:15-42; EX1003, ¶432.

Neal's metering rod 30 is a fuel shutoff because it closes the gasoline fuel passage from the float bowl to the engine, thus shutting off gasoline flow to the engine. EX1031, 6:15-42; EX1003, ¶433.

**b. Element [43.1]**

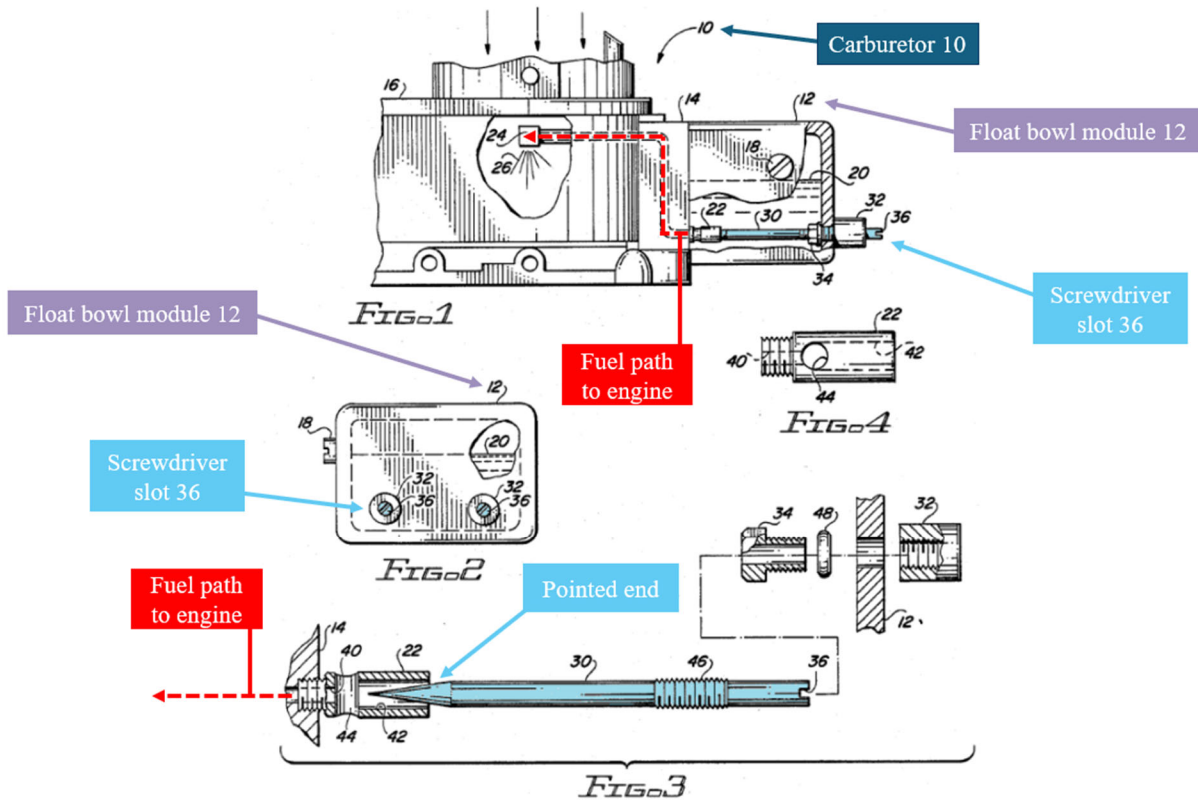
Neal's carburetor has a float bowl (float module 12) and a fuel passage extending from the float bowl to the throat of the carburetor where fuel is dispersed from fuel nozzle 24:



EX1031, Figs. 1-4, 3:66-4:24.

*c. Element [43.2]*

Neal's metering rod 30 is coupled to carburetor 10:



EX1031, Figs. 1-4, 4:1-56, 6:15-42; EX1003, ¶437.

The pointed end of metering rod (first end) is in float bowl module 12 of the carburetor and rotates to close the fuel passage. EX1031, 6:16-24 (when the metering rod is fully screwed inwardly, no fuel can pass into fuel orifice hole 40). The other end (second end) is external to the carburetor to actuate the first end. *Id.*, 3:12-24 (“screwdriver slot is provided at the end of the metering rod which protrudes outside the carburetor”), 4:25-52; 6:15-42.

**d. Element [43.3]**

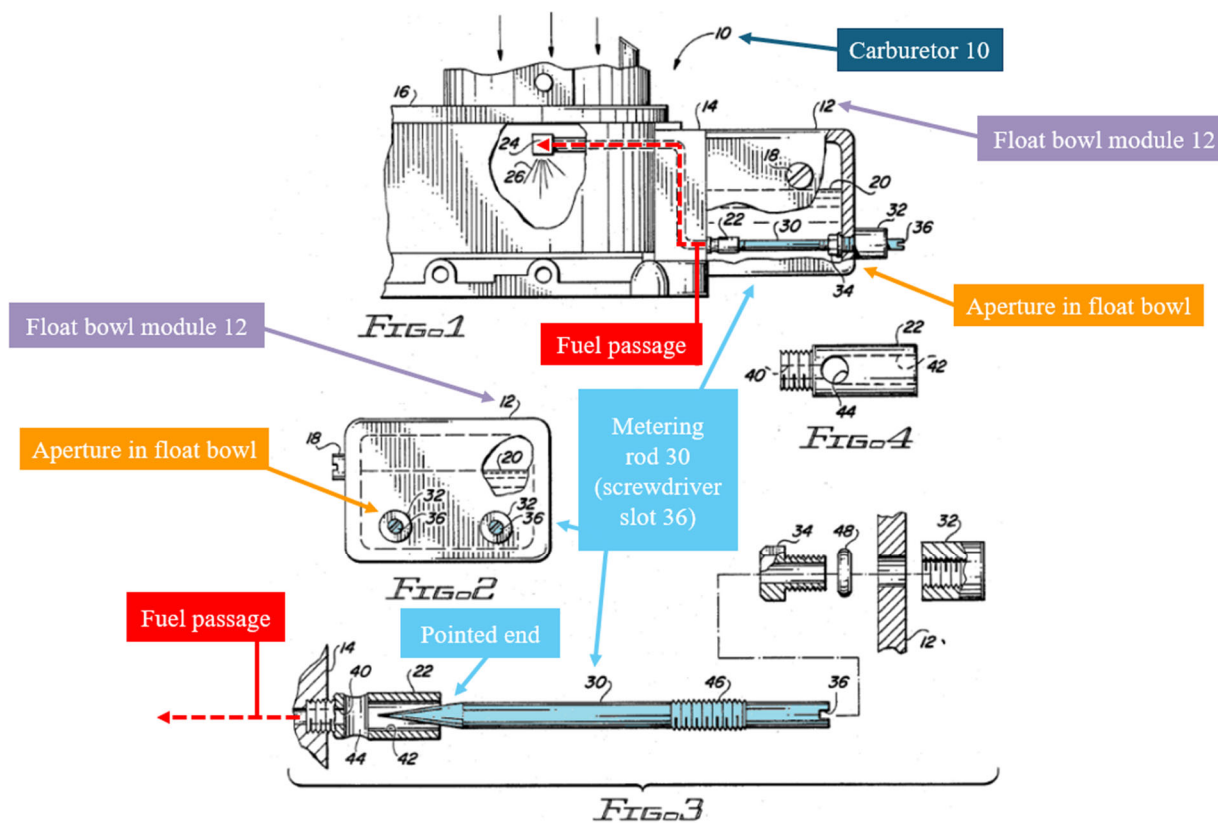
Neal’s metering rod 30 actuates by rotation. EX1031, 3:12-24, 6:15-42; Figs. 1-3.

**2. Claim 44**

Neal's metering rod 30 is manually actuated. EX1031, Abstract ("The metering rod presents a screwdriver slot for manual rotational fuel adjustment."); *id.*, 3:12-24, 6:15-42; Figs. 1-3.

**3. Claim 45**

Neal's metering rod 30 is a shaft that extends through an aperture in the float bowl and is coupled to a valve tip (pointed end) in the float bowl:

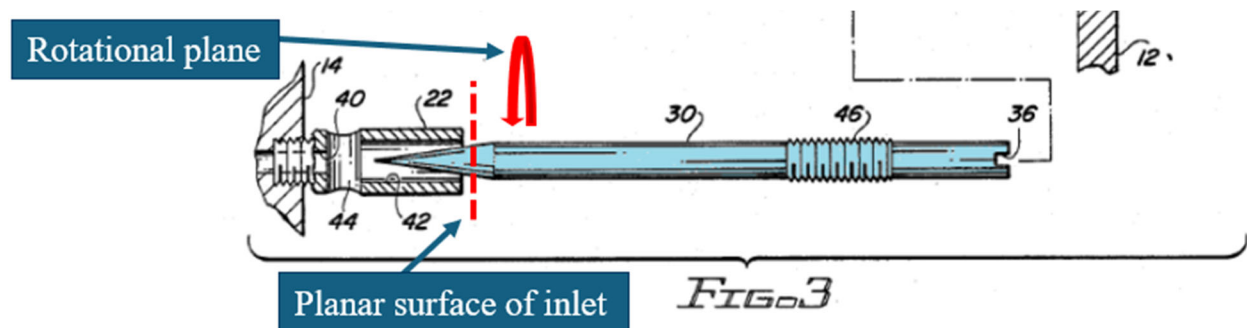


EX1031, Figs. 1-4, 2:67-3:1, 4:25-38; EX1003, ¶444.

The metering rod 30 and the valve tip (pointed end) rotate to open and close the fuel passage. EX1031, 6:15-42, Figs. 1-4; EX1003, ¶445.

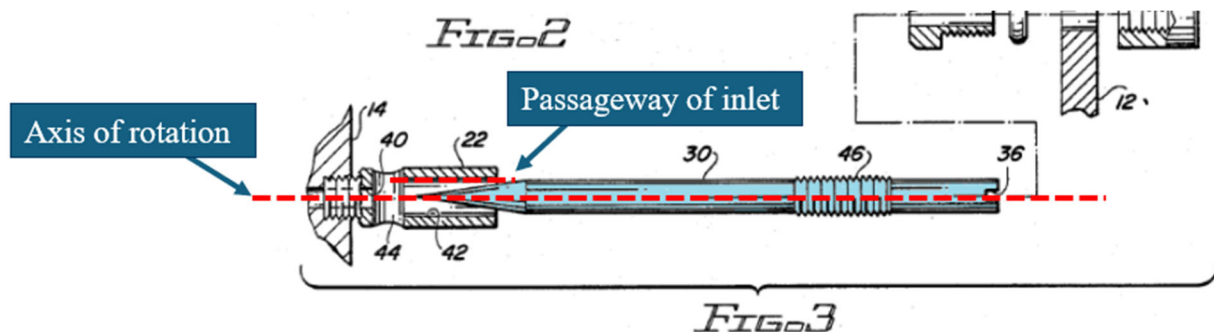
#### 4. Claim 46

Pointed end (valve tip) of Neal's metering rod 30 has a rotational plane that is parallel to the planar surface through which the inlet of the fuel passage penetrates:



EX1031, Fig. 3; EX1003, ¶450.

Pointed end (valve tip) of Neal's metering rod 30 also has an axis of rotation that is parallel to the passageway of the inlet:



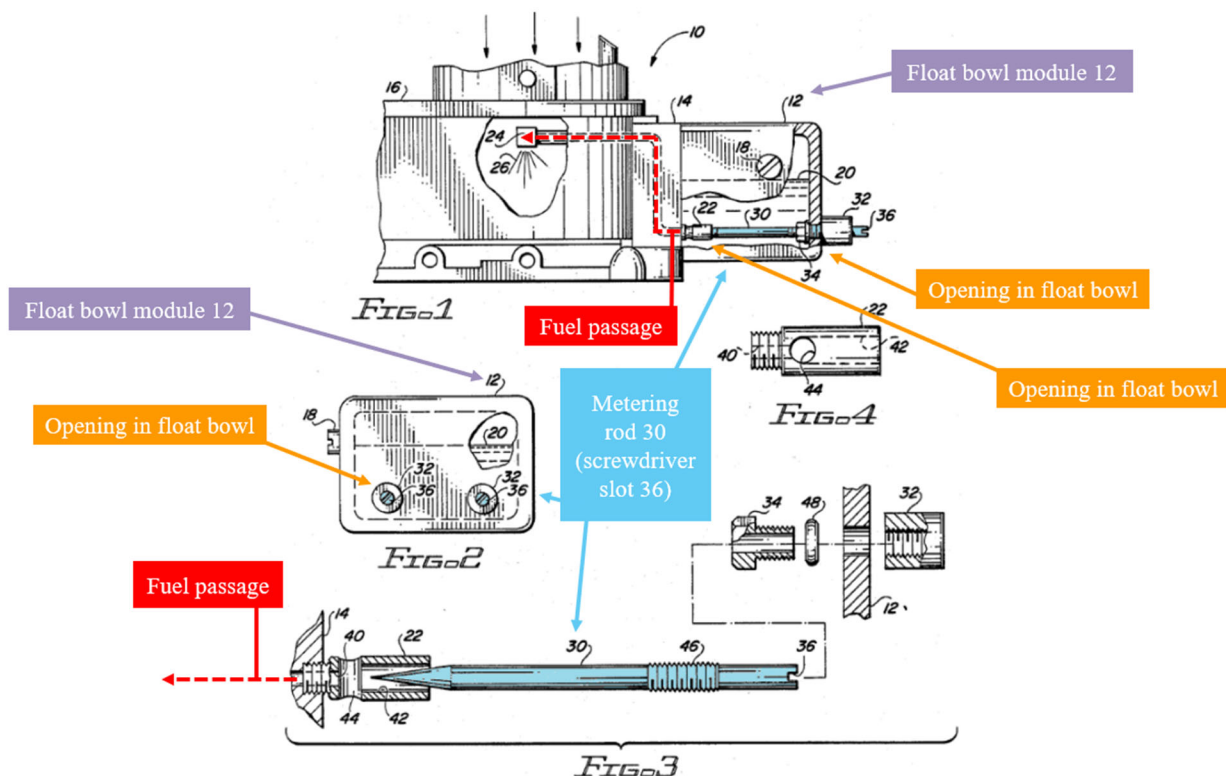
EX1031, Fig. 3; EX1003, ¶451.

Neal's metering rod 30 rotates between a position (first position) permitting fuel flow into the inlet of the fuel passage and a second position blocking fuel flow into the inlet of the passage. EX1031, 6:30-34 (unscrewing metering rod 30 "is continued until substantially the pointed end of the metering rod no longer is

restricting the fuel coming into the traverse fuel hole 44 of main metering jet 22 or restricting the fuel passing into the fuel orifice hole 40”); *id.*, 6:19-23 (“metering rod 30 is first screwed inwardly by means of a screwdriver slot 36 until the pointed end of the metering rod bottoms against the shoulder at the smaller diameter fuel orifice hole 40. At this point, no fuel can pass into the fuel orifice hole 40”); *id.*, 6:15-42; EX1003, ¶452.

## 5. Claim 56

Neal’s metering rod 30 extends through an opening into the float bowl and the first end actuates in the float bowl to close the fuel passage:



EX1031, Figs 1-3, 6:15-42; EX1003, ¶454.

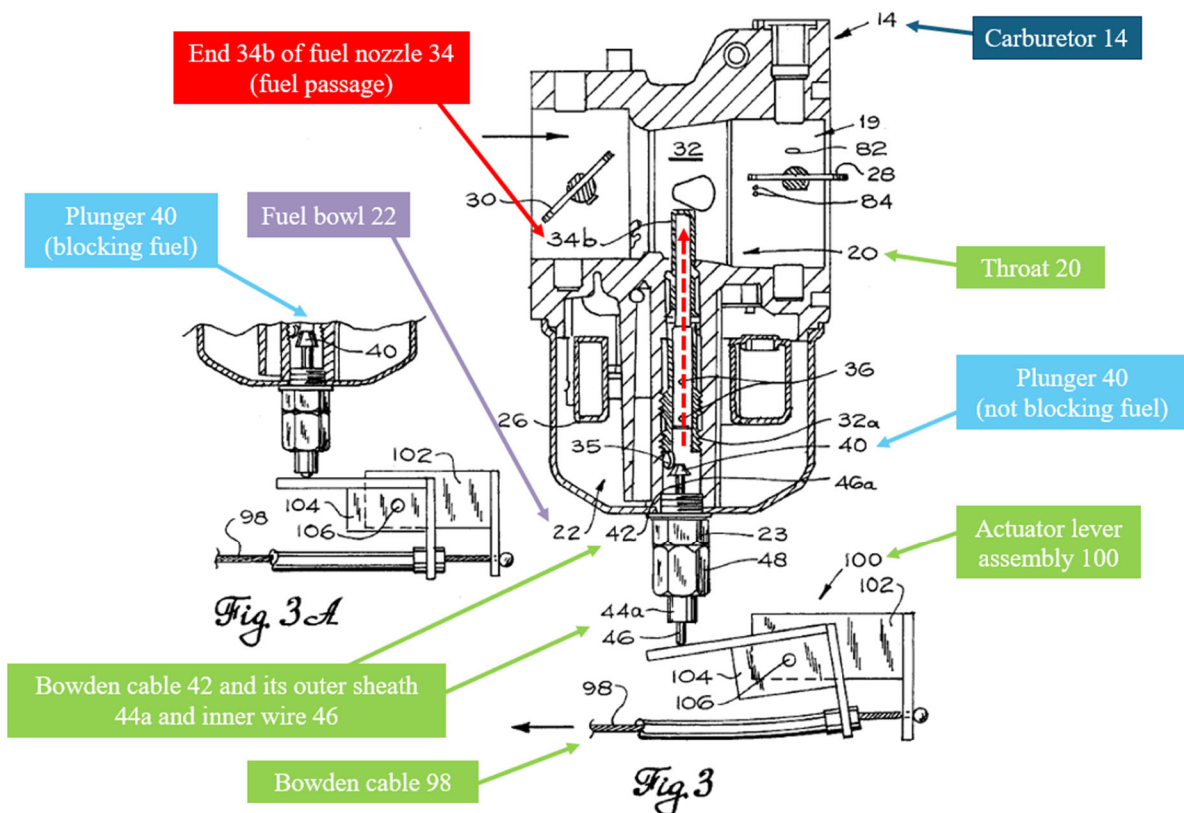
**G. Ground 7: Claims 43-46, 53-54, and 56 are anticipated by and/or obvious in view of Winberg**

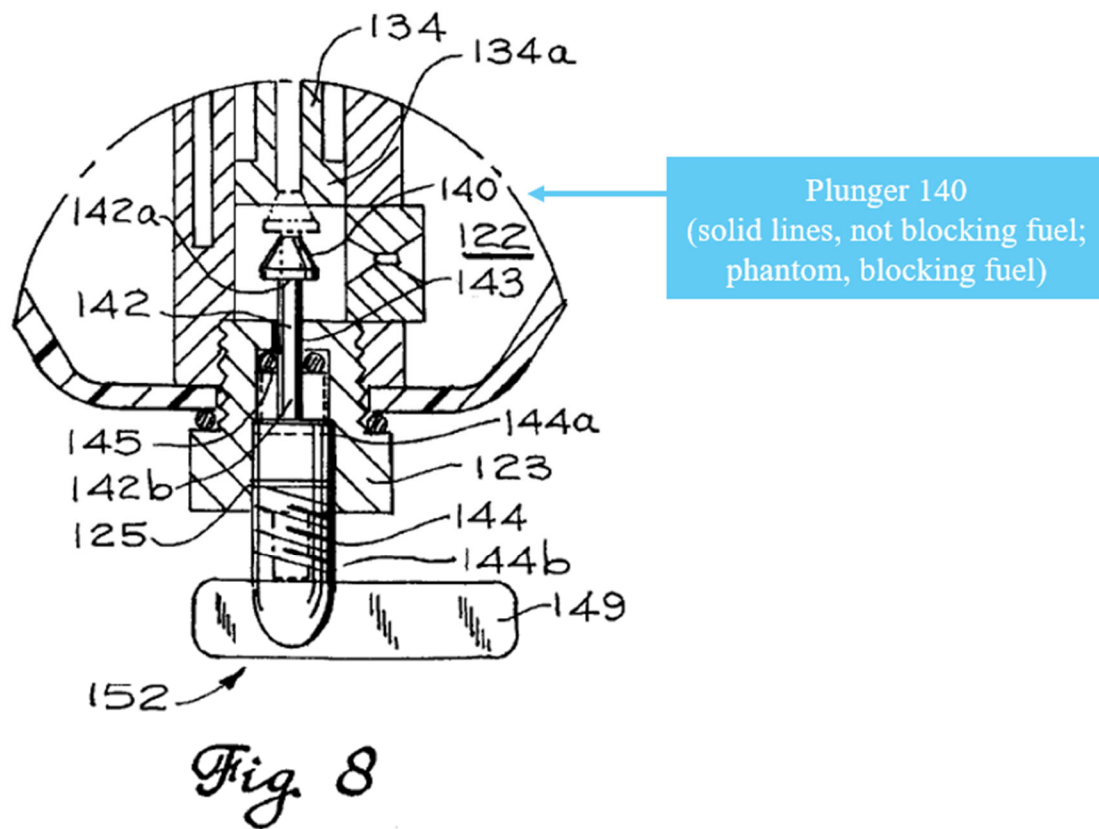
Claims 43-46, 53-54, and 56 of the '398 Patent are anticipated under §102, as detailed below and in the declaration of Dr. Morse. EX1003, ¶¶455-491.

**1. Claim 43**

**a. Element [43.0]**

Winberg discloses carburetor 14 having a fuel shutoff, which has a mechanically operated blocking member or plunger 40/140 that blocks the flow of fuel from the float bowl to the engine, including embodiments shown in Figures 3-3A and 8:

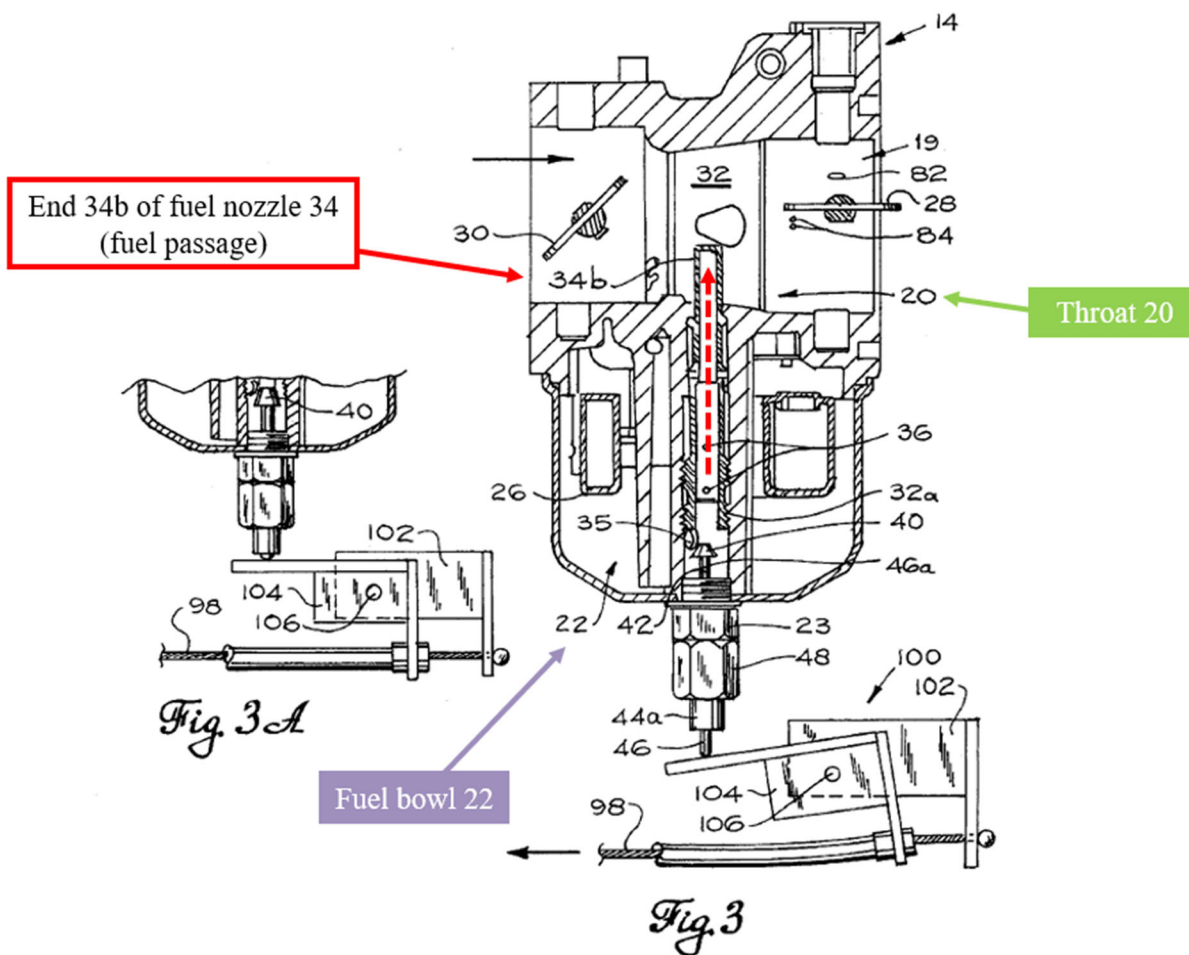


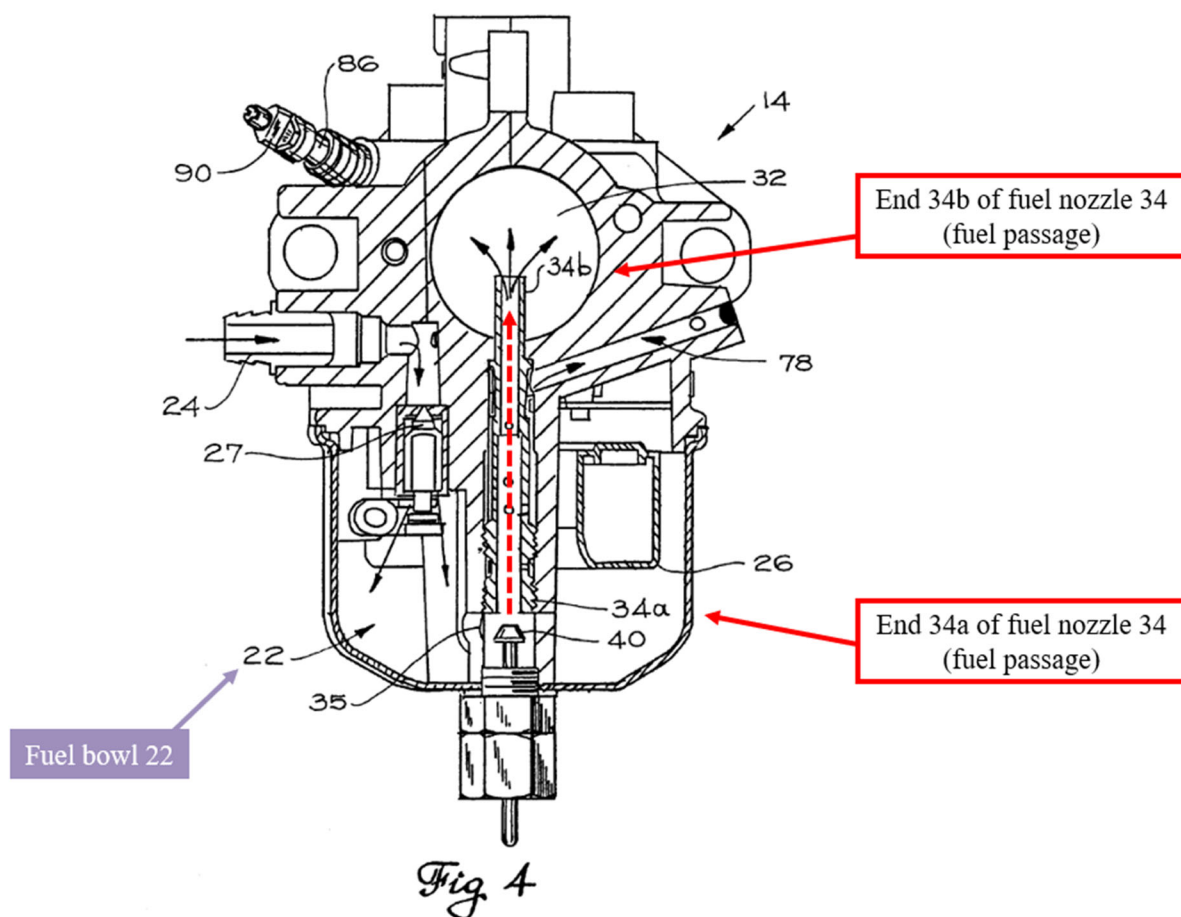


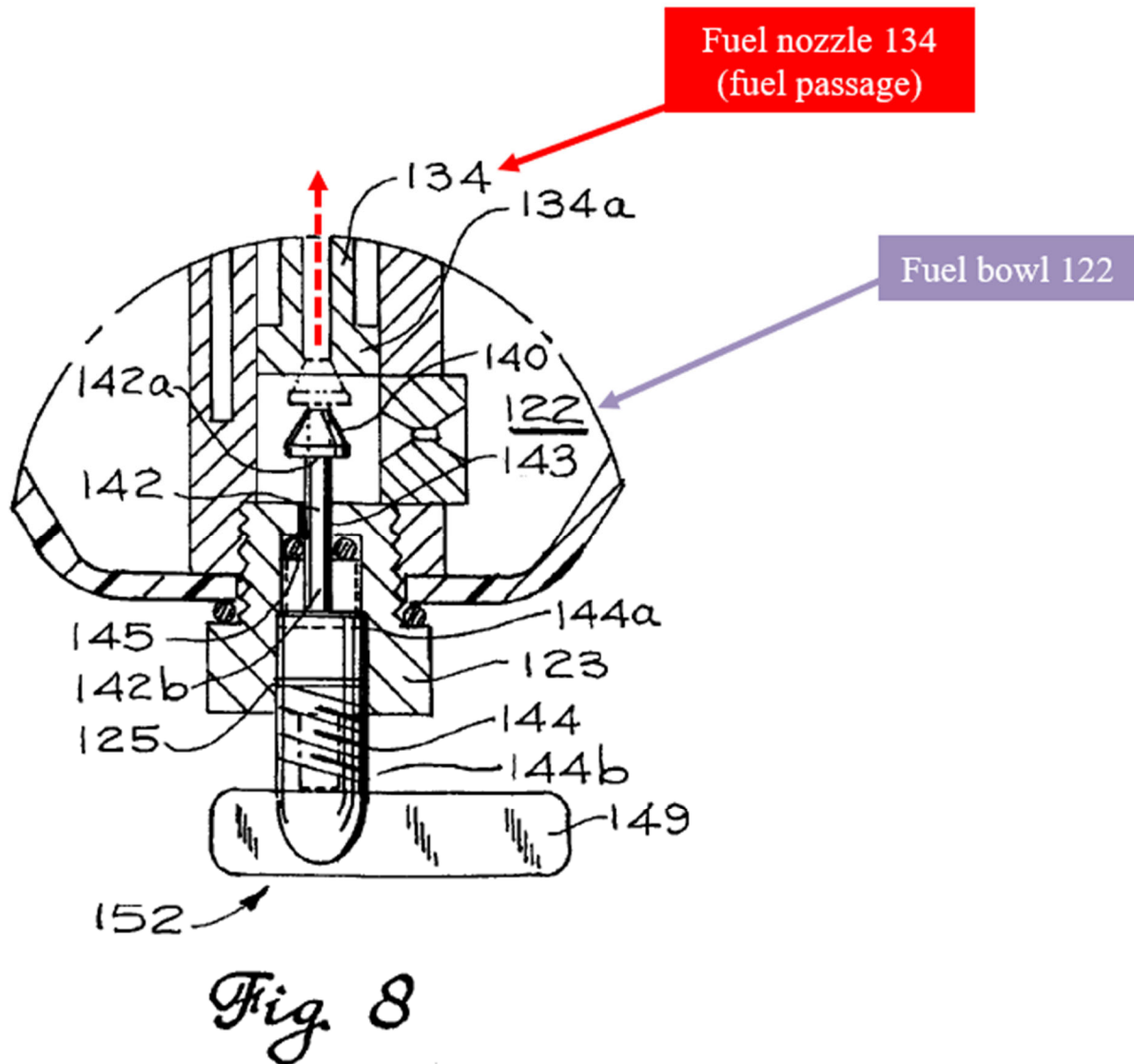
EX1032, Figs. 3-3A & 8, Abstract, 2:6-36, 3:61-4:33, 5:34-6:43, 7:31--8:52; Ex. 1003, ¶460.

***b. Element [43.1]***

Winberg discloses carburetor 14, which has a float bowl (fuel bowl 22/122) and throat 20. EX1032, Abstract, 2:25-29, 3:61-4:33, 7:65-8:52; Figs. 3A-5 & 8. The carburetor 14 has a fuel nozzle 34/134, which has a fuel passage extending from the float bowl to the throat. *Id.*, 4:12-33, 7:65-8:52, Figs. 3A-5 & 8.







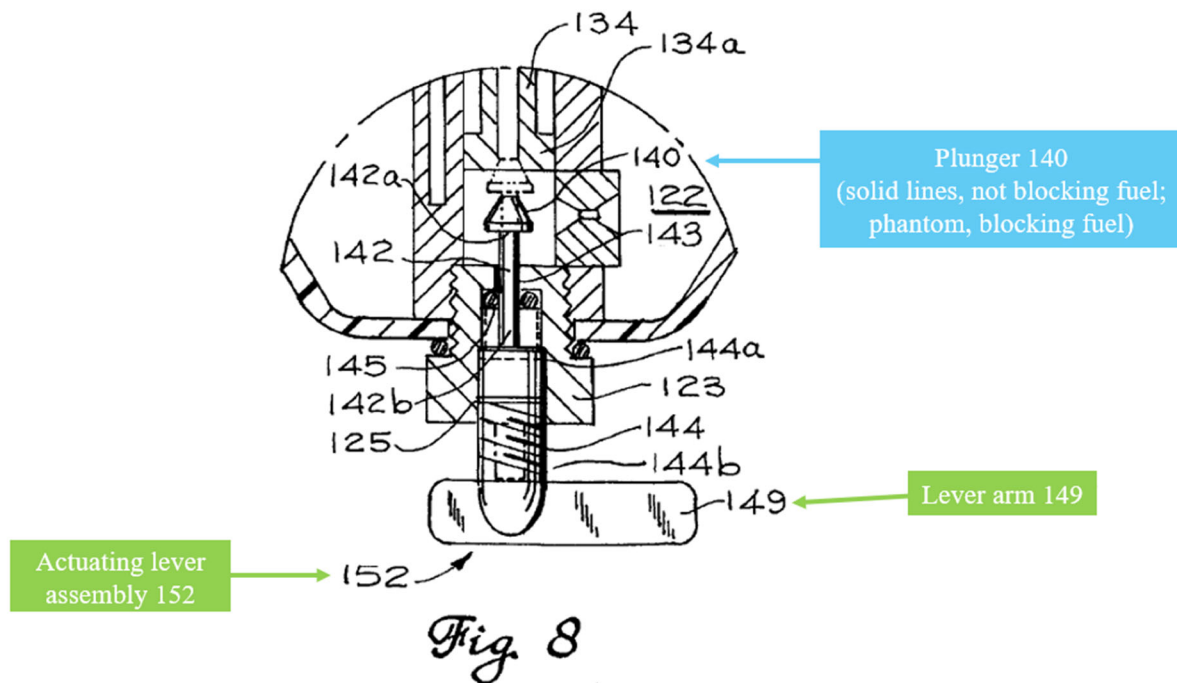
*Id.*, Figs. 3-3A, 4 & 8.

*c. Element [43.2]*

Winberg's fuel shutoff has a plunger 40/140, which is a first end in the carburetor that actuates to close the fuel passage within fuel nozzle 34/134.

EX1032, 5:34-46, 7:31-55, 7:65-8:52, Figs. 3-3A & 8.

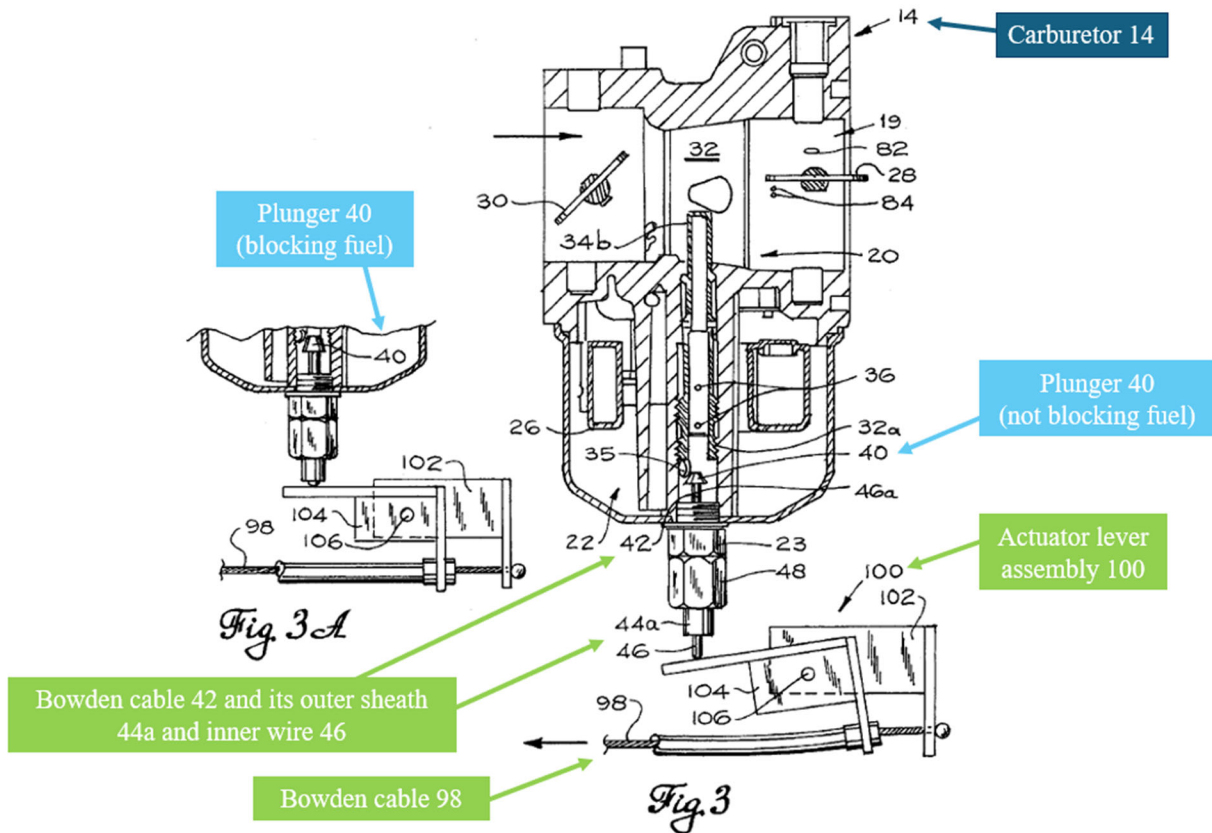
In the Figure 8 embodiment, Winberg's fuel shutoff has actuating lever assembly 152, which is a second end external to the carburetor to actuate the plunger (the first end). EX1032, 7:65-8:52, Fig. 8. Plunger 140 moves between a blocking position (shown in phantom in Figure 8) and a non-blocking position (shown in solid lines in Figure 8) by rotating actuating lever assembly 152 using lever arm 149:



EX1032, Fig. 8, 7:65-8:52; EX1003, ¶465.

In the Figure 3/3A embodiment, Winberg's fuel shutoff has actuator lever assembly 100, which is a second end external to the carburetor to actuate the plunger (the first end). EX1032, 7:31-55; EX1003, ¶466. The plunger moves

between a blocking position (Figure 3A) and a non-blocking position (Figures 3) using Bowden cables 42 and 98 interconnected with actuator lever assembly 100:



EX1032, Figs. 3-3A, 5:34-46, 7:31-55; EX1003, ¶466.

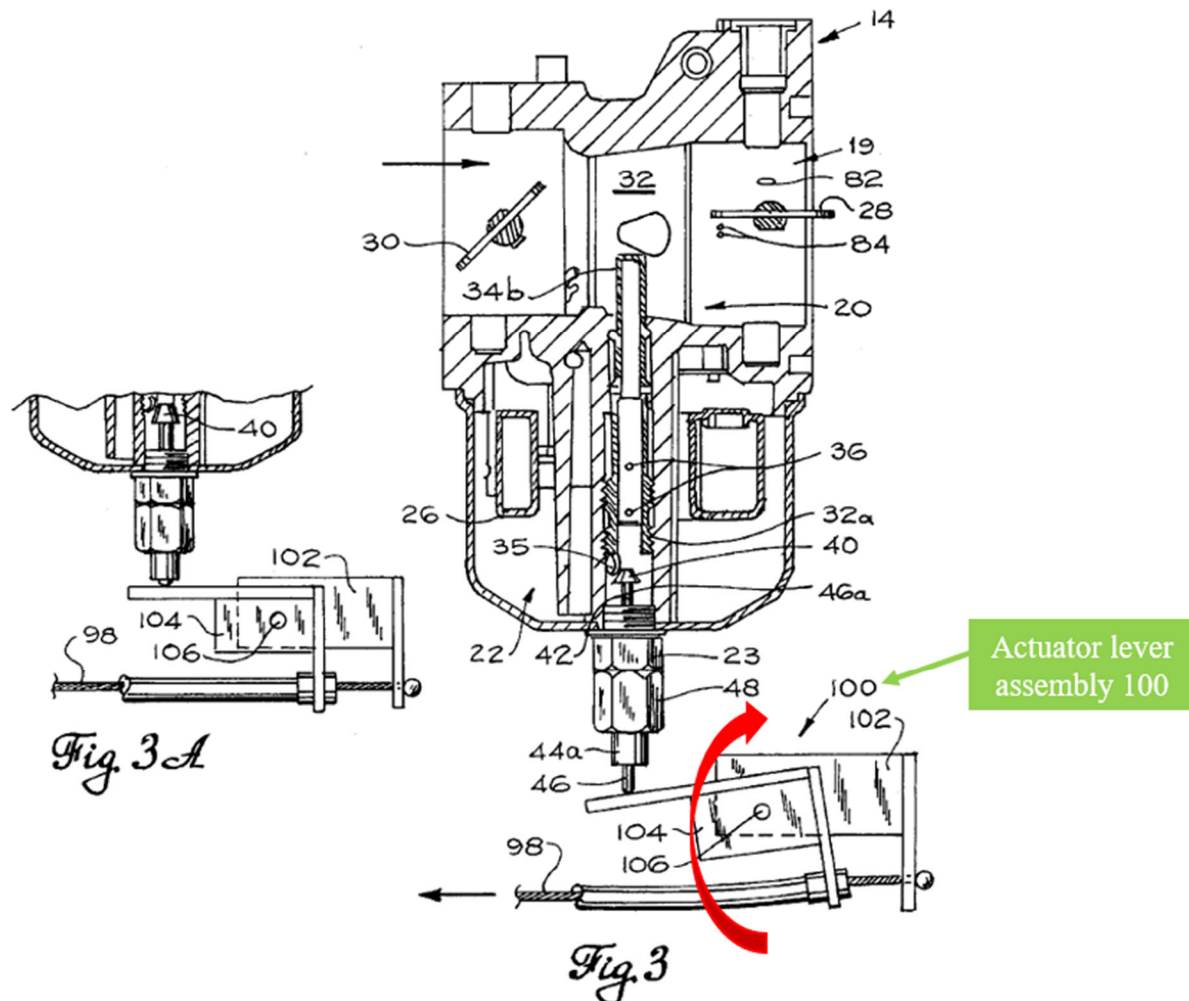
*d. Element [43.3]*

Winberg's fuel shutoff in the Figure 8 embodiment actuates free from linear motion by rotating actuating lever assembly 152. EX1032, 7:65-8:52, Fig. 8; EX1003, ¶468.

Based on Patent Owner's infringement contentions in litigation (EX1033, 9),<sup>5</sup> Winberg's fuel shutoff in Figures 3/3A actuates free from linear motion because movable member 104 of actuating lever assembly 100 rotates about pivot point 106 (EX1032, 7:42-56, Figs. 3-3A), thus the fuel shutoff actuates due to rotational motion. EX1003, ¶469.

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<sup>5</sup> In litigation, Patent Owner contends that a cable that actuates a pivot arm to move a gasoline needle valve in a blocking and non-blocking position in the float bowl is rotational and "free from linear motion" because the rotational motion of the cable and pivot arm causes the gasoline need valve to be "slightly angled." EX1033, 9.



EX1032, Figs. 3-3A.

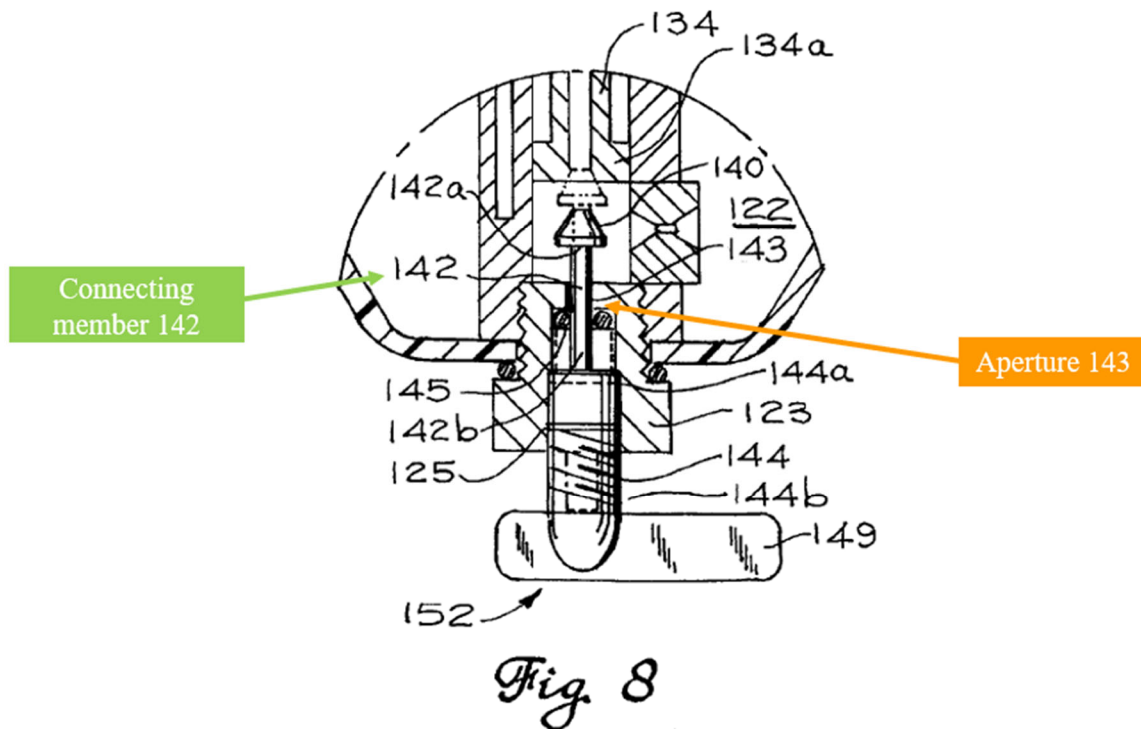
## 2. Claim 44

Winberg's fuel shutoff is manually actuated in the embodiments shown in Figures 8 and 3/3A. EX1032, Abstract, 2:14-24, 7:31-55, 7:65-8:52, Figs. 3-3A & 8; EX1003, ¶471.

## 3. Claim 45

In the Figure 8 embodiment, Winberg's fuel shutoff comprises a shaft (connecting member 142) attached to plunger 140 that extends through aperture

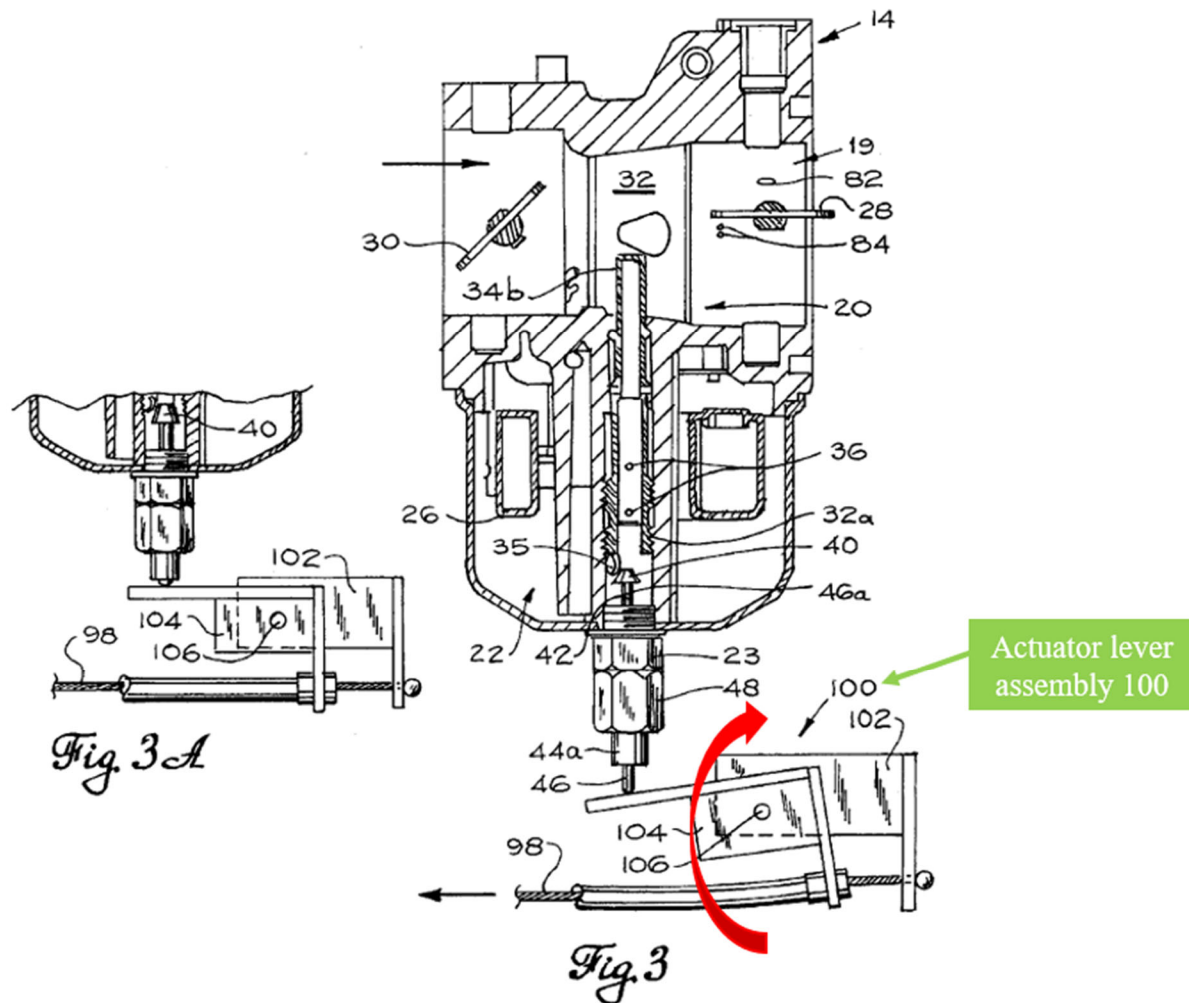
143 in the carburetor. EX1032, 7:65-8:52, Fig. 8; EX1003, ¶473. Winberg's valve tip (plunger 140) rotates to open and close the fuel passage. *Id.*



EX1032, Fig. 8, 7:65-8:52.

In the embodiment of Figures 3/3A, Winberg's fuel shutoff comprises a shaft attached to plunger 40 that extends through aperture 43 in the carburetor. EX1032, 5:53-6:17, 7:31-55, Figs. 3-3A & 6; EX1003, ¶474.

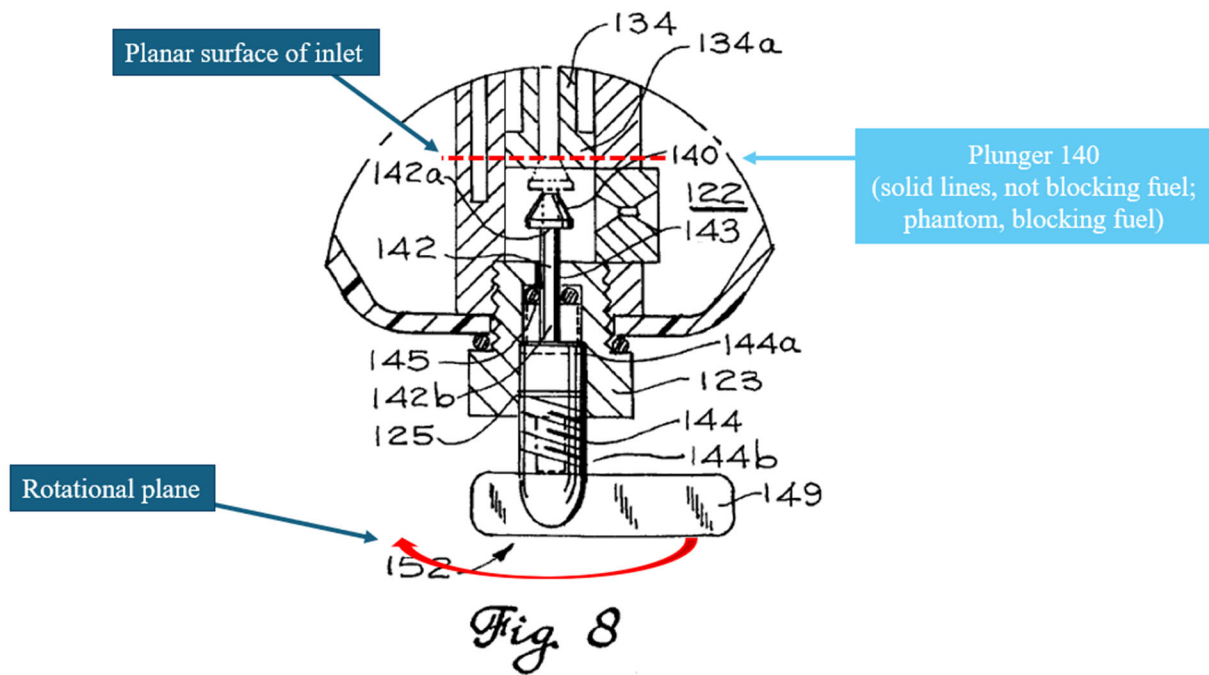
Based on Patent Owner's infringement contentions in litigation (EX1033, 9), Winberg's valve tip (plunger 40) opens and closes the fuel passage because the movable member 104 of the actuator lever assembly 100 rotates about pivot point 106:



EX1032, Figs. 3-3A, 7:42-56; EX1003, ¶475.

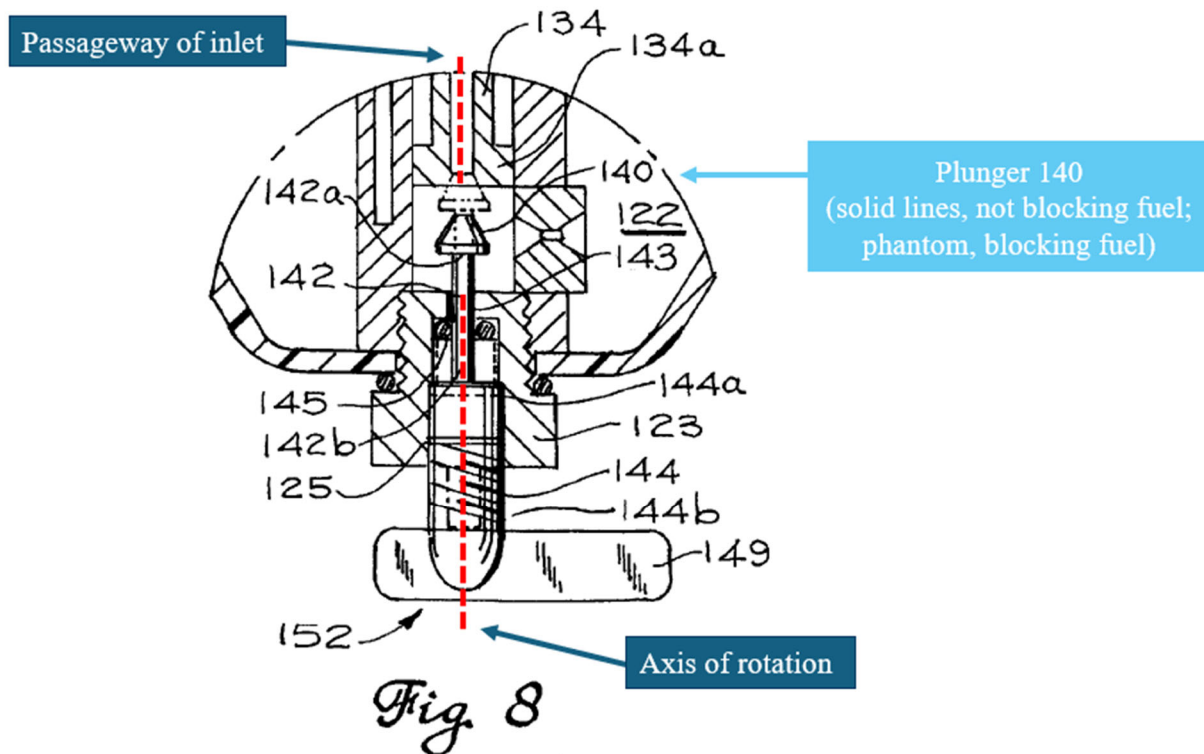
#### 4. Claim 46

In the Figure 8 embodiment, Winberg's valve tip (plunger 140) has a rotational plane that is parallel to the planar surface through which the inlet of the fuel passage penetrates:



EX1032, Fig. 8, 7:65-8:52; EX1003, ¶480.

Winberg's valve tip (plunger 140) also has an axis of rotation that is parallel to the passageway of the inlet:



EX1032, Fig. 8, 7:65-8:52; EX1003, ¶481.

Winberg's plunger 140 rotates between a position permitting fuel flow into the inlet of the fuel passage (first position) and a second position blocking fuel flow into the inlet of the passage. EX1032, Fig. 8, 7:65-8:52; EX1003, ¶482.

## 5. Claim 53

Winberg discloses that the valve tip (plunger 40) is "preferably made of material such as a metal, plastic or rubber that is insoluble in and impervious to fuel." EX1032, 5:44-46.

It would have been obvious to a POSA to use a thermoplastic valve tip. EX1003, ¶485. A POSA would have been motivated to use a thermoplastic

material because such materials were well known to not degrade when used with corrosive fluids, such as fuel. *Id.* A POSA would have had a reasonable expectation of success because thermoplastic plungers were already widely used in fuel applications at the time of the invention. *Id.*

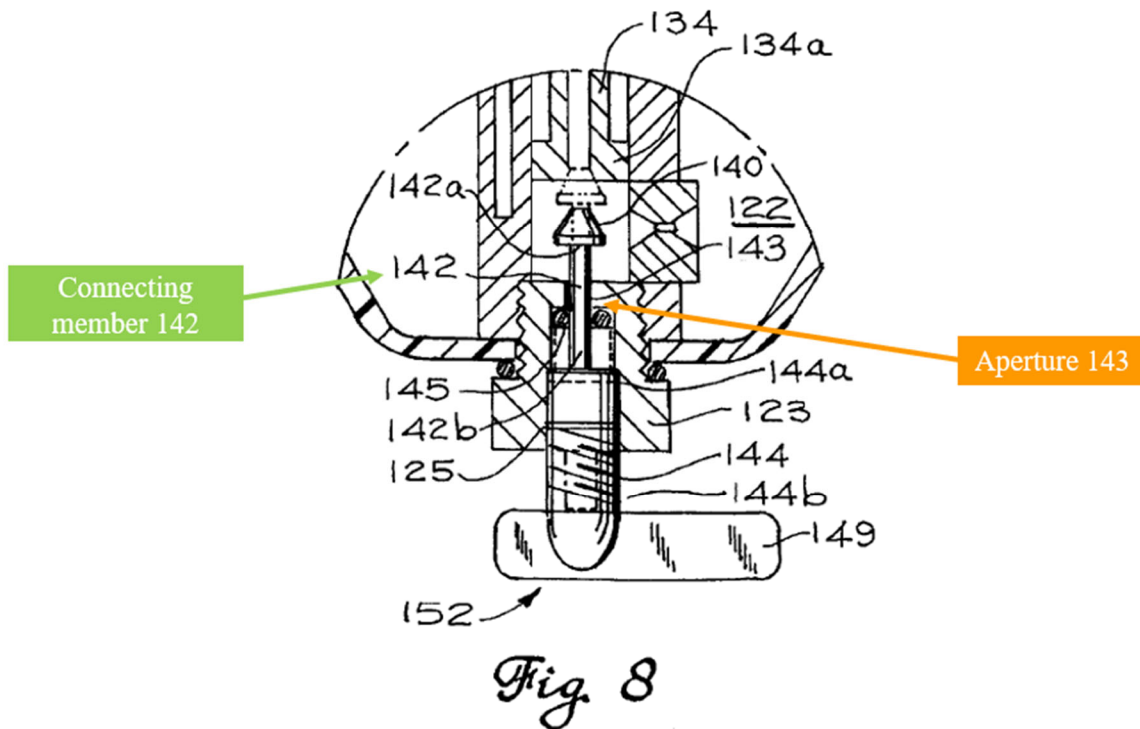
#### **6. Claim 54**

Winberg discloses plunger 40 with a cone shape, but also discloses the plunger “may have a different shape (eg. a plate or sphere).” EX1032, 5:42-52.

It would have been obvious to a POSA to use an oval or stadium shape, which are substantially similar to a sphere. EX1003, ¶488. A POSA would have been motivated to use an oval or stadium shape to make the sides of the plunger less round, thus increasing the surface area of contact with the fuel nozzle 34/134. *Id.* A POSA would have had a reasonable expectation of success because an oval or stadium shape would work at least as well as the cone and sphere shapes disclosed by Winberg given there is no substantial difference in their shapes. *Id.*

#### **7. Claim 56**

In the Figure 8 embodiment, Winberg’s fuel shutoff includes connecting member 142, which extends through an opening in the float bowl (aperture 143) and plunger 140, which actuates in the float bowl to close the fuel passage through fuel nozzle 134:



EX1032, Fig. 8, 7:65-8:52; EX1003, ¶490.

In the Figures 3/3A embodiment, Winberg's fuel shutoff includes a Bowden cable 42, which extends through an opening in the float bowl (aperture 43) and plunger 40, which actuates in the float bowl to close the fuel passage through fuel nozzle 34. EX1032, 5:34-6:6, Figs. 3-3A & 6; EX1003, ¶491.

**H. Ground 8: Claims 17 and 23-26 are obvious over Holzapfel in view of Winberg and Yamamoto**

Claims 17 and 23-26 of the '398 Patent are obvious under §103, as detailed below and in the declaration of Dr. Morse. EX1003, ¶¶492-535.

## 1. Claim 17

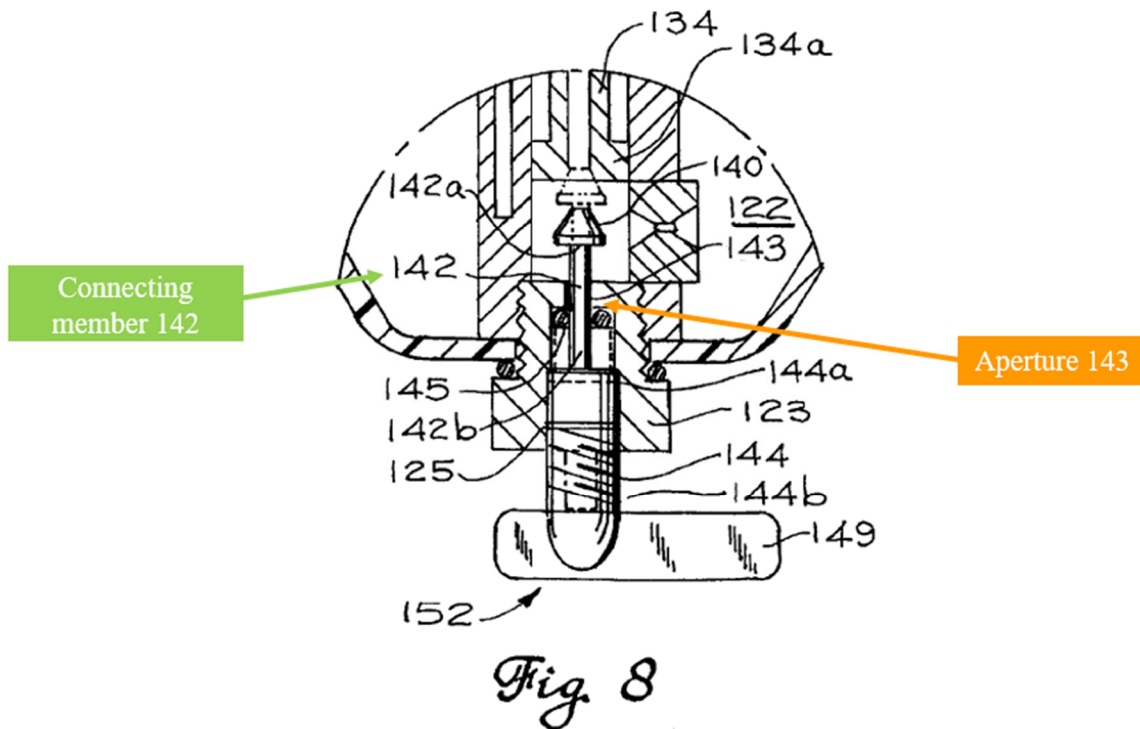
Holzapfel discloses the elements of claim 1. *Supra*, §VII.E.1.

*a. Element [17.1]*

Holzapfel's liquid fuel cut-off comprises rotary valve 14, lever 45, and rod/wire 47. *Supra* §§VII.E.1.g, VII.E.4.c. A POSA would have understood that lever 45 has a rotating shaft that extends through an opening in the carburetor to open and close rotary valve 14, as shown for lever 46 in Figure 3. EX1009, Figures 1 & 3, 2:100-123. Alternatively, this would have been obvious based on the teachings of Holzapfel's Figure 3. EX1003, ¶495.

Alternatively, rather than utilize Holzapfel's float bowl and rotary valve 14 as the liquid fuel cut-off, it would have been obvious to use Winberg's float bowl and liquid fuel cut-off. EX1003, ¶496; EX1032, Abstract, 2:6-36, 3:61-4:32, 7:65-8:52, Fig. 8.

In the Figure 8 embodiment, Winberg discloses a rotating shaft (connecting member 142) that extends through aperture 143 in the carburetor:



EX1032, Fig. 8, 7:65-8:52, EX1003, ¶497.

*i. Motivation/Expectation of Success*

A POSA would have been motivated to use Winberg's float bowl and fuel cutoff rather than Holzapfel's float bowl and rotary valve 14 because the design of Winberg's float bowl and fuel cutoff is more compact and thus better for small engines, such as engines with generators (an obvious application discussed below, §VII.H.2.a). EX1003, ¶498.

In addition, a POSA would have been motivated to use Winberg's float bowl and fuel shutoff to permit easy and quick replacement of plunger 140, which can be easily accessed and removed by unscrewing it from the bottom of the float

bowl. EX1003, ¶499. This motivation would have been particularly important for a generator, to allow an unsophisticated user to replace the valve at minimal expense. *Id.*

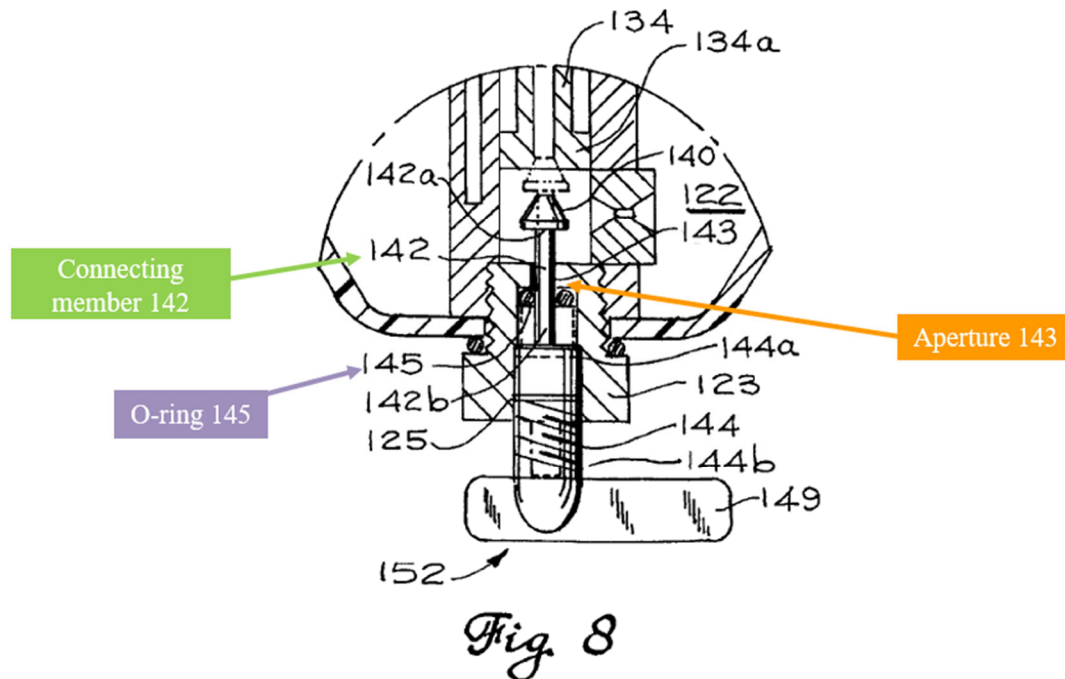
In addition, a POSA would have been motivated to use Winberg's float bowl and fuel cutoff to minimize any gasoline leaks caused by a defective plunger 140 or if the user forgets to close the shutoff valve, particularly for a portable generator that is transported to different locations between uses. *Id.*, ¶500. Because Winberg's fuel nozzle 134 is vertical, any leaks caused by a defective plunger 140 would be minimal compared with Holzapfel's configuration, which has a horizontal fuel passage 13. *Id.*

A POSA would have had a reasonable expectation of success because Winberg's float bowl configuration was common for use with small engines (e.g., Olmr and Neal) and given Winberg's disclosure of using its float bowl and fuel shutoff in generators. *Id.*, ¶501.

***b. Element [17.2]***

It is inherent that the shaft attached to Holzapfel's lever 45 is surrounded by a seal to seal the aperture, otherwise Holzapfel's carburetor would leak. EX1003, ¶503. Alternatively, this would have been obvious given that Holzapfel's lever 45 must have a shaft that extends into the carburetor. *Id.*

Alternatively, Winberg discloses a fuel seal (such as O-ring 145) around the shaft (connecting member 142) to seal the aperture:

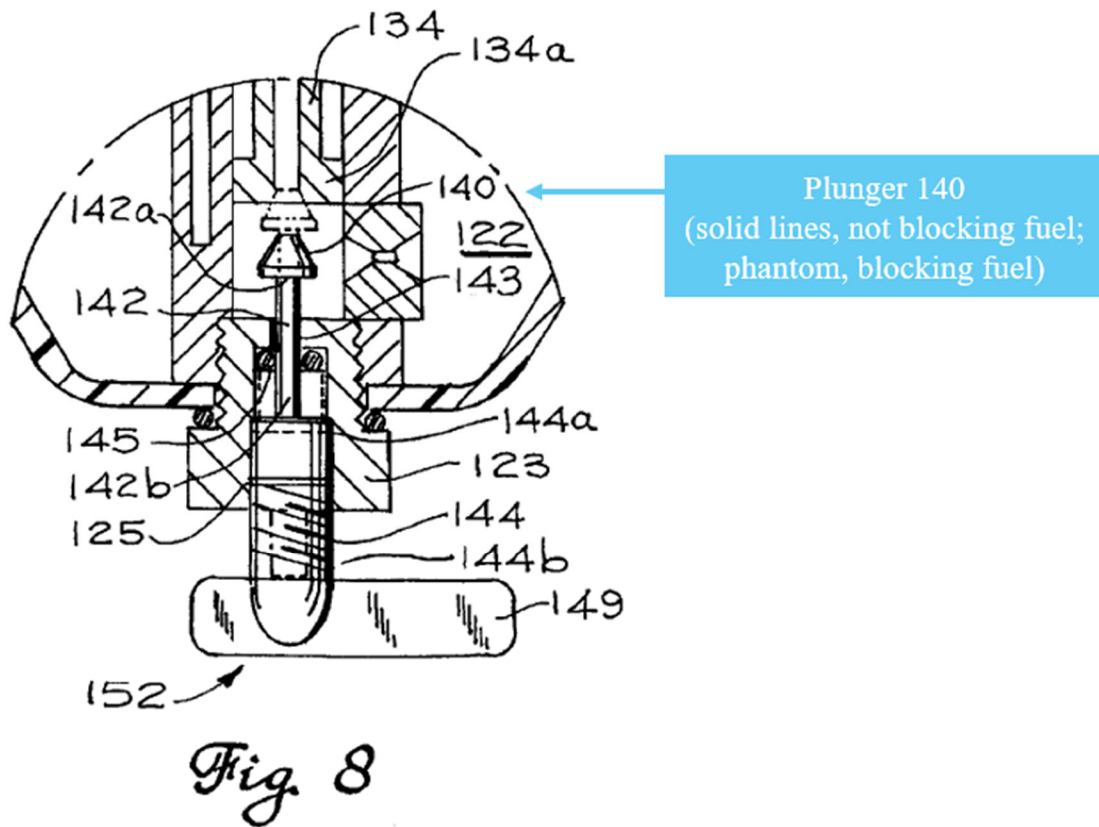


EX1032, Fig. 8, 8:25-29.

*c. Element [17.3]*

Holzappel's rotary valve 14 includes a blocking member coupled to the shaft that rotates between a blocking and a non-blocking position to selectively block the flow of gasoline in fuel passage 13 to the engine. EX1009, Figure 2, 1:100-106, 2:108-123; EX1003, ¶506.

Alternatively, Winberg discloses a blocking member (plunger 140) coupled to the shaft to selectively block a liquid fuel path to the engine:



EX1031, Fig. 8, 7:65-8:52; EX1003, ¶507. Plunger 140 rotates with connecting member 142 between a blocking and a non-blocking position. EX1031, Fig. 8, 7:65-8:52; EX1003, ¶508.

## 2. Claim 23

*a. Element [23.0]*

Holzapfel discloses a dual fuel engine. EX1009, 1:1-5. Yamamoto discloses a batteryless generator. EX1030, Abstract, 2:58-3:13, 5:22-45.

It would have been obvious to a POSA to replace Yamamoto's carburetor with Holzapfel's carburetor to make a dual-fuel generator. EX1003, ¶¶511-513.

A POSA would have found it obvious to incorporate Holzapfel's carburetor and fuel supply system into Yamamoto's generator. *Id.*, ¶511.

***i. Motivation/Expectation of Success***

A POSA would have been motivated to use Holzapfel's carburetor with Yamamoto's engine and generator to provide the user with the option of alternatively using gasoline or LPG to generate electricity. EX1003, ¶512.

Multi-fuel engines 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.*, ¶513. 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 Holzapfel's carburetor for use with Yamamoto's carburetor would have involved nothing more than a simple substitution, whereby Holzapfel's fuel-delivery system and carburetor are used in place of the Yamamoto's carburetor. *Id.*

***b. Element [23.1]***

Yamamoto discloses a generator with a housing and a pull-start engine:

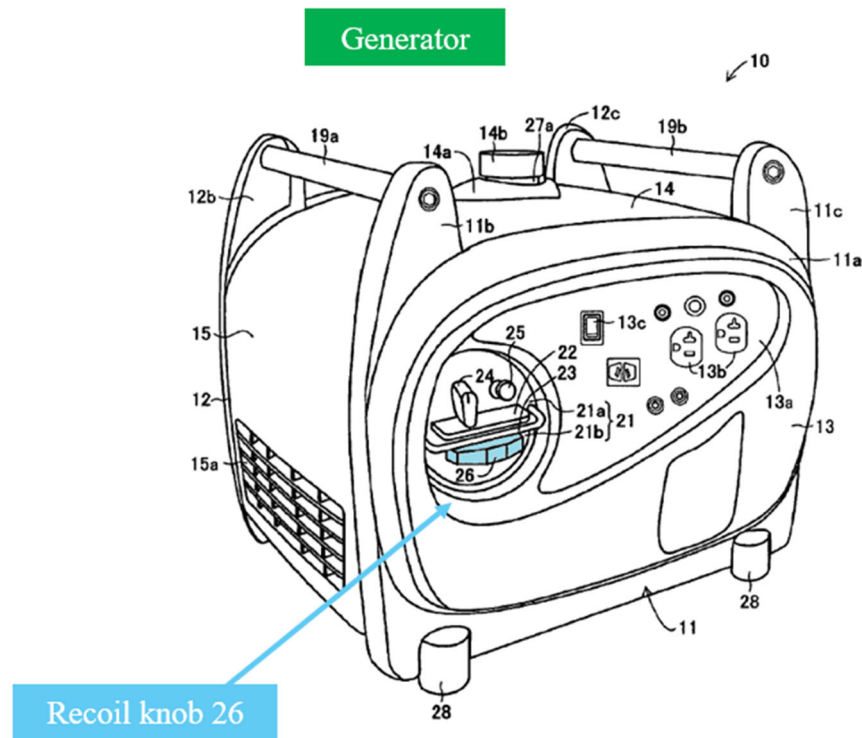


Figure 1

Ex. 1030, Fig. 1, 2:58-3:13, 5:22-45.

Yamamoto discloses that generator 32 generates power as rotor shaft 46 rotates. EX1030, 5:54-58, Fig. 10. Rotor shaft 46 is fitted with a generally cylindrical rotor 47 with an inner peripheral face that is fitted with a plurality of magnets 47a. *Id.*, 5:59-67, Fig. 10. A stationary stator 48 having a core wound with coil 48a sits inside the magnet ring, and as the magnets rotate, an electromotive force is produced in the coil 48a to generate current. *Id.* Accordingly, the device described is an alternator. EX1003, ¶516.

Holzapfel's incorporated carburetor is operable on gaseous and liquid fuel. EX1009, 1:1-5.

***c. Element [23.2]***

Holzapfel's carburetor would be attached to Yamamoto's intake in the same way shown in Figure 1 of Holzapfel. EX1005, Fig. 1, EX1003, ¶519.

Holzapfel's carburetor comprises a float bowl, a throat, and a fuel passage extending from the float bowl to the throat. *Supra* §VII.E.4.b. The fuel passage of Holzapfel's engine provides liquid fuel, and the throat mixes fuel with air. *Supra* §VII.E.1.d.

***d. Element [23.3]***

Holzapfel's fuel shutoff (which includes rotary valve 14) is attached to its carburetor 5 to close the fuel passage 13 upon selection of engine operation to gaseous fuel. *Supra* §§VII.E.1.g, VII.E.4.c.

Alternatively, Winberg's fuel shutoff discloses this element when combined with Holzapfel. *Supra* §VII.H.1.c.

**3. Claim 24**

Holzapfel discloses this element. *Supra* §VII.E.3.

Alternatively, Winberg discloses this element. *Supra* §VII.G.1.d.

**4. Claim 25**

***a. Element [25.1]***

Holzapfel discloses this element. *Supra* §VII.H.1.a.

Alternatively, Winberg discloses this element. *Id.*

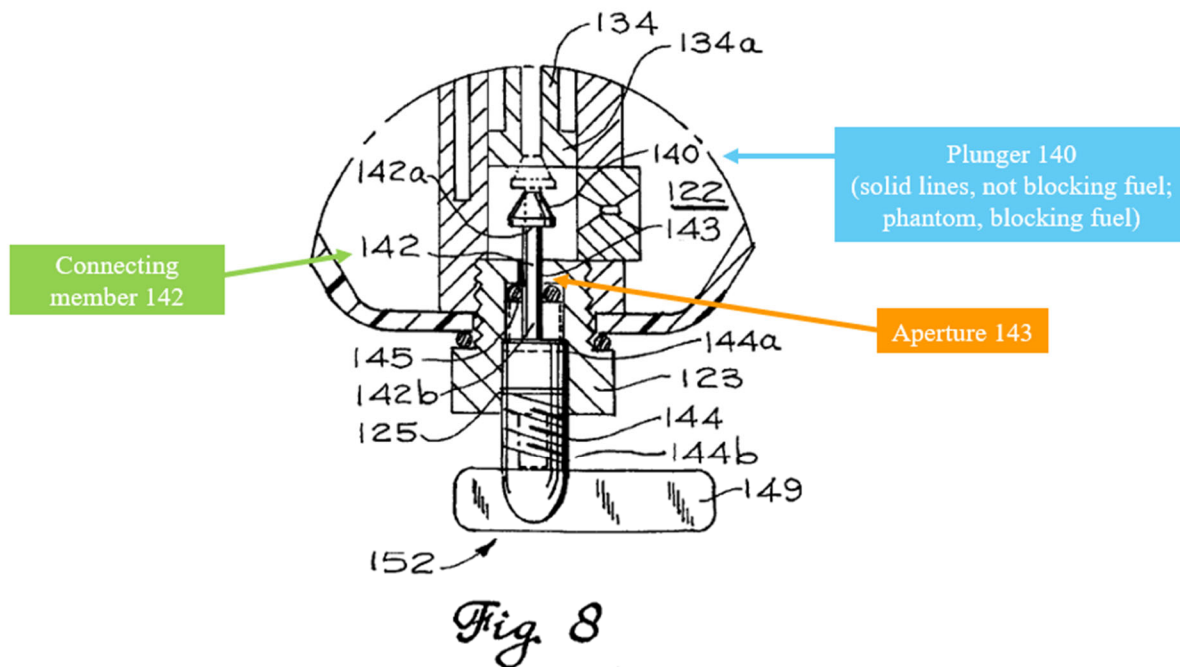
***b. Element [25.2]***

Holzapfel discloses this element. *Supra* §VII.H.1.c.

Alternatively, Winberg discloses this element. *Id.*

## 5. Claim 26

Winberg's plunger 140 is positioned in the float bowl and the shaft (connecting member 142) extends through the opening (aperture 143) of the float bowl:



EX1032, Figs. 8, 7:65-8:52. It would have been obvious to use a shaft that extends substantially horizontally. EX1003, ¶535.

**I. Ground 9: Claims 17 and 23-26 are obvious over Holzapfel in view of Neal and Yamamoto**

Claims 17 and 23-26 of the '398 Patent are obvious under §103, as detailed below and in the declaration of Dr. Morse. EX1003, ¶¶536-573.

**1. Claim 17**

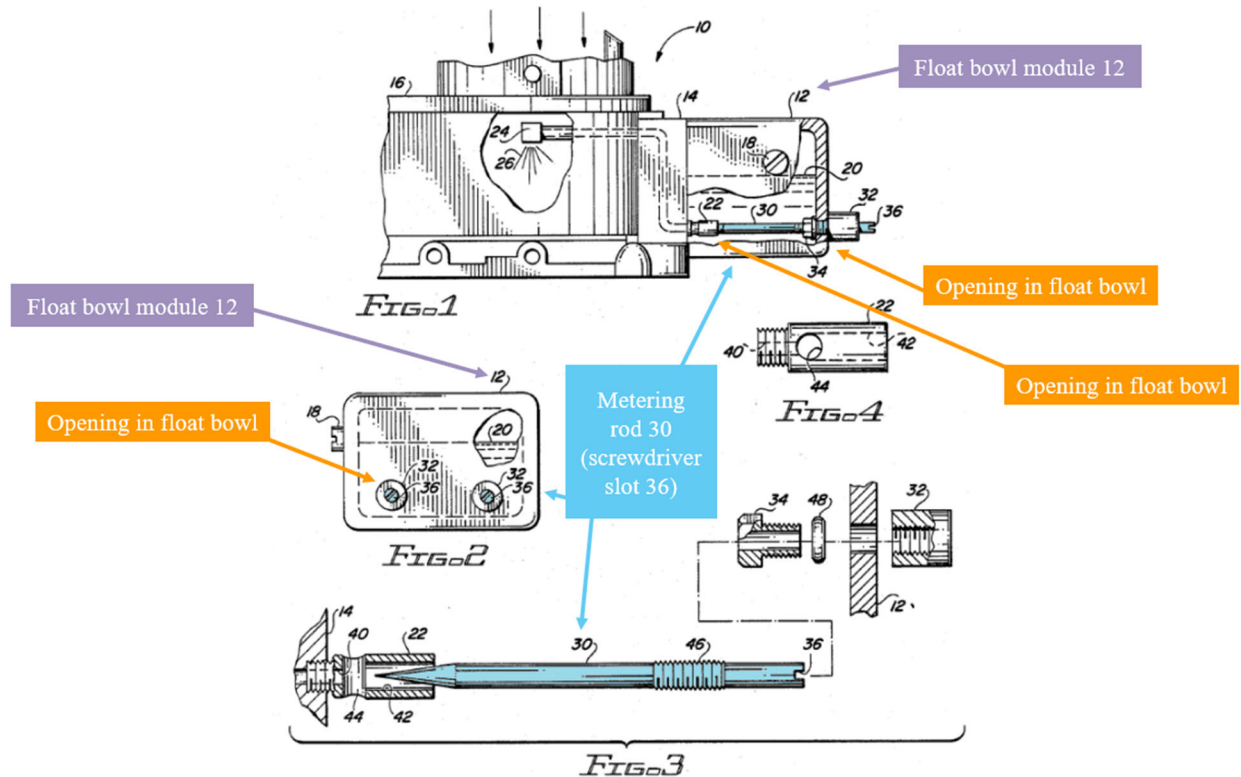
Holzapfel discloses the elements of claim 1. *Supra*, §VII.E.1.

**a. Element [17.1]**

Holzapfel discloses this element or renders it obvious. *Supra* §VII.H.1.a.

Alternatively, rather than utilize Holzapfel's rotary valve 14 as the fuel shutoff, it would have been obvious to use a rotating shaft within Holzapfel's float bowl, such as the metering rod 30 disclosed by Neal. EX1003, ¶541; EX1031, 4:25-51, 6:15-42, Figs. 1-3. Neal's metering rod 30 is a liquid fuel cut-off because it interrupts gasoline flow from the float bowl to the engine. EX1031, 6:15-42; EX1003, ¶541. Although Neal's metering rod 30 can be adjusted (using a screwdriver) to any number of positions, it would have been obvious to configure the control to be a knob or lever that switches between only two positions (open and closed), similar to the Holzapfel lever 45 to ensure the appropriate amount of gasoline flow based on the engine's specifications, as determined by the manufacturer. EX1003, ¶541.

Neal discloses a rotating shaft (metering rod 30) that extends through an aperture in the carburetor:



EX1031, Figs. 1-4, 4:25-51, 6:15-42; EX1003, ¶542.

*i. Motivation/Expectation of Success*

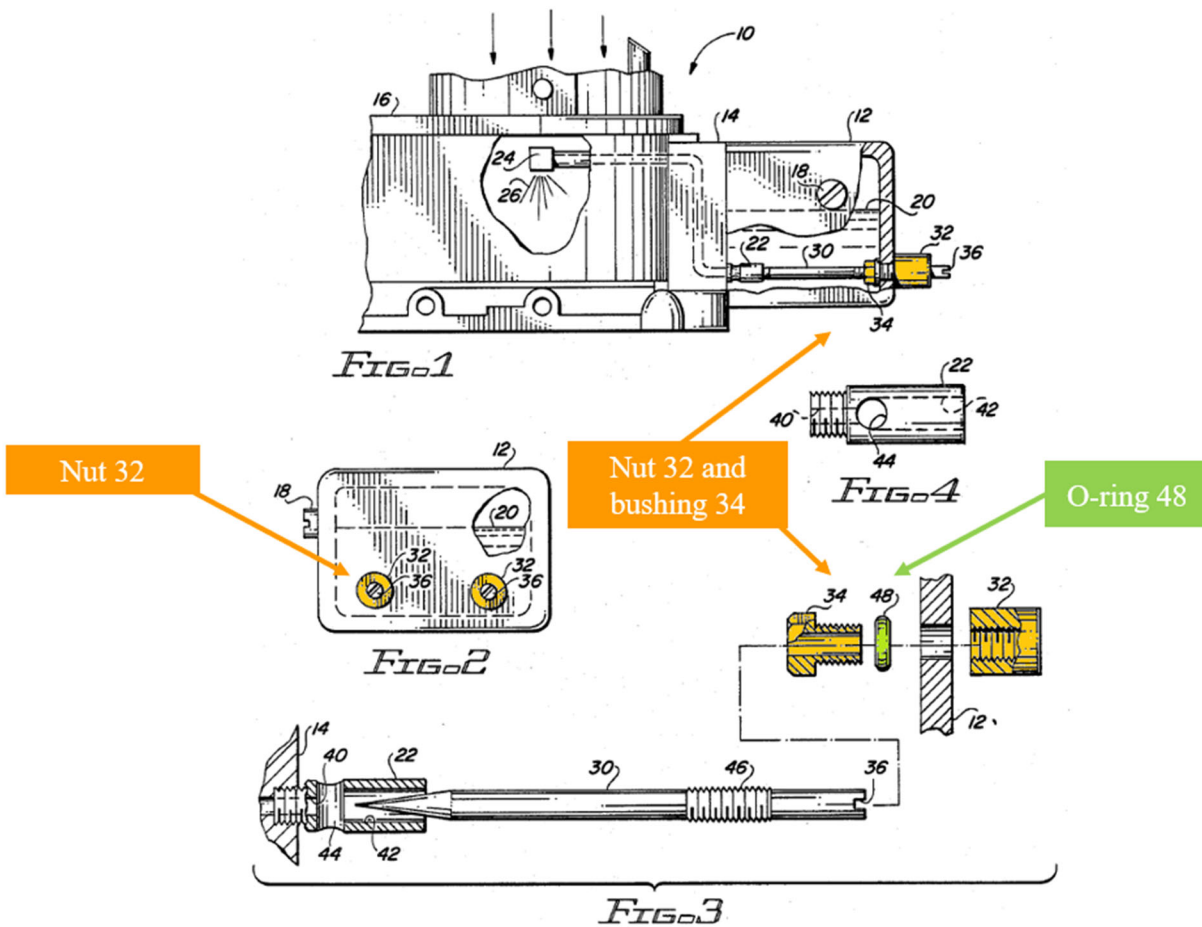
A POSA would have been motivated to use Neal’s metering rod 30 rather than Holzapfel’s rotary valve 14 for the reasons explained by Neal: to permit easy and quick replacement of the valve. EX1003, ¶543; EX1031, 1:55-2:49. Although Neal describes this motivation in the context of racing conditions that change on short notice, the same motivation existed in other contexts. EX1003, ¶543. For example, in the context of generators (an obvious application discussed below, §VII.I.2.a), a POSA would have been motivated to use a simple valve that can easily be replaced by an unsophisticated end user if the valve leaked or was otherwise inoperable. EX1003, ¶543.

A POSA would have had a reasonable expectation of success in using Neal's metering rod as a fuel shutoff because use of similar valves was well known and shown to have success at the time of the invention, as taught by Neal and Winberg. EX1003, ¶544; EX1031, 4:25-51, 6:15-42, Figs. 1-3.

**b. Element [17.2]**

Holzapfel discloses this element or renders it obvious. *Supra* §VII.H.1.b.

Alternatively, Neal discloses a fuel seal (comprising nut 32, bushing 34, and O-ring 48) around the shaft (metering rod 30) to seal the aperture:

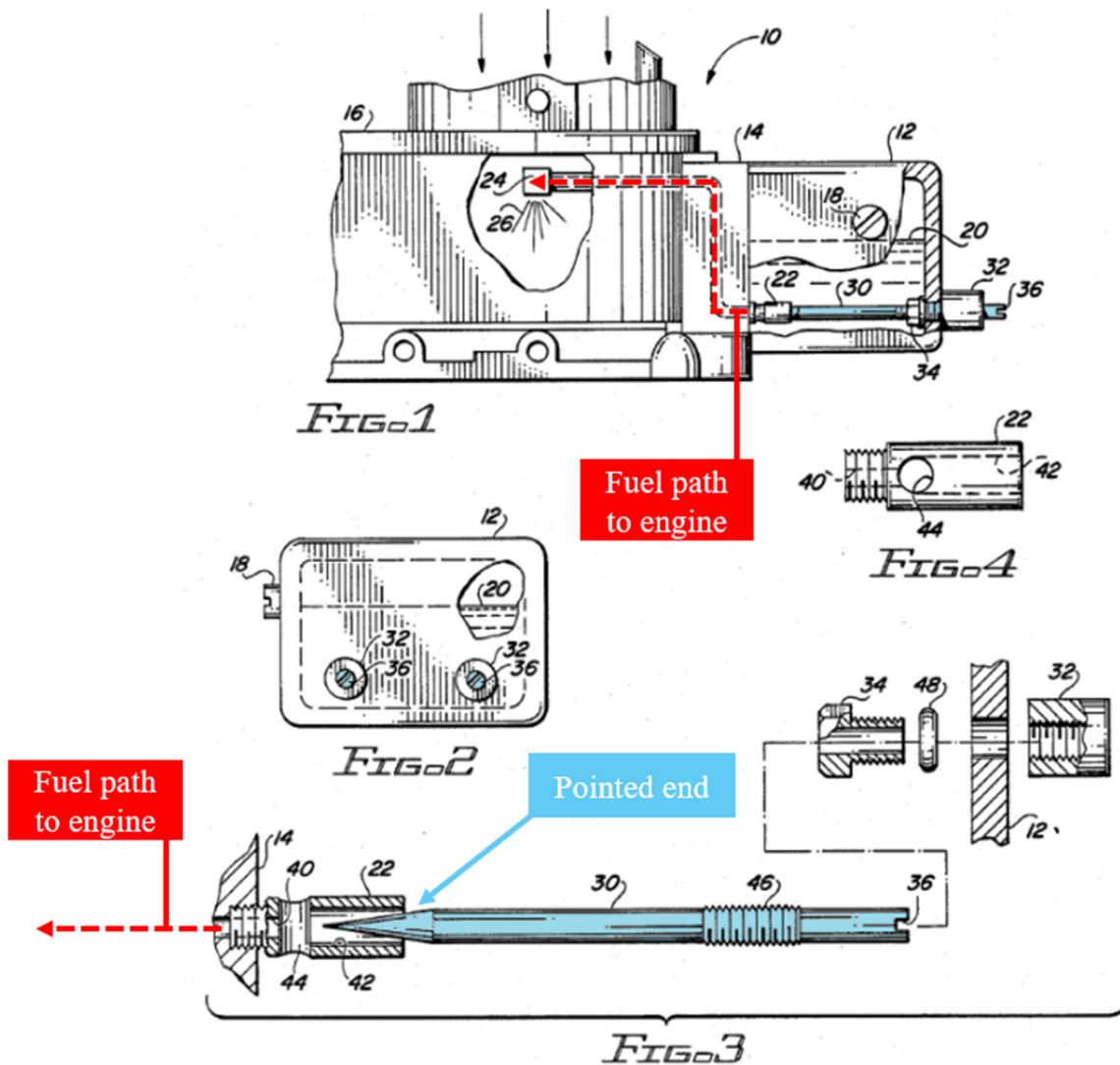


EX1031, Fig. 1-3, 4:25-51, 5:46-6:2; EX1003, ¶547.

*c. Element [17.3]*

Holzapfel discloses this element. *Supra* §VII.H.1.c.

Alternatively, Neal discloses a blocking member (pointed end of metering rod 30) coupled to the shaft to selectively block a liquid fuel path to the engine:



EX1031, Figs. 3, 5, 4:25-51, 5:10-34, 6:15-42; EX1003, ¶550. The pointed end rotates with the metering rod 30 between a blocking and a non-blocking position.

EX1031, 6:15-42; EX1003, ¶551.

**2. Claim 23**

***a. Element [23.0]***

The Holzapfel-Yamamoto combination discloses this element. *Supra* §VII.H.2.a.

***b. Element [23.1]***

The Holzapfel-Yamamoto combination discloses this element. *Supra* §VII.H.2.b.

***c. Element [23.2]***

The Holzapfel-Yamamoto combination discloses this element. *Supra* §VII.H.2.c.

***d. Element [23.3]***

The Holzapfel-Yamamoto combination discloses this element or, alternatively, discloses this element in further combination with Neal. *Supra* §§VII.H.1.c, VII.I.1.c.

**3. Claim 24**

The Holzapfel-Yamamoto combination discloses the elements of this claim or alternatively, discloses the elements of this claim in further view of Neal. *Supra* §§VII.H.3, VII.F.1.d.

**4. Claim 25**

***a. Element [25.1]***

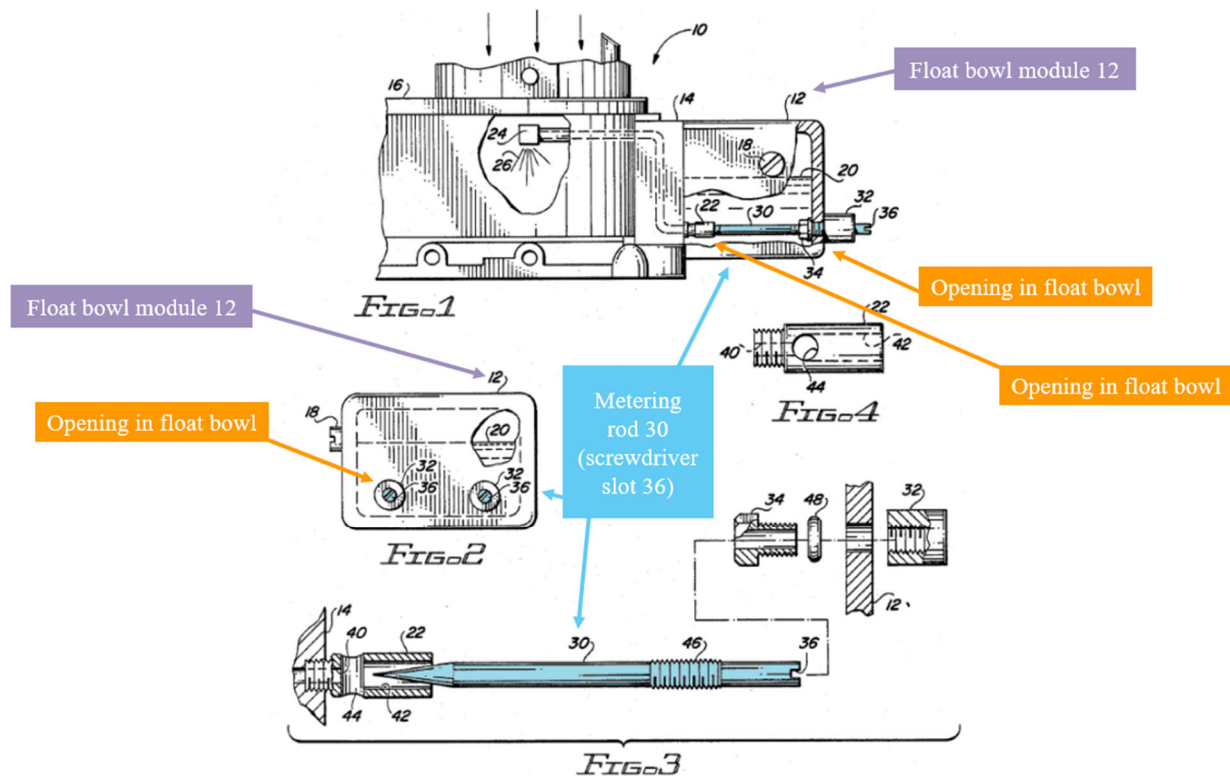
The Holzapfel-Yamamoto combination discloses this element or alternatively, discloses this element in further view of Neal. *Supra* §§VII.H.1.a, VII.H.4.a, VII.I.1.a.

***b. Element [25.2]***

The Holzapfel-Yamamoto combination discloses this element or alternatively, discloses this element in further view of Neal. *Supra* §§VII.H.1.c, VII.H.4.b, VII.I.1.c.

**5. Claim 26**

Neal's metering rod 30 is positioned in the float bowl and the shaft (the rod) extends substantially horizontal through the opening of the float bowl:



EX1031, Figs. 1-4; EX1003, ¶573.

## 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 '398 Patent is or has been involved in several pending litigations.

Patent owner has asserted the '398 Patent and related 10,221,780 ('780 Patent), 10,393,034 ('034 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,

U.S. Patent No. 10,697,398

in *Champion Power Equipment Inc. v. Firman Power Equipment Inc.*, 23-cv-02371-DWL (D. Ariz.).

Patent Owner has asserted the '398 Patent and related '780 Patent, '120 Patent, '145 Patent, '985 Patent, '654 Patent, '970 Patent, and '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 '398 Patent and related '654 Patent, '985 Patent, '780 Patent, '034 Patent, '120 Patent, '145 Patent, '970 Patent, and '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 has asserted the '398 Patent and related '780 Patent, '034 Patent, '120 Patent, '145 Patent, '985 Patent, '654 Patent, '970 Patent, and '895 Patent, as well as other non-family member patents 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.

Patent Owner has asserted the '398 Patent and related '780 Patent, '034 Patent, '120 Patent, '145 Patent, '985 Patent, and '895 Patent, as well as other non-family member patents, in *Champion Power Equipment Inc. v. Westinghouse Elec.*

*Corp. et al.* in the United States District Court of Nevada, Civil Action No. 3:25-cv-00239-ART-CLB.

**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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|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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

[HarborFreight-Champion-IPRs@foley.com](mailto:HarborFreight-Champion-IPRs@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. 10,697,398

Date: September 3, 2025

Respectfully submitted,

By: /Kimberly K. Dodd/

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*Lead Counsel for Co-Petitioners*

**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 13,939 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: September 3, 2025

By: /Kimberly K. Dodd/

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## **CERTIFICATE OF SERVICE**

The undersigned hereby certifies that on September 3, 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 53074

Courtesy copies of the same documents were served electronically on Patent Owner's litigation counsel and IPR counsel in related IPRs by email at the following addresses:

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