IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

_____

BEFORE THE PATENT TRIAL AND APPEAL BOARD

_____

HARBOR FREIGHT TOOLS USA, INC.,

GENERAC POWER SYSTEMS, INC., and

MWE INVESTMENTS, LLC,

Petitioners

v.

CHAMPION POWER EQUIPMENT, INC.,

Patent Owner.

_____

Patent No. 10,697,398

Issued: Jun. 30, 2020

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

_____

Inter Partes Review No. IPR2025-01271

_____

DECLARATION OF TIMOTHY L. MORSE, Ph.D., P.E.

TABLE OF CONTENTS

TABLE OF CONTENTS 2
I. INTRODUCTION 8
II. QUALIFICATIONS AND EXPERIENCE 9
III. MATERIALS AND OTHER INFORMATION CONSIDERED 12
IV. SUMMARY OF OPINIONS 14
V. UNDERSTANDING OF PATENT LAW 16
A. Claim Construction 16
B. Obviousness 16
C. Anticipation 19
VI. THE PERSON OF ORDINARY SKILL IN THE ART 20
VII. STATE OF THE ART 22
A. Carburetors 22
B. Multi-Fuel Combustion Engines 23
VIII. SUMMARY OF THE ’398 PATENT 24
A. The ’398 Patent 24
B. Prosecution History 27
IX. LEVEL OF ORDINARY SKILL IN THE ART 29
X. CLAIM CONSTRUCTION 29
XI. OVERVIEW OF THE ASSERTED PRIOR ART 30
A. JPS61283734A (“Nakafushi”) 30
B. U.S. Patent No. 5,301,644 (“Olmr”) 33

C. Kubota DF972-E2 Workshop Manual ("Workshop Manual").....33

D. U.S. Patent No. 1,931,698 ("Holzapfel").....37

E. U.S Patent No. 5,161,496 ("Matsushima").....39

F. U.S. Patent No. 7,549,403 ("Yamamoto).....40

G. U.S. Patent No. 4,776,988 ("Neal").....41

H. U.S. Patent No. 6,213,083 ("Winberg").....43

XII. THE CHALLENGED CLAIMS ARE UNPATENTABLE.....45

A. Ground 1: Claims 1, 3, 22, and 57 are anticipated by the Workshop Manual.....45

1. Claim 1.....46

2. Claim 3.....60

3. Claim 22.....61

4. Claim 57.....62

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.....70

1. Claim 2.....71

2. Claim 4.....72

3. Claim 5.....72

4. Claim 6.....74

5. Claim 7.....74

6. Claim 8.....75

7. Claim 9.....77

8. Claim 10.....78

9. Claim 11 80
10. Claim 12 80
11. Claim 13 80
12. Claim 14 82
13. Claim 19 82
14. Claim 20 82
15. Claim 21 86
16. Claim 23 91
17. Claim 32 94
18. Claim 33 95
19. Claim 34 96
20. Claim 35 98
21. Claim 36 98
22. Claim 37 99
23. Claim 38 99
24. Claim 39 100
25. Claim 40 100
26. Claim 41 100
27. Claim 42 101
28. Claim 58 101

C. Ground 3: Claims 1, 3, 22, and 57 are anticipated by Nakafushi 102

1. Claim 1 102
2. Claim 3 112

3. Claim 22 112

4. Claim 57 113

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 122

1. Claim 2 122

2. Claim 4 122

3. Claim 5 123

4. Claim 6 127

5. Claim 7 127

6. Claim 8 128

7. Claim 9 128

8. Claim 10 129

9. Claim 11 130

10. Claim 12 131

11. Claim 13 131

12. Claim 14 132

13. Claim 19 132

14. Claim 20 133

15. Claim 21 134

16. Claim 23 138

17. Claim 32 141

18. Claim 33 142

19. Claim 34 143

20. Claim 35 144

21. Claim 36 145

22. Claim 37 145

23. Claim 38 146

24. Claim 39 146

25. Claim 40 147

26. Claim 41 147

27. Claim 42 148

28. Claim 58 148

E. Ground 5: Claims 1, 15-16, and 43-44 are anticipated by Holzapfel 148

1. Claim 1 149

2. Claim 15 158

3. Claim 16 159

4. Claim 43 159

5. Claim 44 162

F. Ground 6: Claims 43-46 and 56 are anticipated by Neal 162

1. Claim 43 162

2. Claim 44 166

3. Claim 45 166

4. Claim 46 167

5. Claim 56 169

G. Ground 7: Claims 43-46, 53-54, and 56 are anticipated by and/or obvious in view of Winberg 170

1. Claim 43 172

2. Claim 44 180

3. Claim 45 180

4. Claim 46 185

5. Claim 53 187

6. Claim 54 188

7. Claim 56 189

H. Ground 8: Claims 17 and 23-26 are obvious over Holzapfel in view of Winberg and Yamamoto 190

1. Claim 17 190

2. Claim 23 195

3. Claim 24 199

4. Claim 25 199

5. Claim 26 200

I. Ground 9: Claims 17 and 23-26 are obvious over Holzapfel in view of Neal and/or Yamamoto 201

1. Claim 17 201

2. Claim 23 206

3. Claim 24 208

4. Claim 25 208

5. Claim 26 209

XIII. CONCLUSION 210

I, Timothy Morse, submit this Declaration and declare as follows:

I. INTRODUCTION

1. I have been retained as an expert on behalf of Petitioner Harbor Freight Tools, Inc. ("Harbor Freight") as an independent expert consultant in support of Petitioner's request for Inter Partes Review No. IPR2025-01271 to review the challenged claims of U.S. Patent No. 10,697,398 ("the '398 patent," Ex. 1001), assigned to Champion Power Equipment, Inc. ("Patent Owner" or "Champion"). My opinions are set forth below.

2. My employer, Exponent, Inc., is being compensated for my time in connection with this *Inter Partes* Review at my standard consulting rate, but my compensation is not in any way tied to or affected by the outcome of this matter.

3. I have been asked to provide my opinions regarding whether Claims 1-17, 19-26, 32-46, 53-54, and 56-58 of the '398 Patent are invalid.

4. This report sets forth the opinions that I have formed based on the information available to me as of the date below. The opinions and facts set forth in this report are based upon my analysis of the '398 Patent and its claims, the prior art, the state of the art at the time of the invention, as well as my knowledge and extensive experience in this field.

5. My analysis of the materials submitted in this proceeding is ongoing and I will continue to review any new material that is provided. This declaration is

indicative of only those opinions that I have formed to date. I reserve the right to amend, revise, and/or supplement my opinions stated herein based on any new information that may become available to me or my continuing analysis of the materials already provided.

6. I am not currently and have not at any time in the past been an employee of Harbor Freight. I have no financial interest in Harbor Freight outside of assisting Harbor Freight as an expert in this and any related matters.

II. QUALIFICATIONS AND EXPERIENCE

7. My qualifications for forming the opinions in this report are summarized here and explained in more detail in my curriculum vitae ("CV"), which I understand is being appended hereto.

8. As detailed in my CV, I have extensive experience in the design, development, and manufacture of multi-fuel internal combustion engines and generators, with a career spanning over fifteen years in this field. I have specific expertise in thermal and flow processes and have a good understanding of the relevant mechanical principles and constraints associated with the implementation of such processes into physical products and equipment, including internal combustion engines and generators. I have also engaged in extensive consulting work, specializing in failure analysis, failure prevention, and design risk assessment of power generation equipment and facilities, including power plants, fixed

emergency power generation, and portable generators. I have personally investigated the causes of failure of many different types of portable generators.

9. I earned my Bachelor of Engineering in Mechanical Engineering from the Cooper Union for the Advancement of Science and Art in 2003. I completed a Master of Science in Mechanical Engineering in 2007 and a Doctor of Philosophy in Mechanical Engineering in 2009, both from Cornell University. I am a licensed Professional Engineer in mechanical engineering in California, Florida, Kansas, Massachusetts, New Hampshire, New York, Pennsylvania, Rhode Island, and Vermont. I am also a Certified Fire and Explosion Investigator with the National Association of Fire Investigators.

10. I am a member of the National Fire Protection Association (NFPA) and serve on two code committees responsible for developing safety standards in the US. One of these committees is the NFPA Technical Committee on Vehicular Alternative Fuel Systems (VAF-AAA), responsible for NFPA 52: Vehicular Natural Gas Fuel Systems Code. NFPA 52 applies to vehicles and vehicle internal combustion engines that operate with natural gas. One of my functions as a member of this committee is to understand how safety considerations for more common gasoline powered vehicles apply to natural gas powered vehicles. The other committee I serve on is the NFPA Technical Committee on Liquified Petroleum Gases (LPG-AAA), responsible for NFPA 58: Liquified Petroleum Gas Code. NFPA 58 applies to the use

of LPG in a wide range of applications, including portable generators and portable generator fueling systems.

11. I have performed research and analysis for the Portable Generators Manufacturers Association (PGMA). This work has included evaluating the safety of portable generators, including the generation of carbon monoxide, which is a byproduct of combustion. This research work has been presented to the US Consumer Product Safety Commission (CPSC).

12. I am also an active contributor to the scholarly literature in my field, being a named author on over twenty publications. Most of my publications went through the peer review process, appearing in sources like the Journal of Fluid Mechanics and the Journal of Fluids and Structures. Broadly speaking, these publications relate to the design and safety of fluid and thermal systems, like how the valve closure time affects pressure in a fluid system. In addition to researching and writing on emerging safety issues, I have presented my work over twenty-five times to various audiences including practicing engineers, which has led me to appreciate how a less experienced engineer would perceive the prior art and approach the technical problems disclosed in the prior art.

13. I also have broader consulting experience in the development and design of thermal and flow processes, products, and equipment. My project experience includes turbines, compressors, valves, heat exchangers, boilers,

furnaces, refrigeration systems, piping systems, autoclaves, heat transfer systems, flammable liquids, cryogenic liquids, consumer products, and medical devices. This work has included analysis of HVAC systems, the engineering analysis of gas extraction facilities, and the investigation into failures of generators and heat exchanges, among other applications.

14. I am currently employed as a Principal Engineer at Exponent, Inc., a US-based engineering and scientific consulting firm. Before joining Exponent, I was a researcher in the Fluid Dynamics Research Laboratories at Cornell University where I conducted research on the wakes of stationary and oscillating structures in a flow and particularly on how flow-induced vibration due to vortex shedding causes fatigue and failure of structures.

III. MATERIALS AND OTHER INFORMATION CONSIDERED

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

16. I have considered the materials referenced herein, including the ’398 Patent (Ex. 1001), the file history of the ’398 Patent (excerpts at Ex. 1002), and the prior art references listed in the table below. Each of these documents is a type of document that an expert in my field would have reasonably relied upon when forming his or her opinion.

Exhibit No.	Description
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”)
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”)
1009	U.S. Patent No 1,931,698 (“Holzapfel”)
1012	Kubota DF972-E2 Workshop Manual (“Workshop Manual”)
1018	U.S. Patent No. 5,809,979 (“Tsuda”)
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”)

Exhibit No.	Description
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, Bélá G., (1995) ("Liptak")
1039	U.S. Patent Pub. No. 2007/0137591 ("Sugimoto")

17. My opinions are additionally guided by my appreciation and understanding of how a POSA would have understood the claims of the '398 Patent at the time of the earliest possible priority date of the patents, which I understand is June 12, 2015.

IV. SUMMARY OF OPINIONS

18. Based on my experience and expertise, it is my opinion that:

- Claims 1-17, 19-26, 32-46, 53-54, and 56-58 recite nothing more than devices that were already known in the industry prior to the effective filing date of the ’398 patent;
- Claims 1, 3, 22, and 57 are anticipated by the Kubota DF972 Workshop Manual;
- Claims 2, 4-14, 19-21, 23, 32-42, and 58 are obvious over the Kubota DF972 Workshop Manual in view of Matsushima, Yamamoto, and Olmr;
- Claims 1, 3, 22, and 57 are anticipated by Nakafushi;
- Claims 2, 4-14, 19-21, 23, 32-42, and 58 are obvious over Nakafushi in view of Matsushima, Yamamto, and Olmr;
- Claims 1, 15-16, and 43-44 are anticipated by Holzapfel;
- Claims 43-46 and 56 are anticipated by Neal;
- Claims 43-46, 53-54, and 56 are anticipated by and/or obvious in view of Winberg;
- Claims 17 and 23-26 are obvious over Holzapfel in view of Winberg and/or Yamamoto; and
- Claims 17 and 23-26 are obvious over Holzapfel in view of Neal and/or Yamamoto.

V. UNDERSTANDING OF PATENT LAW

19. I am not an attorney. For purposes of this report, I have an understanding about certain aspects of the law that are relevant to my opinions, as described below.

A. Claim Construction

20. I understand that claim terms must be construed under the Phillips standard. Under that standard, words of a claim are given their plain and ordinary meaning as understood by a person of ordinary skill in the art (also "POSA") at the time of invention, in light of the specification and prosecution history, unless those sources show an intent to depart from such meaning, as well as pertinent evidence extrinsic to the patent. For purposes of this declaration, I applied the plain and ordinary meaning of each term as would have been understood by a person of ordinary skill in art at the time of the alleged invention unless explicitly stated otherwise.

B. Obviousness

21. I understand that a patent claim can be considered to have been obvious to person of ordinary skill in the art at the time the application was filed. This means that, even if all of the elements of a claim are not found in a single prior art reference, the claim is not patentable if the differences between the subject matter in the prior art and the subject matter in the claim would have been obvious to a person of ordinary skill in the art at the time the application was filed.

22. I further understand that a determination of whether a claim would have been obvious must consider several factors, including, among others:

- the level of ordinary skill in the art at the time the application was filed;
- the scope and content of the prior art; and
- what differences, if any, existed between the claimed invention and the prior art.

23. I understand that the teachings of two or more references may be combined in the same way as disclosed in the claims, if such a combination would have been obvious to a person of ordinary skill in the art. In determining whether a combination based on either a single reference or multiple references would have been obvious, it is appropriate to consider at least the following factors:

- whether the teachings of the prior art references disclose known concepts combined in familiar ways, which, when combined, would yield predictable results;
- whether a person of ordinary skill in the art could implement a predictable variation, and would see the benefit of doing so;
- whether the claimed elements represent one of a limited number of known design choices, and would have a reasonable expectation of success by a person of ordinary skill in the art;

- whether a person of ordinary skill in the art would have recognized a reason to combine known elements in the manner described in the claim;
- whether there is some teaching or suggestion in the prior art to make the modification or combination of elements claimed in the patent; and
- whether the innovation applies a known technique that had been used to improve a similar device or method in a similar way.

24. I understand that a person of ordinary skill in the art has ordinary creativity and is not an automaton.

25. I understand that in considering obviousness, it is important not to determine obviousness using the benefit of hindsight derived from the patent being considered, and I have not done that in regard to my opinions expressed herein.

26. I understand that certain factors—often called "secondary considerations"—may support or rebut an assertion of obviousness of a claim. I understand that such secondary considerations include, among other things, commercial success of the alleged invention, skepticism of those having ordinary skill in the art at the time of the alleged invention, unexpected results of the alleged invention, any long-felt but unsolved need in the art that was satisfied by the alleged invention, the failure of others to make the alleged invention, praise of the alleged invention by those having ordinary skill in the art, and copying of the alleged invention by others in the field. I further understand that there must be a nexus—a

connection—between any such secondary considerations and the alleged invention. I also understand that contemporaneous and independent invention by others is a secondary consideration tending to show obviousness.

C. Anticipation

27. I understand that a patent claim is invalid if it is anticipated by a single item of prior art. I understand that an anticipation analysis involves two steps. First, the patent claims are construed to ascertain their scope. Second, each construed asserted claim is compared to the prior art reference on an element-by-element basis. If the prior art reference discloses or contains each and every element of the claimed invention as arranged in the claim, either expressly or inherently, then it anticipates the claim.

28. I understand that anticipation by inherent disclosure is appropriate only when a prior art reference necessarily includes or discloses the unstated claim element. I also understand that the discovery of a new or previously unreported or unappreciated property of a prior art composition, or of a scientific explanation for how a prior art composition operates, does not make the prior art composition patentably new to the entity or person that discovered the new property or mode of operation. I further understand that there is no requirement that a POSA would have recognized the inherent disclosure at the time of the invention.

29. For anticipation by a prior art publication or document, I understand that the reference's description must enable a POSA to practice the claimed invention without undue experimentation. I further understand that the following factors may be considered to determine whether any experimentation would have been undue:

- The quantity of experimentation necessary.
- The amount of direction or guidance presented.
- The presence or absence of working examples.
- The nature of the claimed invention.
- The state of the prior art.
- The relative skill of those in the art.
- The predictability or unpredictability of the art.
- The breadth of the claims.

VI. THE PERSON OF ORDINARY SKILL IN THE ART

30. I understand that there are multiple factors relevant to determining the level of ordinary skill in the pertinent art, including the educational level of active workers in the field at the time of the alleged invention, the sophistication of the technology, the type of problems encountered in the art, and the prior art solutions to those problems.

31. In determining the characteristics of a hypothetical person of ordinary skill in the art of the ’398 Patent at the time of the claimed invention, I considered

several things, including the type of problems encountered in this field, and the rapidity with which innovations were made. I also considered the sophistication of the technology involved, and the educational background and experience of those actively working in the field, and the level of education that would be necessary to understand the ’398 patent. Finally, I placed myself back in the relevant period of time and considered the state of the art and the level of skill of the persons working in this field at that time.

32. It is my opinion that the subject matter of the ’398 Patent focuses on the fuel-delivery system(s), such as a carburetor and/or gaseous fuel regulator, for a dual-fuel engine or generator. Based on the materials I have considered (including the prior art cited herein), my own knowledge and experience, and the level of skill required to design and build a dual-fuel carburetor, I have come to the conclusion that a person of ordinary skill in the art of the ’398 Patent would hold a bachelor’s-level or equivalent degree in mechanical engineering, physics, or related fields and have three years of work experience in combustion engines operating on various fuel sources such as liquid fuels and gaseous fuels. This hypothetical person would be capable of performing various design tasks and would understand the basic mechanical features and operation of carburetors, regulators, engines, and generators; this hypothetical person would also have an appreciation for carburetors, regulators, engines, and generators and issues and concerns faced by users/operators

that use the same. There are also basic engineering principles that the person of ordinary skill in the art would appreciate, as I discuss in Section VII below. I believe these understandings are demonstrated, for example, by the prior art I discuss herein. A person could also have qualified as a person of ordinary skill in the art with some combination of (1) more formal education (*e.g.*, an M.S. degree) and less technical experience or (2) less formal education and more technical or professional experience in the fields listed above. For example, a person having significant experience servicing or operating dual-fuel combustion engines, or incorporating such engines into finished products (*e.g.*, lawnmowers, lifts, floor cleaners, or the like), would qualify as a POSA.

33. Although my qualifications and experience exceed those of the hypothetical person having an ordinary level of skill in the art, my analysis and conclusions herein are from the perspective of a person of ordinary skill in the art as of June 12, 2015 (which I understand to be the earliest possible priority date for the claims of the '398 Patent), unless otherwise noted.

VII. STATE OF THE ART

A. Carburetors

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

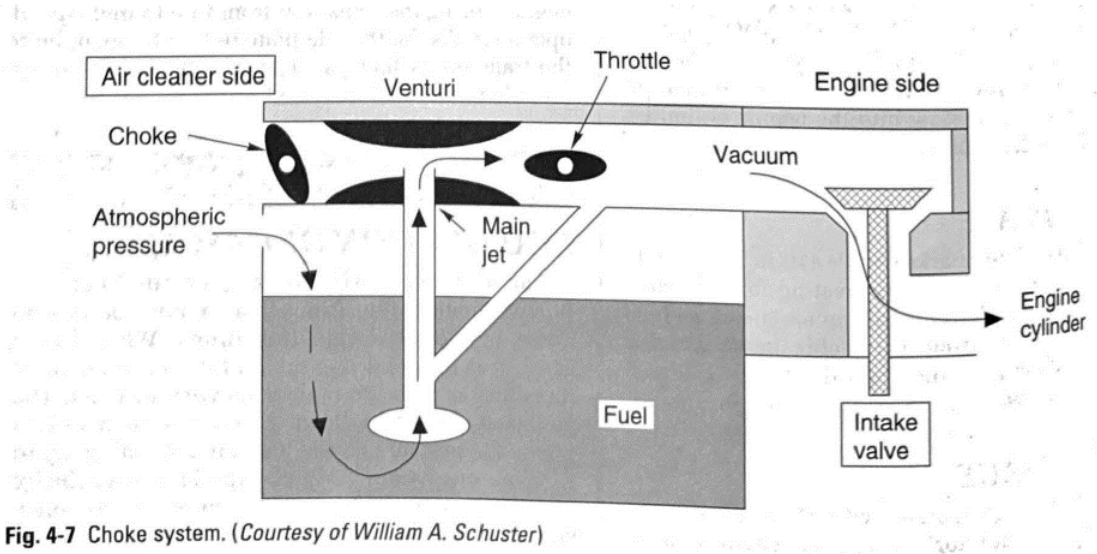


Fig. 4-7 Choke system. (*Courtesy of William A. Schuster*)

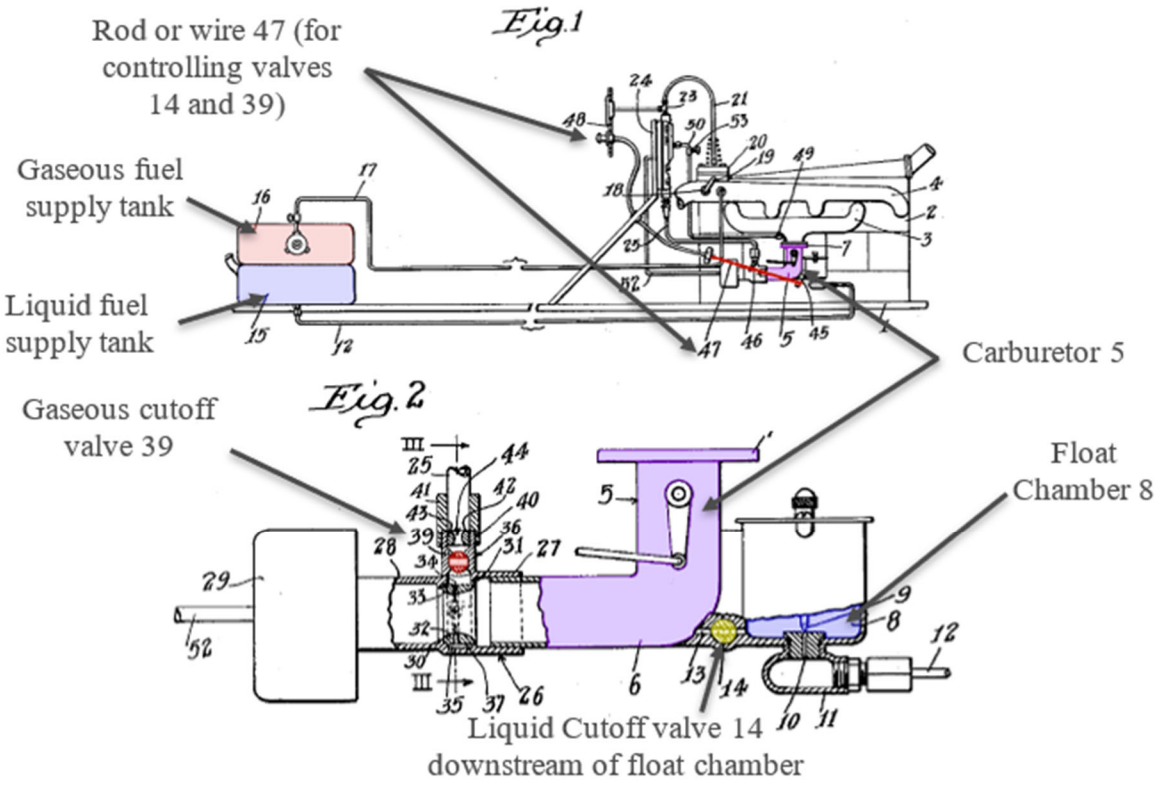
EX1006, 8.

35. 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.

B. Multi-Fuel Combustion Engines

36. 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, 1:3-5. A "rod or wire 47" controls both the liquid and gaseous valves, as seen in Holzapfel's Figures 1 and 2 below:



EX1009, Figures 1 – 2 (annotated).

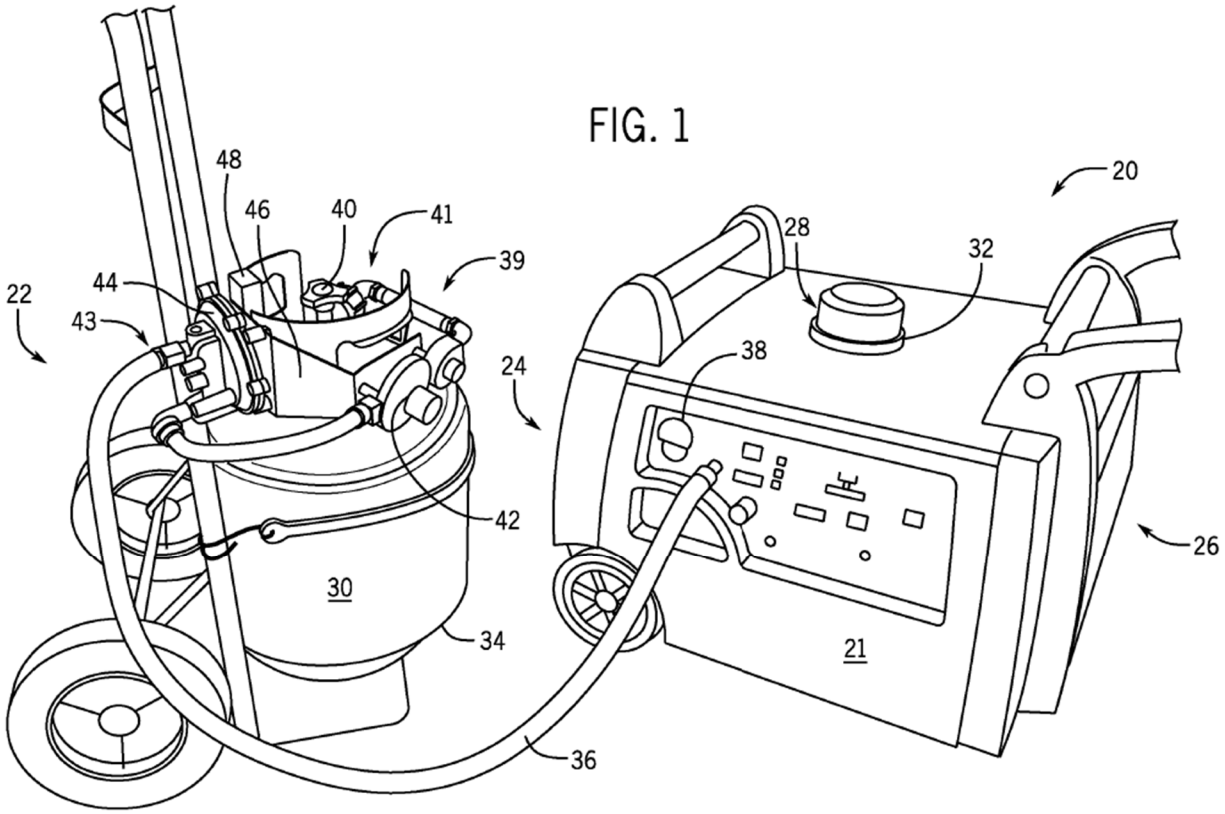
37. Notably, Holzapfel's liquid cutoff 14 is located downstream from the carburetor float chamber 8. EX1009, 1:100-107, Fig. 2.

VIII. SUMMARY OF THE '398 PATENT

A. The '398 Patent

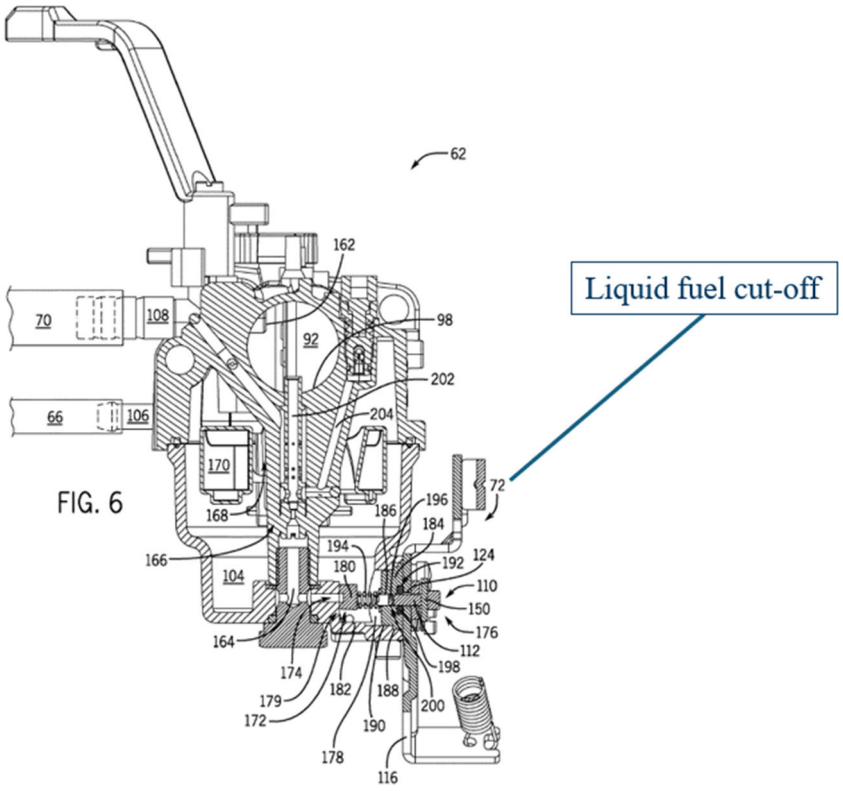
38. The '398 Patent discloses embodiments of dual-fuel engines/generators operable on liquid or gaseous fuels. EX1001, 1:14-16. The '398 Patent acknowledges that dual-fuel generators typically run on liquid fuel (such as gasoline)

and an alternative gaseous fuel (such as propane). *Id.*, 1:18-35. Figure 1 of the ’398 Patent discloses a perspective view of a generator with such an engine, as shown below:



39. 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.

40. 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 discloses the liquid fuel cut-off can be manually or electrically operated, such as by a solenoid. *Id.*

41. 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

42. The ’398 Patent is part of a family that includes at least 13 U.S. patents and/or pending applications.[1]

43. 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.

44. 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 a Notice of Appeal and 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.

45. 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. Thus, the Examiner rejected claim 1 as obvious over Poehlman in view of Tsuda, contending

[1] 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.

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

46. 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 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.*

47. Patent Owner made similar arguments for purposes of "the fuel shutoff coupled to the carburetor" of original claim 35 (issued claim 43), and also argued that Tsuda failed to teach a fuel shutoff with "a first end in the carburetor that actuates to close a fuel passage (extending from the float bowl to the throat) and a second end external to the carburetor to actuate the first end, wherein the fuel shutoff actuates free from linear motion." *Id.*, 516-519.

48. For purposes of original claim 19 (issued claim 23) and original claim 48 (issued claim 57), Patent Owner argued the combination of Poehlman and Sugimoto did not teach a fuel shutoff attached to the carburetor. *Id.*, 503-509.

49. 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 comment on the reasons for allowance for the other issued claims (issued claims 23, 43, and 57). *Id.*

IX. LEVEL OF ORDINARY SKILL IN THE ART

50. I understand that 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. I further understand that a POSA is a person of ordinary creativity and thus is able to make inferences from the art.

51. For purposes of this IPR, I apply the level of skill in the art as possessed by the POSA I described previously in paragraph 32 above.

X. CLAIM CONSTRUCTION

52. I have not identified any claim terms that need an express construction in order to address the issues raised herein, but reserve the right to respond to any constructions offered by Patent Owner, its expert(s), and/or the Board. I have therefore applied the plain and ordinary meaning of the claim terms in this declaration.

XI. OVERVIEW OF THE ASSERTED PRIOR ART

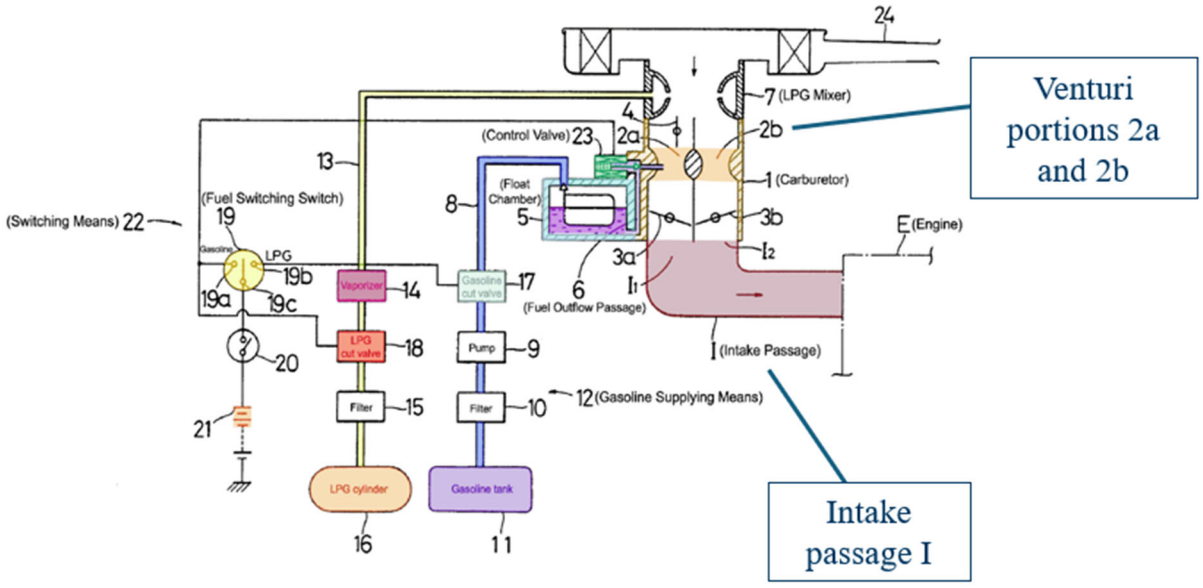
A. JPS61283734A ("Nakafushi")

53. Nakafushi is directed to an engine configured to selectively use gasoline or liquefied petroleum gas ("LPG")[2] as fuel. EX1005, ¶[0001]. Nakafushi notes that when engine operation is switched from gasoline to LPG, a residual amount of gasoline remains in the float chamber (i.e., float bowl) and gets mixed with the LPG, resulting in over-rich air-to-fuel ratio. *Id.*, ¶¶[0003]-[0004]. Also, because the residual gasoline is drained from the float chamber, when the engine is switched back to gasoline, gasoline delivery is delayed until the level of gasoline in the float chamber recovers. *Id.*, ¶[0004]. During this delay, the air-to-fuel ratio becomes over-lean. *Id.* Nakafushi solves these problems by including a control valve 23 downstream of the float chamber to prevent it from being emptied of gasoline when switching to LPG operation. *Id.*, ¶¶[0006]-[0008], Fig. 1.

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

[2] LPG is a general term for a group of hydrocarbon gases that are stored as liquids under pressure. LPG typically includes propane, butane, or a mix of both.

FIG. 1



Id., ¶[0010], Fig. 1 (annotated).

55. Gasoline is stored in tank 11 and pumped to float chamber 5 through gasoline supply passage 8, which is opened and closed by gasoline cut valve 17. EX1005, ¶¶[0012]-[0013]. Gasoline in the float chamber 5 is sucked into the venturi portions 2a and 2b through a fuel outflow passage 6. *Id.*, ¶[0010]. Control valve 23 opens and closes the fuel outflow passage 6, thus controlling gasoline flow from the float chamber 5 to the intake I. *Id.*, ¶[0014].

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

57. Nakafushi discloses a fuel switching switch 19 that controls which fuel is fed to the engine. *Id.*, ¶¶[0013]-[0014]. When switch 19 is set to the gasoline side contact 19a: (1) LPG cut valve 18 closes to block the LPG supply; (2) gasoline cut valve 17 opens to allow gasoline flow through passage 8 to the carburetor float chamber; and (3) control valve 23 opens to allow gasoline flow from the float chamber 5 to the intake I. *Id.*

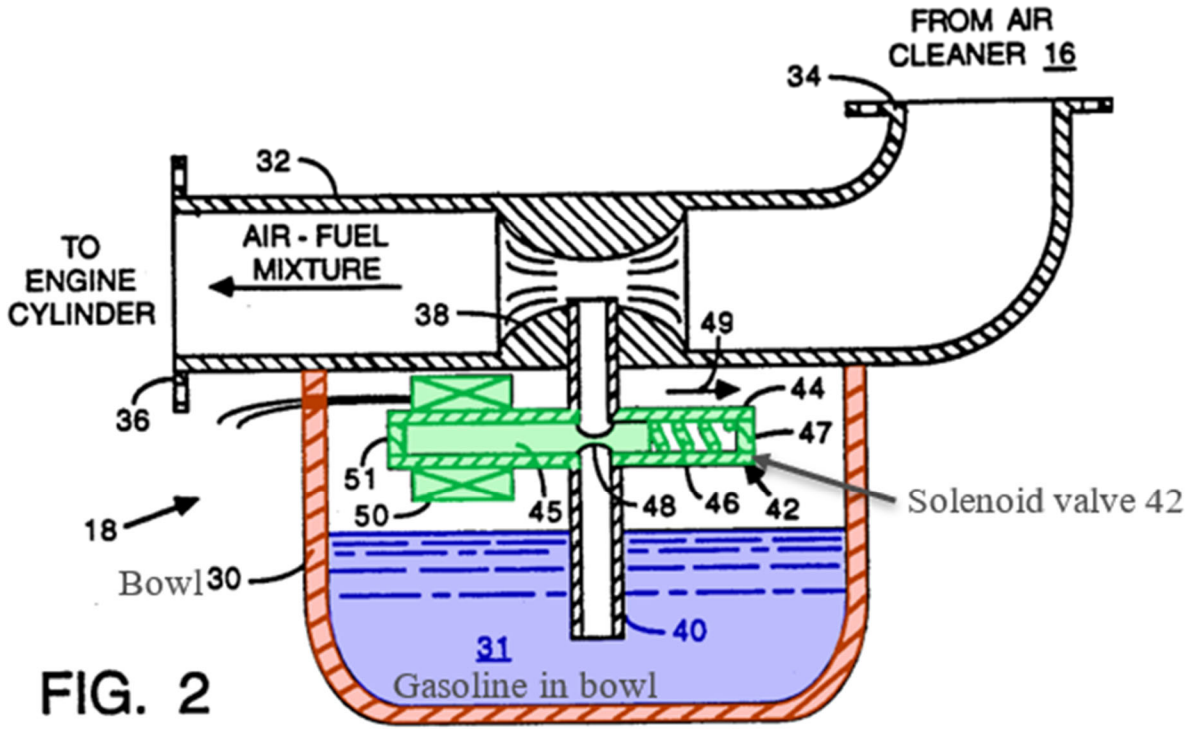
58. Conversely, when the switch 19 is set to the LPG side contact 19b: (1) gasoline cut valve 17 and control valve 23 are closed to block the flow of gasoline; and (2) LPG cut valve 18 is opened, allowing LPG to flow through passage 13 to the LPG mixer 7 in the carburetor. *Id.*

59. Closing control valve 23, which is downstream of the float chamber, prevents residual gasoline from exiting the float chamber when switching to LPG operation. *Id.*, ¶[0014], Fig. 1. Because gasoline is not drained from the float chamber, that gasoline is more readily available to fuel the engine upon switching back to gasoline operation. *Id.*

60. Nakafushi thus addresses the alleged "problems" identified by the '398 Patent, and discloses the same solution claimed in the '398 Patent some 30 years earlier than the '398 Patent.

B. U.S. Patent No. 5,301,644 ("Olmr")

61. Olmr teaches locating a solenoid valve 42 within the float bowl 30 of the carburetor. EX1007, 1:33-48, 2:30-42, Fig. 2. Specifically, solenoid valve 42 "provide[s] a mechanism for cutting off the supply of fuel to an internal combustion engine when the engine is being stopped." *Id.*, 1:33-36. This is illustrated in Olmr's Figure 2:

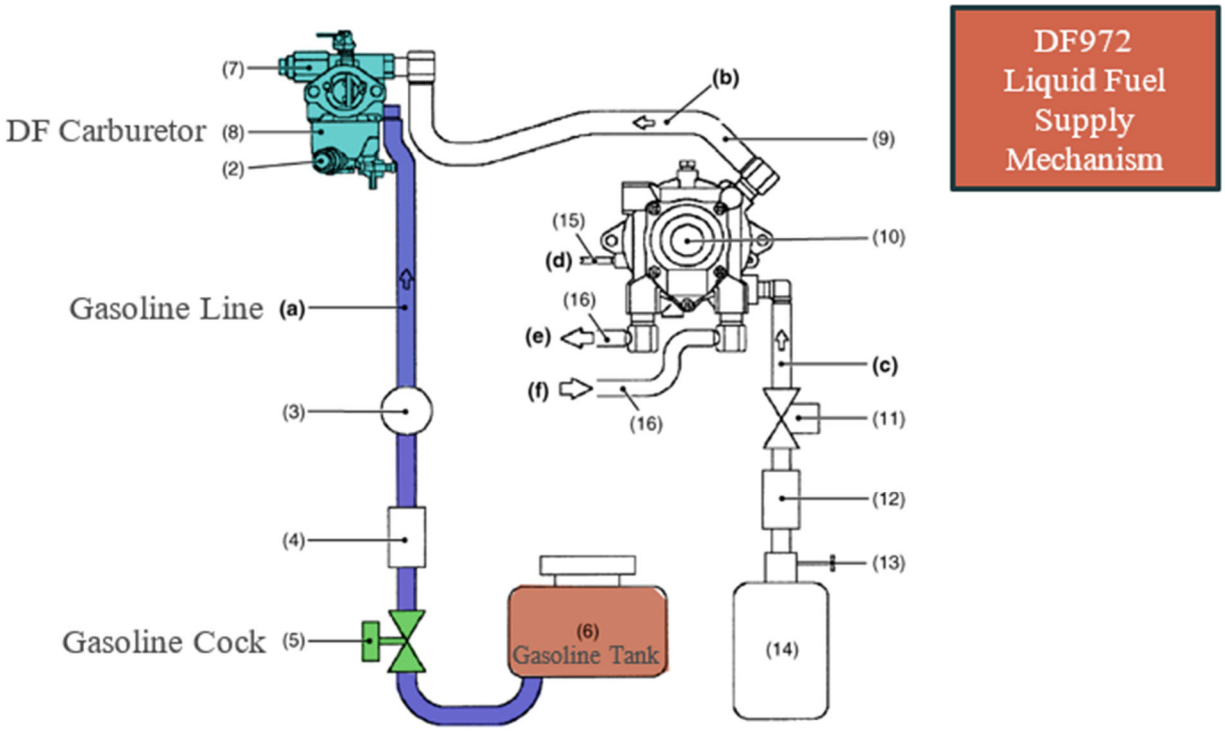


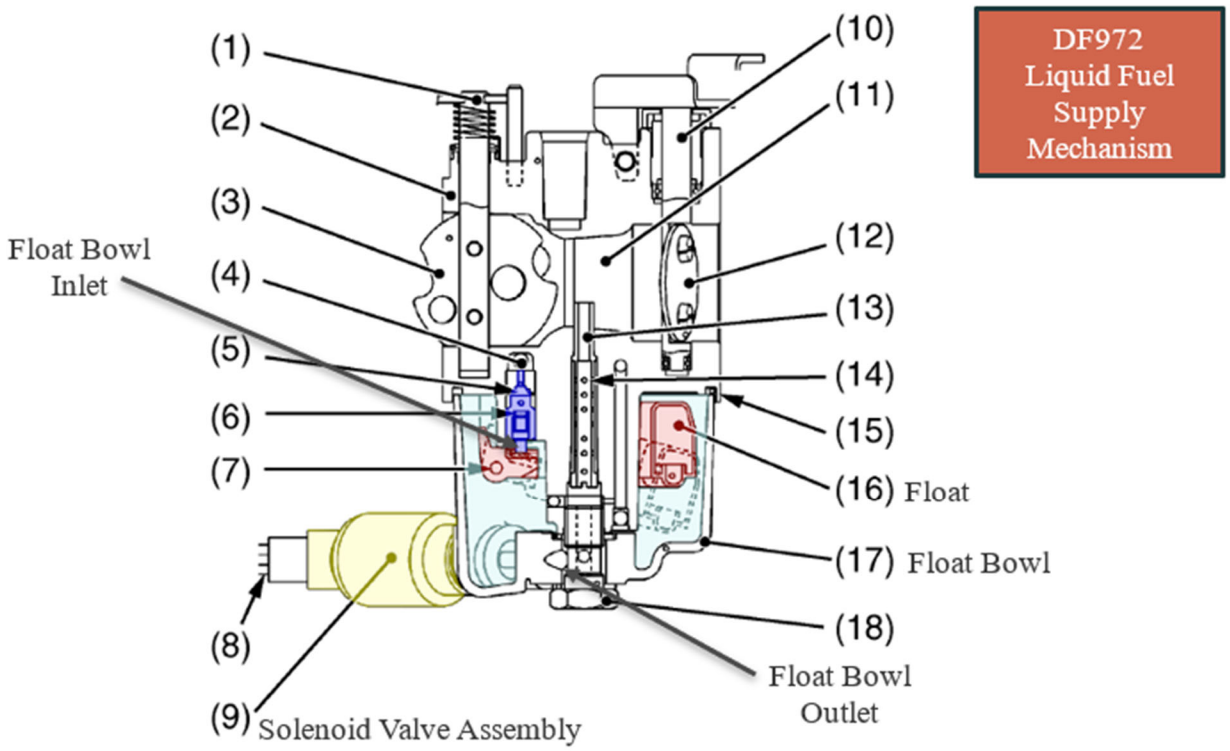
Id., Figure 2 (annotated).

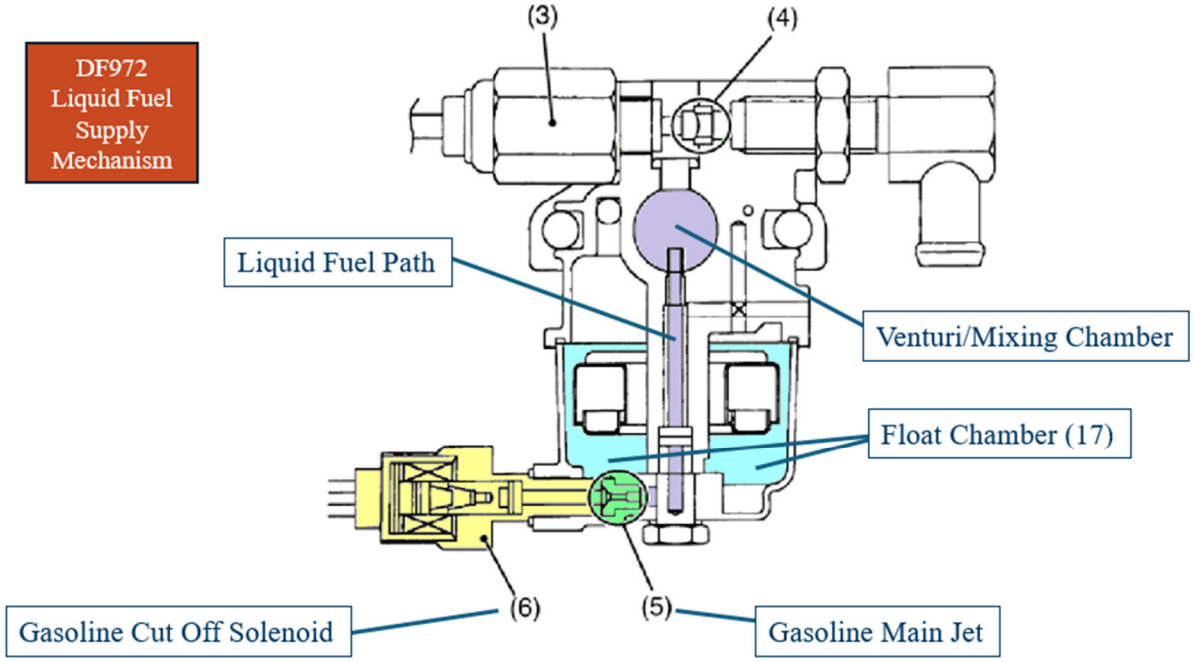
C. Kubota DF972-E2 Workshop Manual ("Workshop Manual")

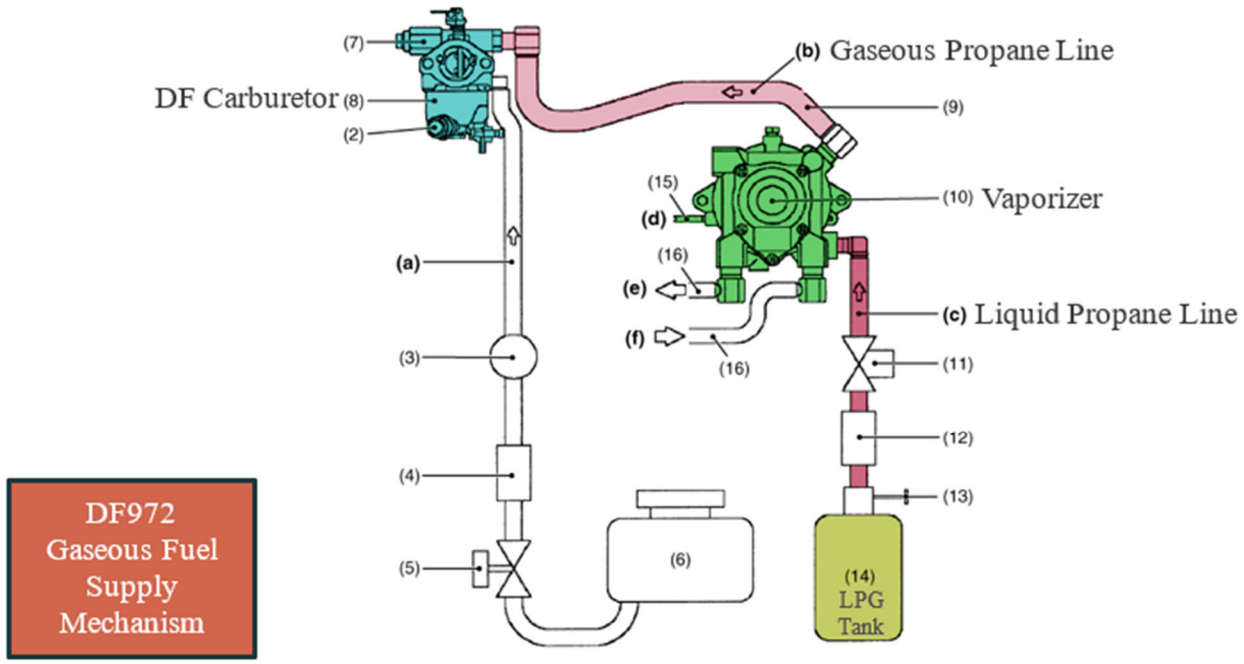
62. The Workshop Manual describes the Kubota DF972 engine—a dual-fuel engine with an alternator to function as a generator that runs alternatively off

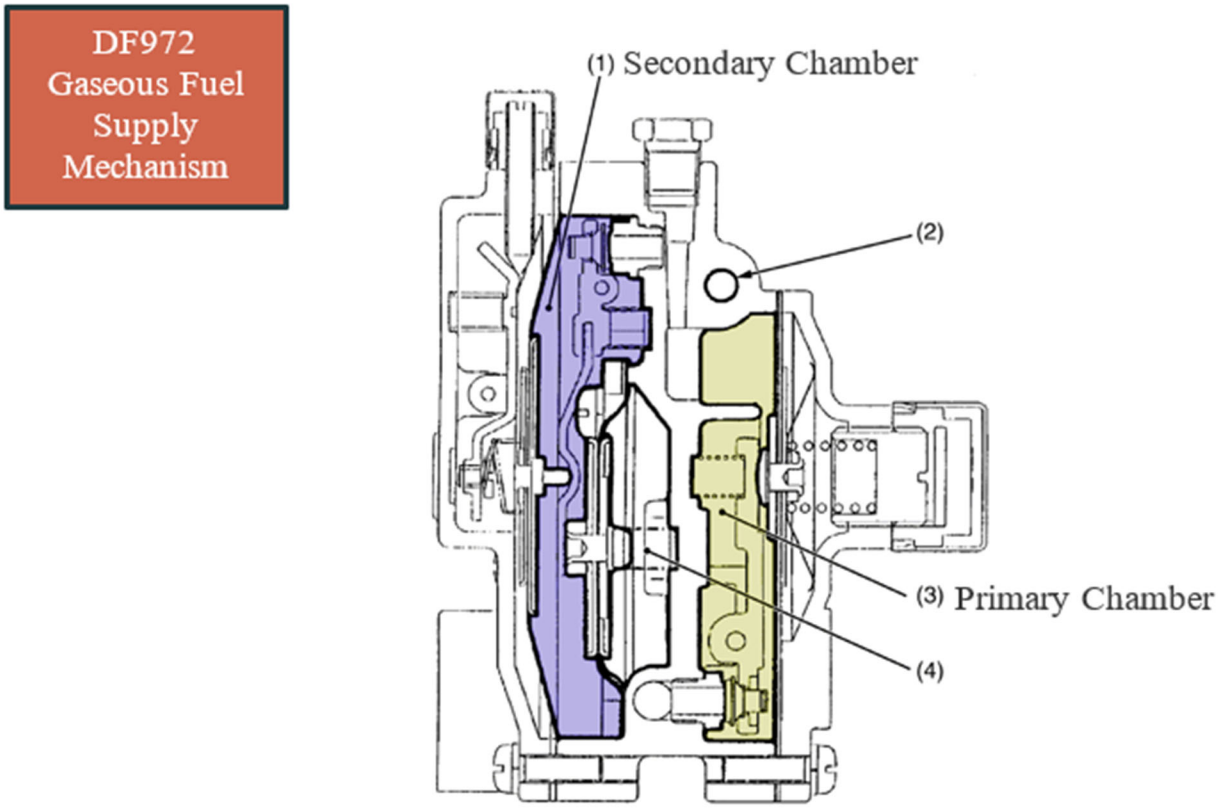
gasoline or LPG. EX1012, 8. The Workshop Manual discloses a carburetor through which gasoline and LPG are routed, as shown below:




DF972
Liquid Fuel
Supply
Mechanism
(1)
(2)
(3)
Float Bowl
Inlet
(4)
(5)
(6)
(7)
(8)
(9)
Solenoid Valve Assembly
(10)
(11)
(12)
(13)
(14)
(15)
(16) Float
(17) Float Bowl
(18)
Float Bowl
Outlet

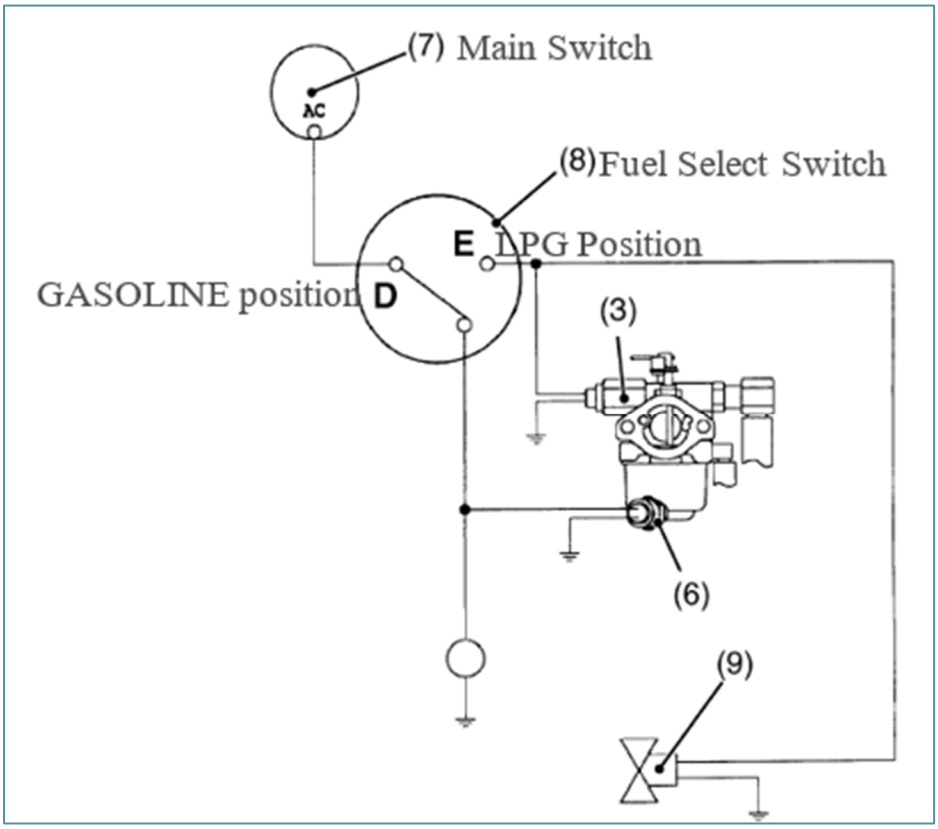

DF972
Liquid Fuel
Supply
Mechanism
(3)
(4)
Liquid Fuel Path
Venturi/Mixing Chamber
Float Chamber (17)
(6)
(5)
Gasoline Cut Off Solenoid
Gasoline Main Jet





Id., 65, 67-69 (annotated).

63. The Workshop Manual teaches a fuel select switch (8) that controls whether a Gasoline Cut Off Solenoid (located downstream of the float bowl) allows gasoline to pass through the carburetor, or whether an LPG cut off solenoid allows LPG to pass through the carburetor, to power the engine/generator, shown below:



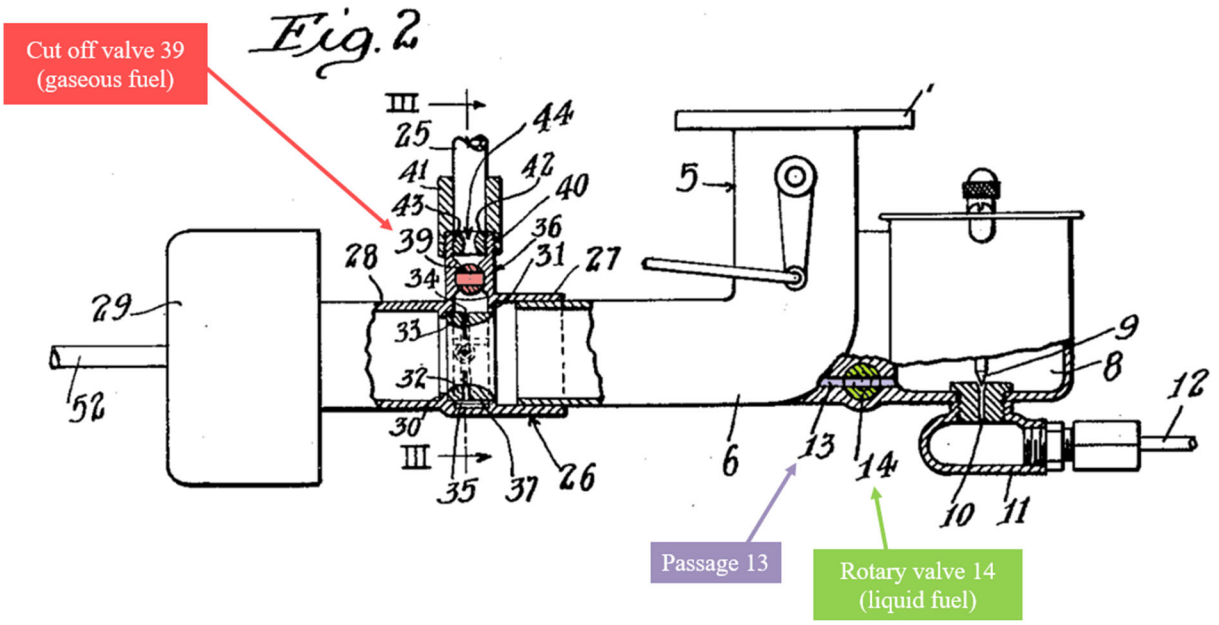
EX1012, 68 (annotated).

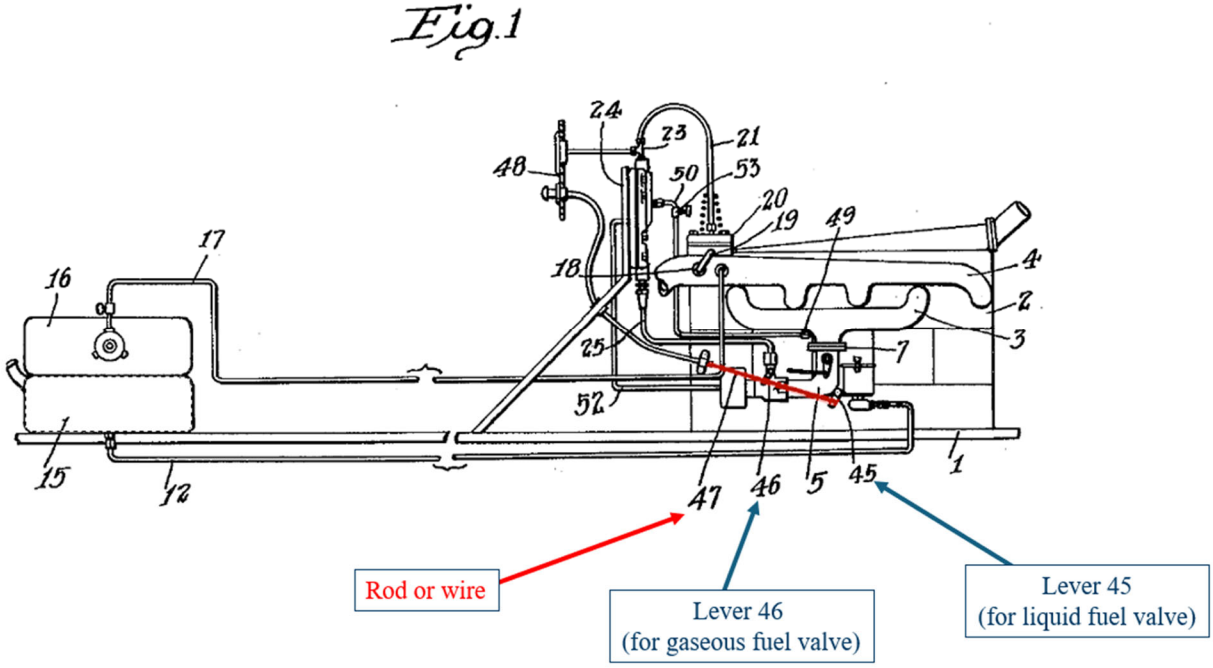
D. U.S. Patent No. 1,931,698 ("Holzapfel")

64. Holzapfel discloses "a fuel system embodying the supplying of liquid fuel and gaseous fuel to an engine in alternation at will." EX1009, 1:3-5.

65. A "rod or wire 47" controls the levers 45 and 46 for the liquid and gaseous valves, 14 and 39, respectively. EX1009, 2:100-123, Figures 1-2. The liquid

valve 14 is a rotary valve located in the fuel passage between the float bowl in the intake. *Id.*

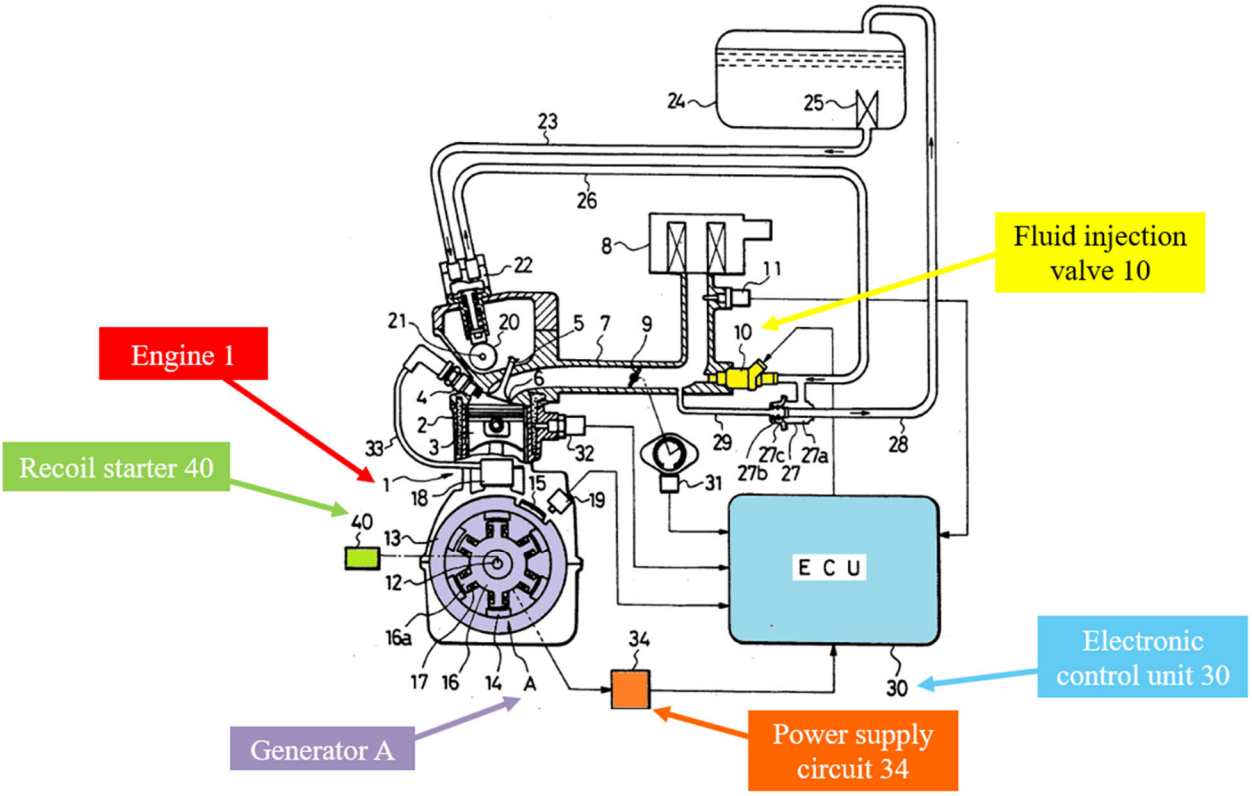




Id., Figures 1-2 (annotated).

E. U.S Patent No. 5,161,496 ("Matsushima")

66. Matsushima discloses a battery-less internal combustion engine and generator that is started using a manual recoil starter 40 (EX1029 Abstract, 1:59-2:2, 3:53-66, 4:43-49, 4:63-68):



EX1029, Fig. 1 (annotated).

67. During engine startup, the generator supplies voltage to an electronic control unit (ECU) 30, as well as fuel pump 22, spark plug 4, and fuel injection valve 10. *Id.*, 5:1-48. Power supply circuit 34 rectifies, smooths, and stabilizes output voltage from the generator. *Id.*, 4:43-46.

F. U.S. Patent No. 7,549,403 ("Yamamoto)

68. Yamamoto discloses a battery-less internal combustion engine and generator with a recoil starter 39 (EX1030 2:58-68, 4:35-40, 5:22-26):

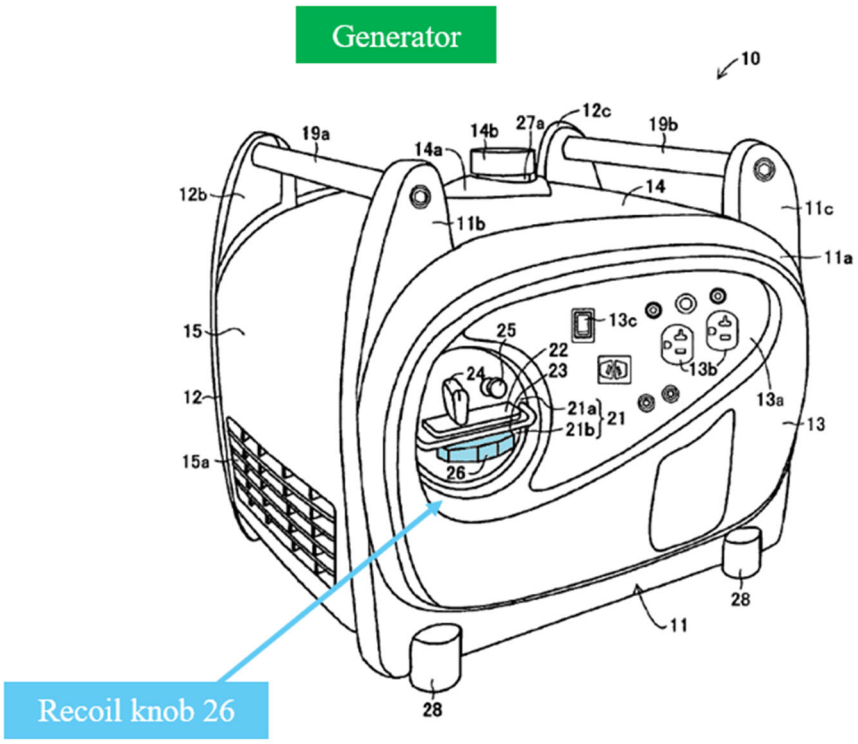


Figure 1

EX1030, Fig. 1 (annotated).

69. The recoil knob 26 is attached to the recoil starter 39 via recoil rope 26a; the recoil starter 39 drives the engine crankshaft 41, which initiates engine start-up when engaged by the recoil knob 26 and rope 26a. EX 1030, 5:22-26.

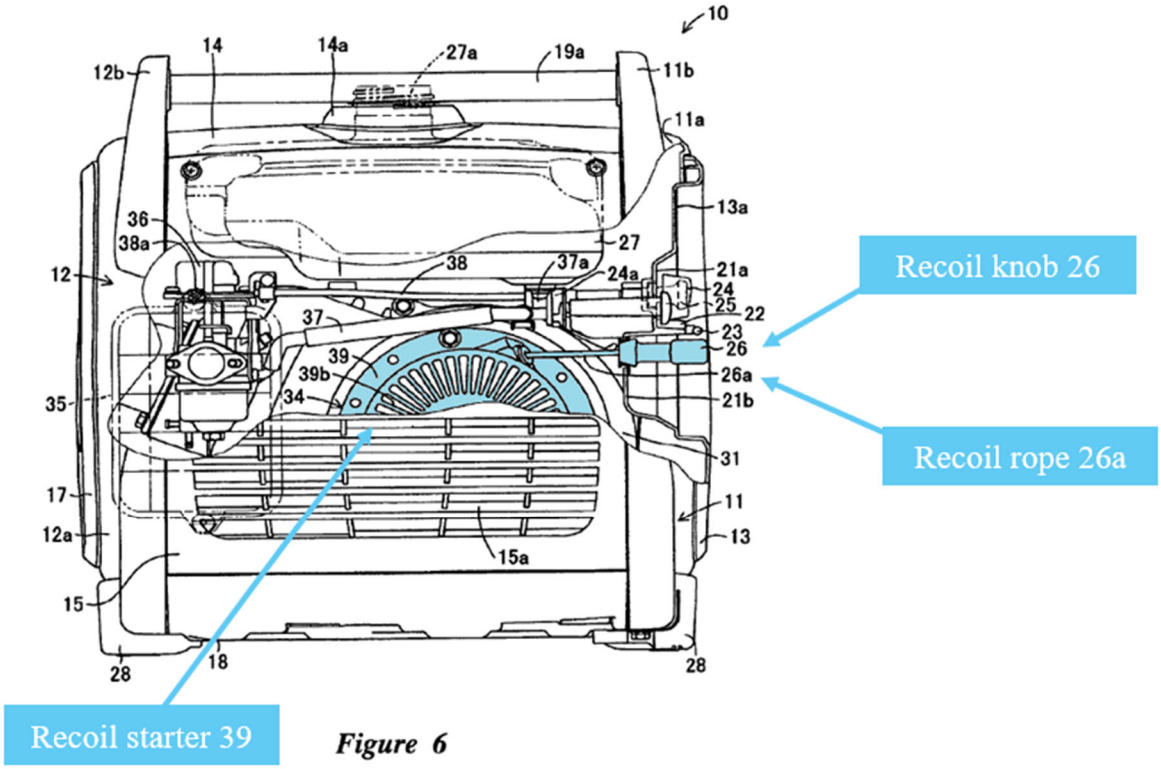
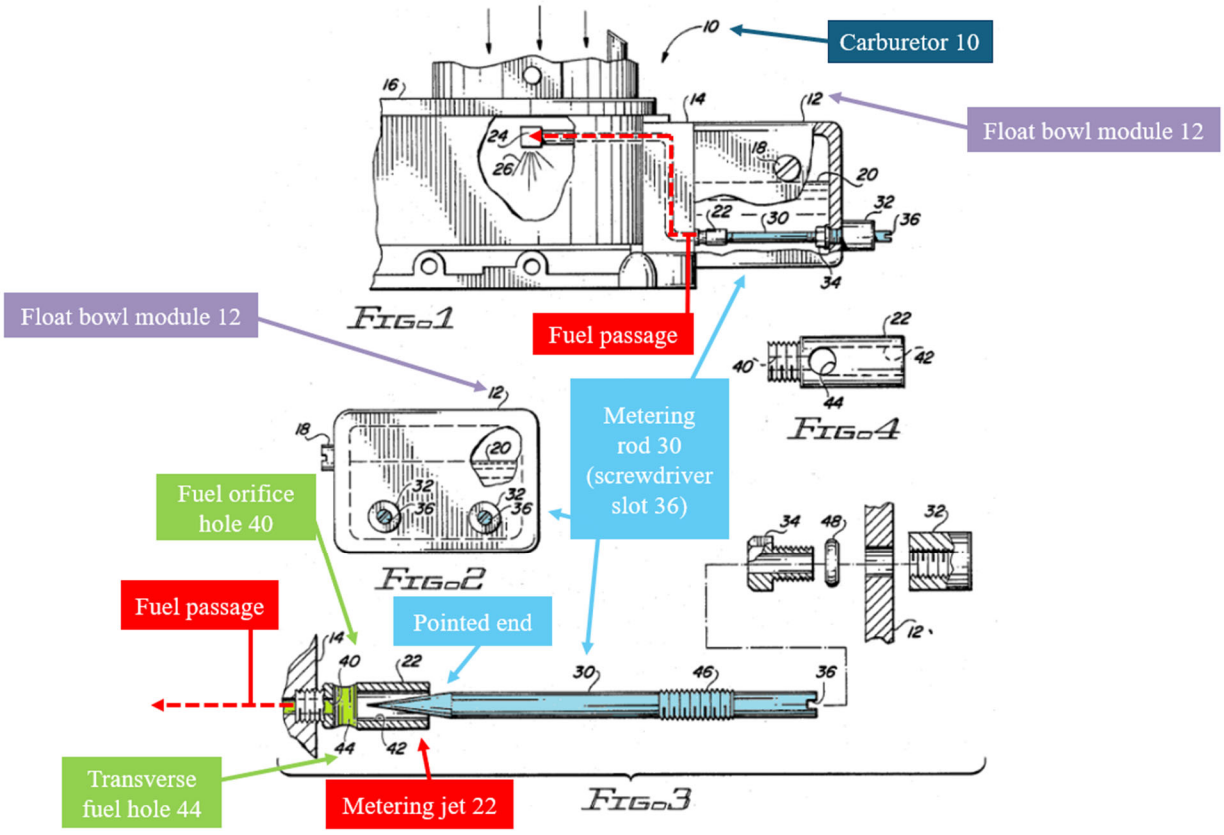


Figure 6

Id., Figure 6 (annotated).

G. U.S. Patent No. 4,776,988 ("Neal")

70. Neal discloses a valve in the form of a metering rod 30 in the float bowl 12 of an internal combustion engine for controlling the flow of gasoline to the engine (EX1031, 4:25-52; 6:15-42):



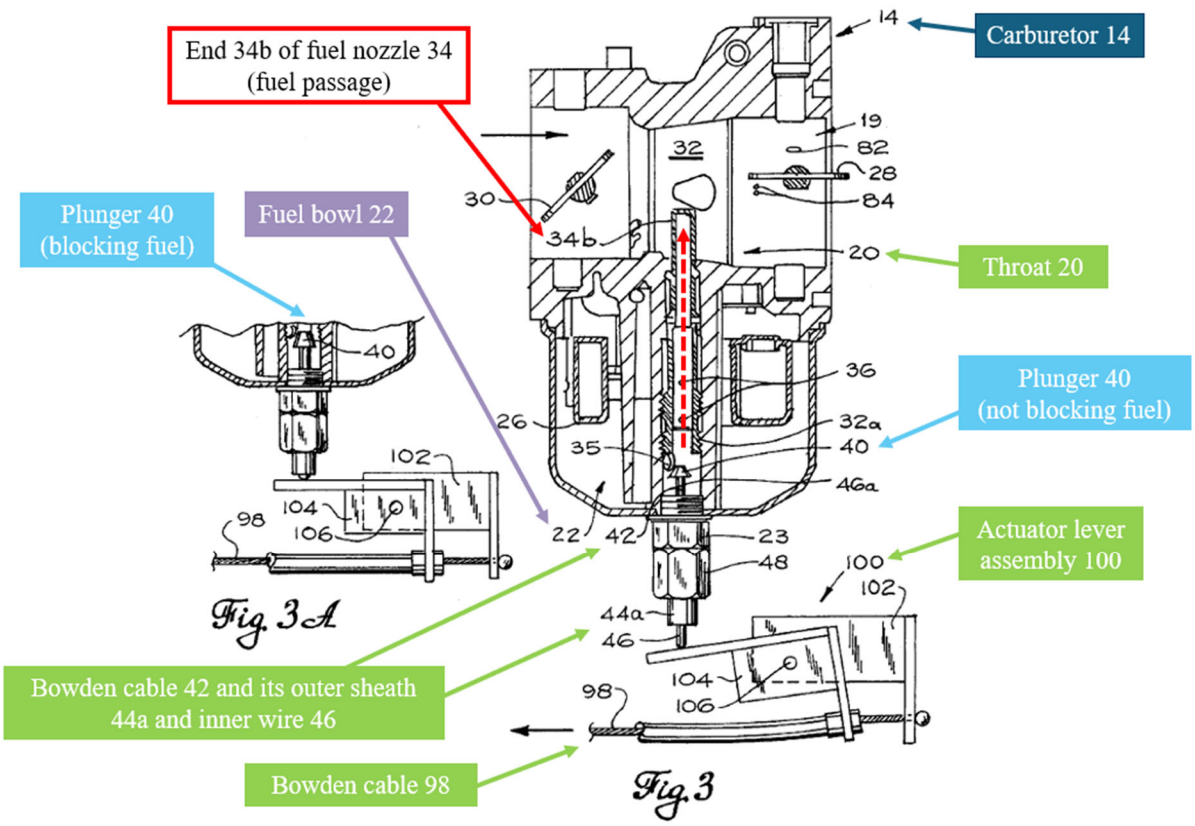
EX1031, Figures 1-4 (annotated).

71. The metering rod 30 extends from the exterior of the float bowl 12, through the wall of the float bowl, and across to the other end of the float bowl to engage with the metering jet 22 within the float bowl. *Id.*, 4:25-52; 6:15-42, Figures 1 & 3. The metering rod rotates using a screwdriver from the exterior of the float bowl at the screwdriver slot 36 to control the opening of the metering jet and, thus, the flow of fuel to the engine. *Id.* When the metering rod is fully screwed inwardly, no fuel can pass into fuel orifice hole 40. *Id.* As the metering rod is unscrewed, the amount of fuel that can pass into transverse fuel hole 44 and fuel orifice hole 40 to the engine increases. *Id.*

H. U.S. Patent No. 6,213,083 ("Winberg")

72. Winberg discloses a fuel shutoff system in the float bowl of an engine. EX1032, Abstract, Figures 1-7, 3:61-4:33, 5:34-6:43, 7:31-64. The fuel shutoff includes a blocking member or plunger 40 that blocks (Figure 3A) and unblocks (Figures 3 and 6) the flow of fuel from the float bowl 22 to the fuel passage in fuel nozzle 34, thus blocking the flow of fuel from the float bowl to the throat 20. *Id.*

73. The fuel shutoff actuates via a Bowden cable 42 attached to the plunger 40 at one end and to the actuator lever 49 in the actuator lever assembly 52 at the other end. *Id.*, 5:54-6:62. The actuator lever rotates about first pivot 54 between a run and stop position. *Id.* In Figures 3 and 3A, the actuator lever 49, actuator lever assembly 52, and first pivot 54 are labeled as moveable member 104, actuator lever assembly 100, and pivot point 106, *see id.*, 7:31-55, wherein these components are relabeled in the context of a lawn mower.



Id., Figures 3-3A (annotated).

74. In the embodiment of Figure 8, the fuel shutoff actuates by rotating a connecting member 142 using a lever arm 149 attached to a lever assembly 152, which moves plunger 140 between a blocking position and a non-blocking position:

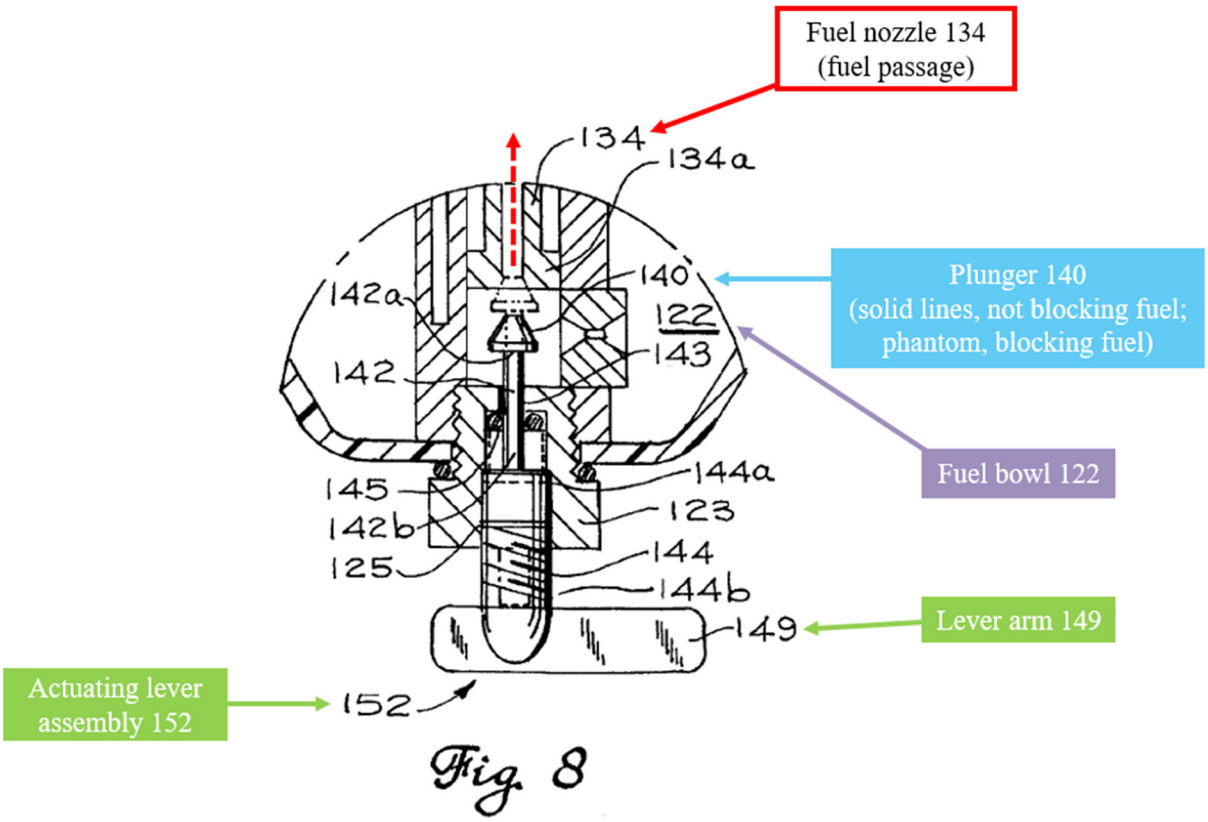


Fig. 8

Id., Fig. 8, 7:65-8:53.

XII. THE CHALLENGED CLAIMS ARE UNPATENTABLE

75. In my opinion, the cited prior art references, alone or in combination, disclose the limitations of the Challenged Claims. Grounds 1-9 are directed to the apparatus and method collectively addressing Claims 1-17, 19-26, 32-46, 53-54, and 56-58.

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

76. In my opinion, Claims 1, 3, 22, and 57 of the '398 Patent are anticipated for at least the reasons described below.

1. Claim 1

a. Element [1.0]

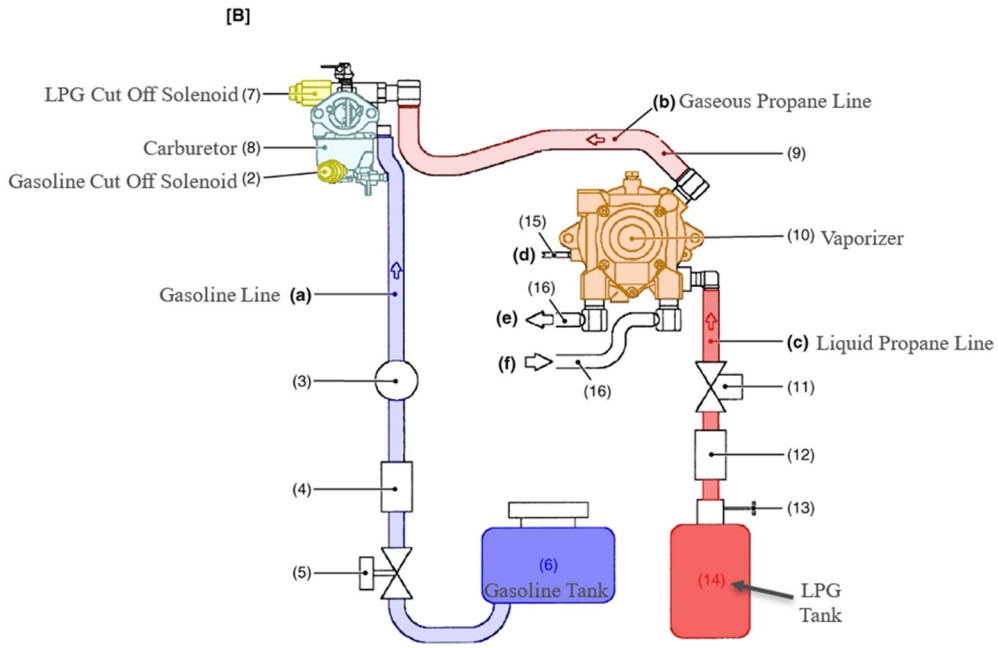
77. Element [1.0] recites "a dual fuel engine."

78. The Workshop Manual discloses a "Dual Fuel (Gasoline/LPG) Engine." EX1012, 8.

b. Element [1.1]

79. Element [1.1] recites "an engine operable on a gaseous fuel and a liquid fuel."

80. The Workshop Manual teaches that the DF972 engine uses both "Gasoline fuel" and "LPG fuel." *Id.*, 8, 65. The figure below discloses the DF972 fuel system:



Id., 65 (annotated).

81. The Workshop Manual discloses operation on a gaseous fuel, referred to as both LPG and "LP Gas" (*see* EX1012, 1, 10, 26, 30, 64, 68-69, 84, and *id.,* 8 and 12, respectively). While tank (14) contains LPG in both liquid and vapor form, the Workshop Manual explains "[t]he liquid fuel is evaporated in [the] vaporizer and is sent to the DF [dual fuel] carburetor (8) as a gaseous fuel." *Id.*, 65 (also denoting "Gaseous Propane Line" (b)), 69 (describing the vaporizer operation).

82. As confirmed by the '398 Patent (EX1001, 4:9-10, Claim 3), gasoline is a liquid fuel and LPG is a gaseous fuel. *See also id*., 4:27-34, 7:66-67. Specifically, even though LPG is conveniently stored in a liquid state under high pressure, LPG exists as a gas at normal temperatures and pressures, which the '398 specification confirms. *See id*. 1:41-47. LPG supplied in this way will typically leave the storage tank as a liquid and gas mixture in equilibrium until there is a change in temperature and/or pressure. For example, when the LPG exiting the tank travels to a first regulator that reduces the pressure, the LPG will be vaporized to gaseous form as it passes through the regulator. Vaporizers/regulators that have the dual function of vaporizing fuel and regulating its pressure were well known in the art. *See, e.g*., EX1018, 7:36-38; EX1039, ¶[0078].

83. That fuels such as LPG that are stored in liquid form and get vaporized on their pathway to the engine carburetor are still considered a "gaseous fuel" for purposes of interpreting the claims is confirmed by the prosecution history leading

to the ’398 Patent. Specifically, during prosecution (*see* EX1002, 180), the Examiner rejected certain pending claims over Sugimoto, which taught a dual-fuel generator that stored a “first fuel” in liquid form under high pressure (*see, e.g.*, EX1039, ¶¶[0071]-[0072] (identifying liquefied butane as a first fuel source), which was subsequently vaporized in the pressure regulator on the way to the engine carburetor (*see id.*, ¶¶[0001], [0003], [0078], [0085], [0100], Claim 1); Sugimoto also taught supplying a second fuel to the same regulator as a gas (*id.*, ¶[0078]). Consequently, for the rejection, the Examiner characterized Sugimoto as a dual fuel generator “operable on a gaseous fuel and a liquid fuel.” EX1002, 180.

84. In response to this rejection, Patent Owner took issue with the Examiner’s characterization of Sugimoto’s “first fuel” (i.e., liquid butane stored under pressure and vaporized in pressure regulator 62) as being the claimed liquid fuel. Specifically, Patent Owner argued that in Sugimoto:

> In addition, Sugimoto does not disclose the Examiner’s asserted “engine operable on a gaseous fuel and a liquid fuel….” Sugimoto actually discloses “[t]he external fuel bottle 71 supplies the second fuel gas in gas phase to the fuel gas pressure regulator 62” and “[t]he fuel pressure regulator 62 functions as a vaporizer for vaporizing the first fuel gas supplied thereto in liquid phase.” Sugimoto, ¶[0078]. Since the first fuel gas is vaporized by the fuel pressure regulator 62, the first fuel gas and the second

> fuel gas are provided in a gaseous form to the carburetor…. As such, the Examiner has not shown that Sugimoto discloses an engine operable on a gaseous fuel and a liquid fuel, as called for in claims 19 and 48.

EX1002, 225. In effect, the Patent Owner took the position that Sugimoto did not disclose both a liquid fuel and a gaseous fuel, but instead disclosed two different gaseous fuels (and, therefore, no liquid fuel). Based on this prosecution history, it is clear that the Patent Owner considers a fuel that is delivered to the carburetor in a gaseous state to be a "gaseous fuel," regardless of what state it is stored in (e.g., as a liquid under high pressure) or whether it gets vaporized after leaving the storage tank on the way to the engine.

85. Thus, based on the specification, claims, and the prosecution history of the '398 Patent, a POSA would have understood that LPG is a "gaseous fuel" as described in the claims of the '398 Patent, even if it is stored under pressure as a liquid and gets converted to gaseous form via a vaporizer/pressure regulator before reaching the carburetor.

c. Element [1.2]

86. Element [1.2] recites "a switch to change operation of the engine between gaseous fuel and liquid fuel."

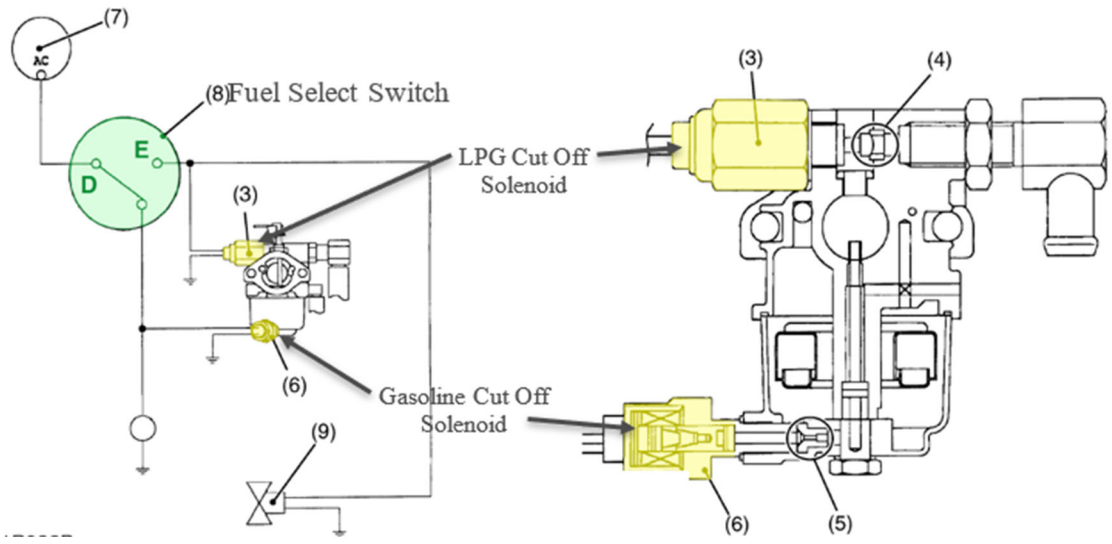
87. The Workshop Manual discloses a switch (i.e., "Fuel Select Switch") that changes operation of the engine between gaseous fuel and liquid fuel:

> 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.

88. Because the Gasoline Cut Off Solenoid opens upon receipt of current (and, conversely, is closed in the absence of current), it is a normally closed solenoid.

89. This switch is also shown in the Workshop Manual figures:



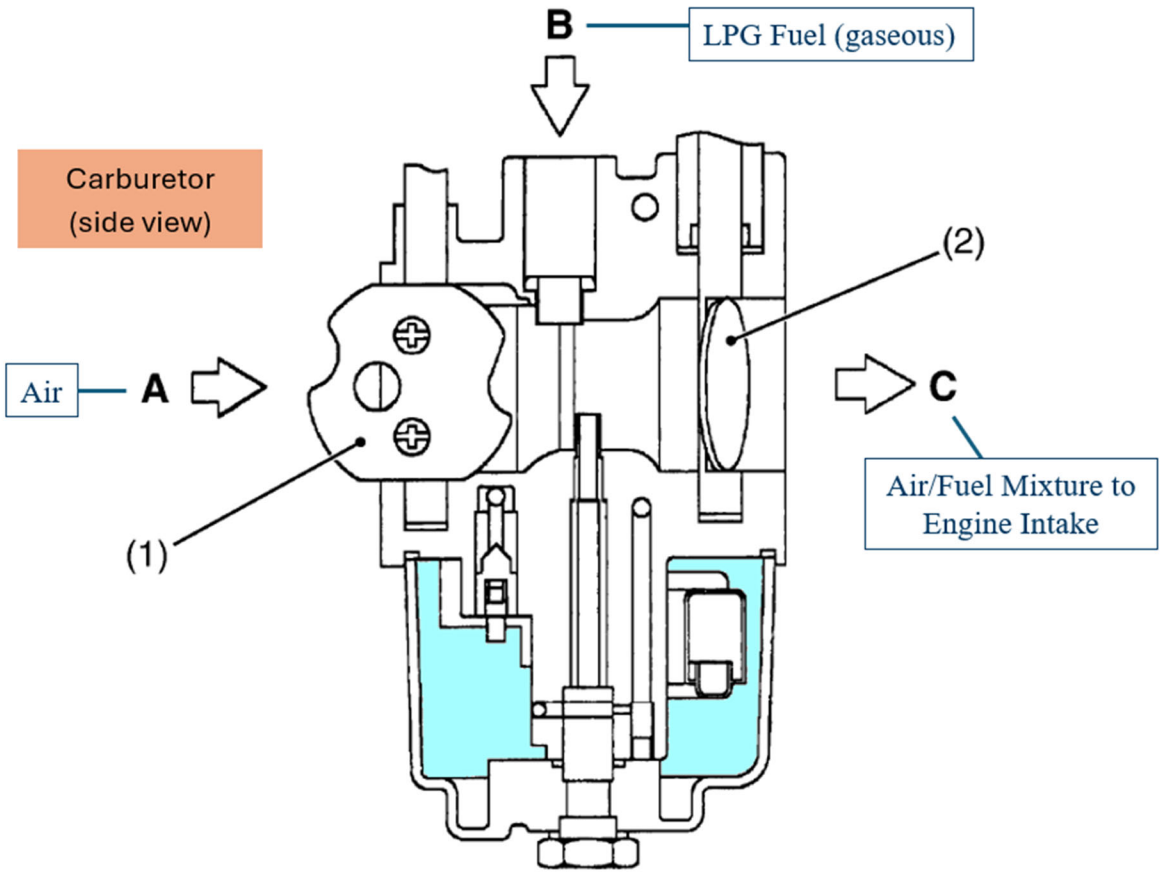
Id. (annotated).

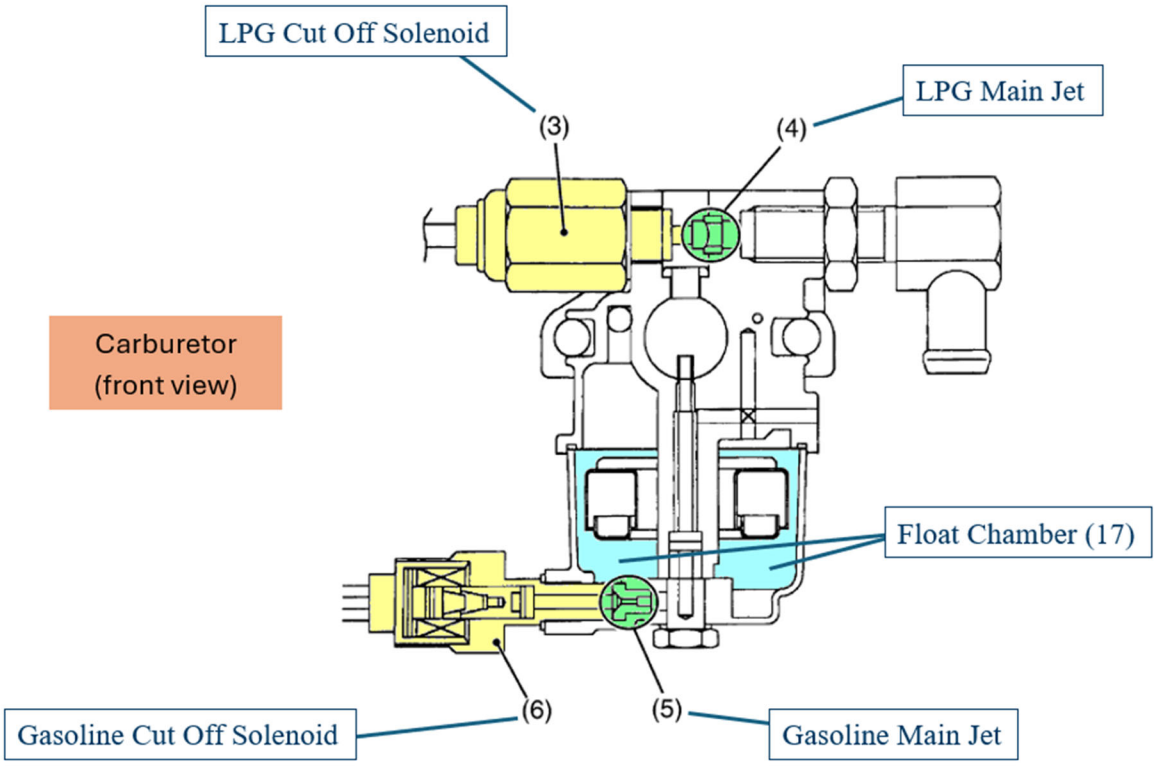
d. Element [1.3]

90. Element [1.3] recites "a carburetor attached to an intake of the engine to mix air and fuel and connect a gaseous fuel source and a liquid fuel source."

91. 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.

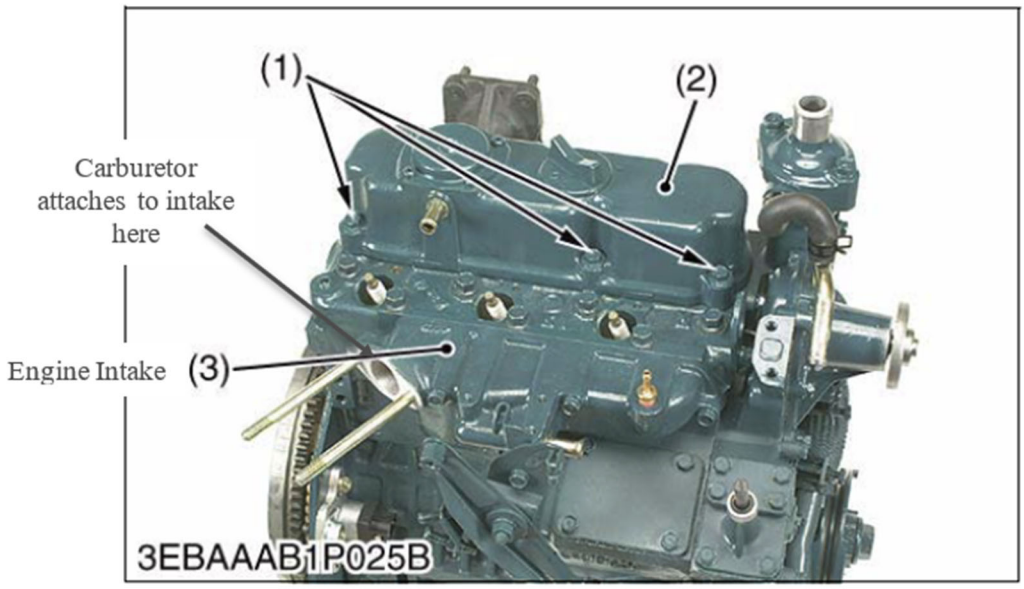
92. The Workshop Manual figures illustrate the carburetor operation:

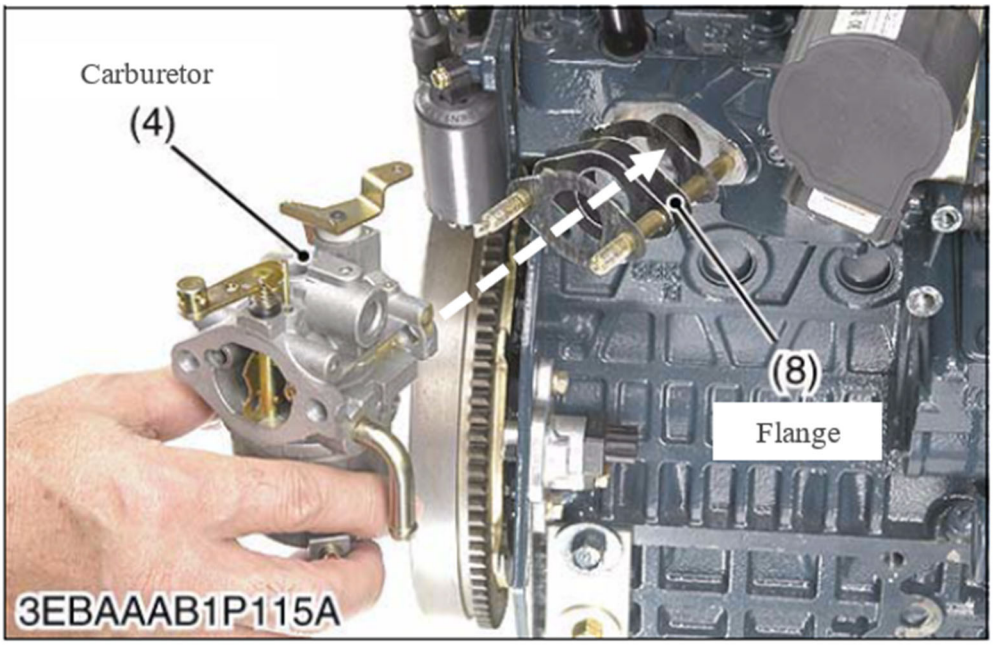


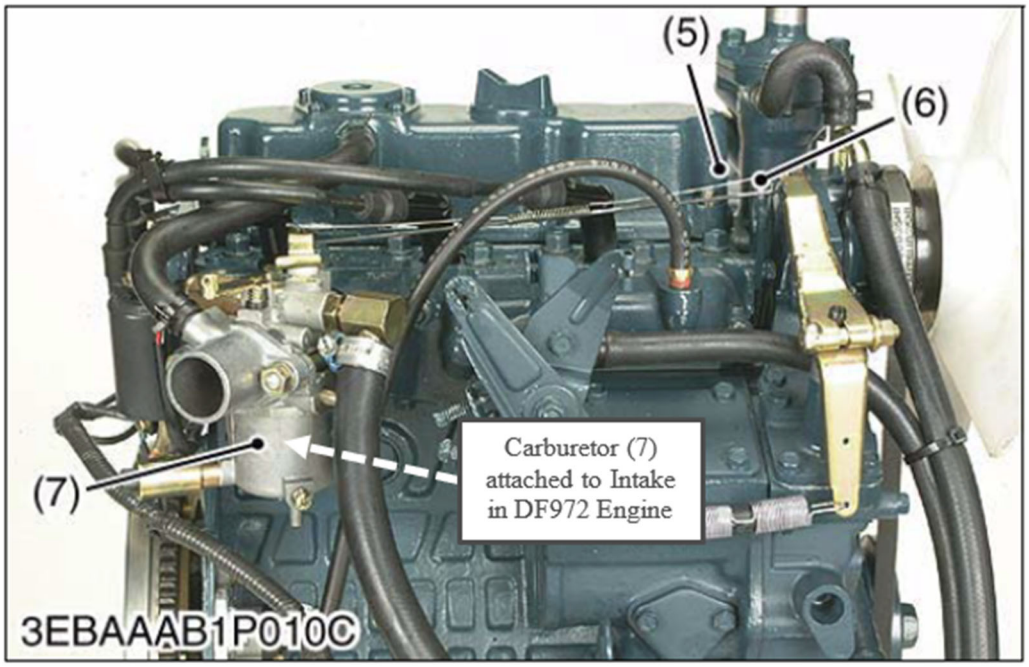


Id. (annotated).

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

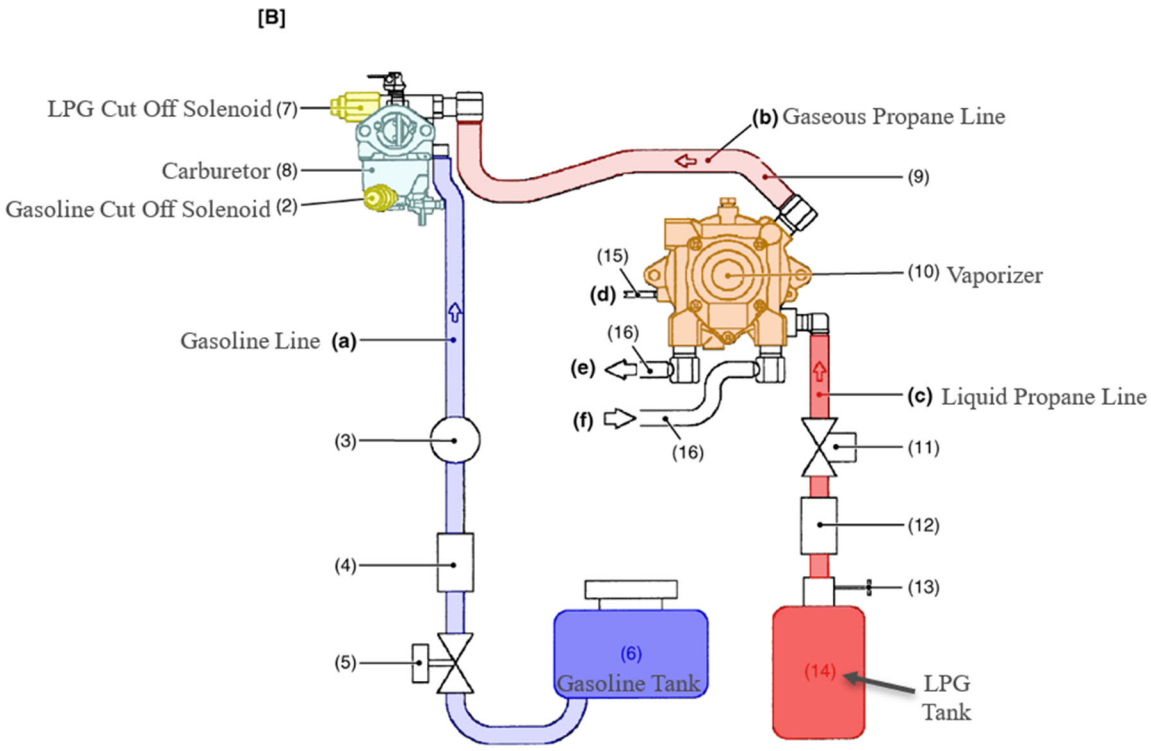

(1)
(2)
Carburetor attaches to intake here
Engine Intake
(3)
3EBAAAB1P025B


Carburetor
(4)
(8)
Flange
3EBAAAB1P115A



EX1012, 115, 119 (annotated).

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

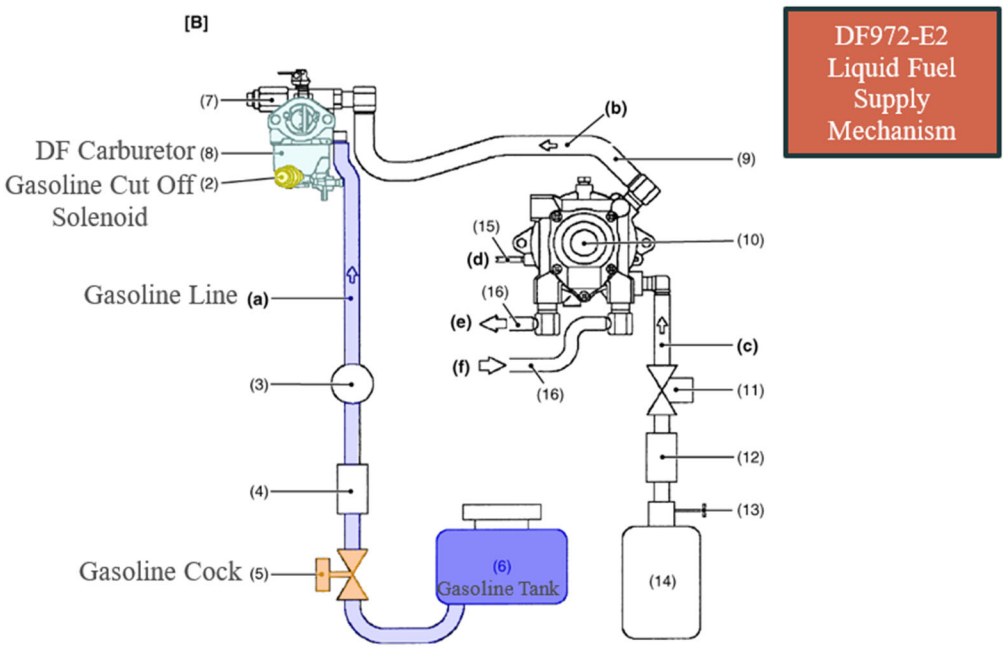


EX1012, 65 (annotated).

e. Element [1.4]

95. Element [1.4] recites "a liquid fuel valve positioned along a liquid fuel line coupling the liquid fuel source to the carburetor."

96. 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:



EX1012, 65 (annotated).

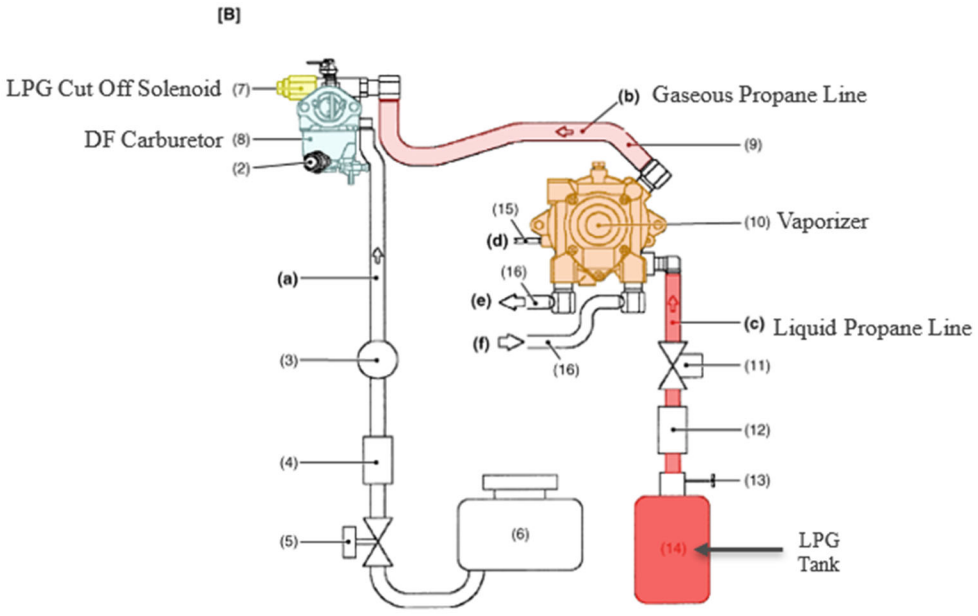
f. Element [1.5]

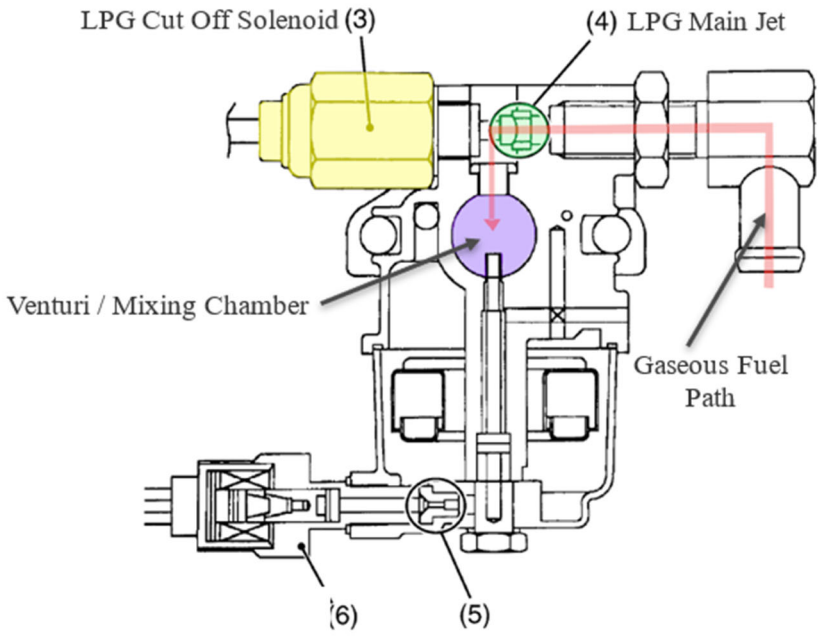
97. Element [1.5] recites "a gaseous fuel valve positioned along a gaseous fuel line coupling the gaseous fuel source to the carburetor."

98. The Workshop Manual discloses a gaseous cutoff (LPG Cut Off Solenoid)[3] that opens and closes a gaseous fuel source (LPG Tank (14)) to the engine. EX1012, 65, 68 ("When the fuel select switch (8) is turned to the "LPG" position "E", the battery current … flows to the LPG cut off solenoid (3) and LPG shut off solenoid valve (9). Then, … LPG fuel flows to the mixing chamber."). As

[3] Referred to as LPG Cut Off Solenoid (7) on page 65 of the manual and LPG Cut Off Solenoid (3) on page 68 of the manual. EX1012, 65, 68.

shown below, the LPG Cut Off Solenoid (7) is positioned on the Gaseous Propane Line (b) coupling the LPG tank to the carburetor:



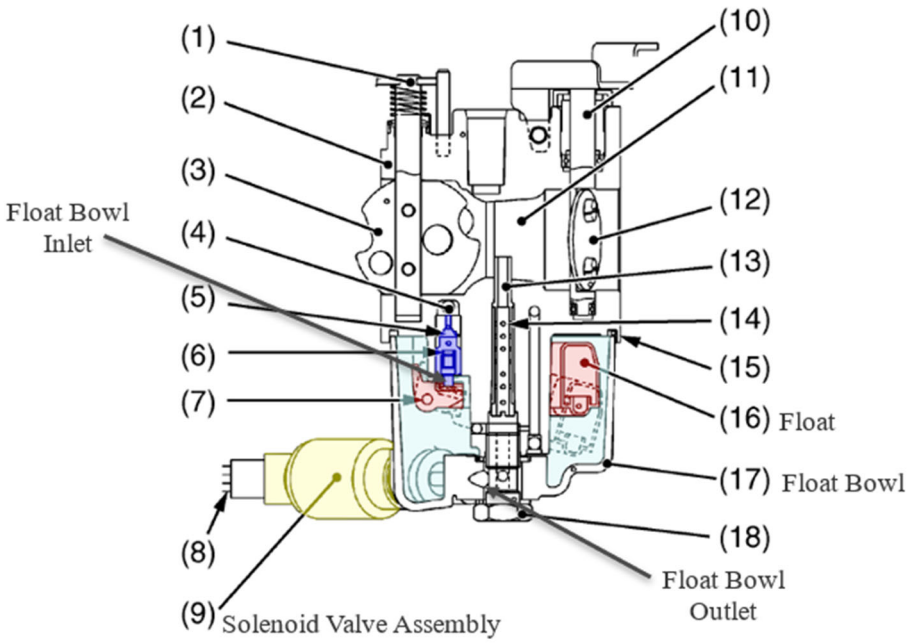


Id., 65, 68 (annotated).

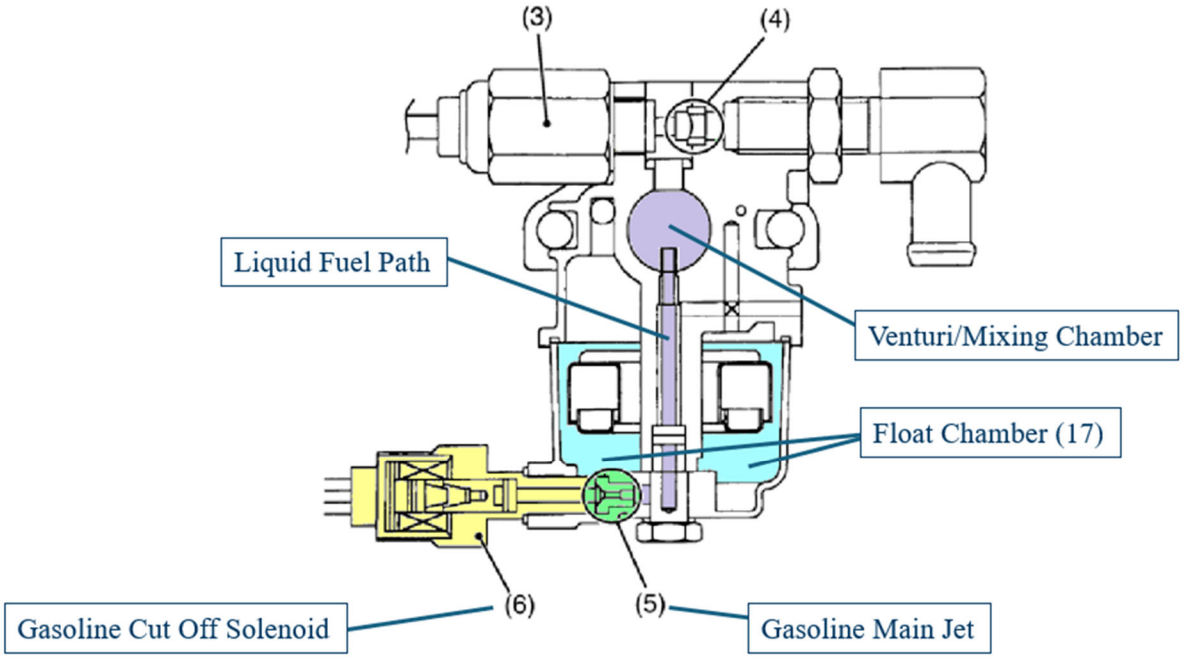
g. Element [1.6]

99. Element [1.6] recites "a liquid fuel cut-off incorporated into the carburetor to interrupt liquid fuel upon actuation of the switch from liquid fuel to gaseous fuel."

100. The Workshop Manual discloses Gasoline Cut Off Solenoid (6) (EX1012, 65, 68), which is a "liquid fuel cut-off" for purposes of Element [1.6]. As discussed (*see* §XII.A.1.c), the fuel select switch changes operation of the engine between gaseous and liquid fuel which results in the liquid fuel cut off interrupting liquid fuel. EX1012, 65, 68 ("When the fuel select switch (8) in 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)).



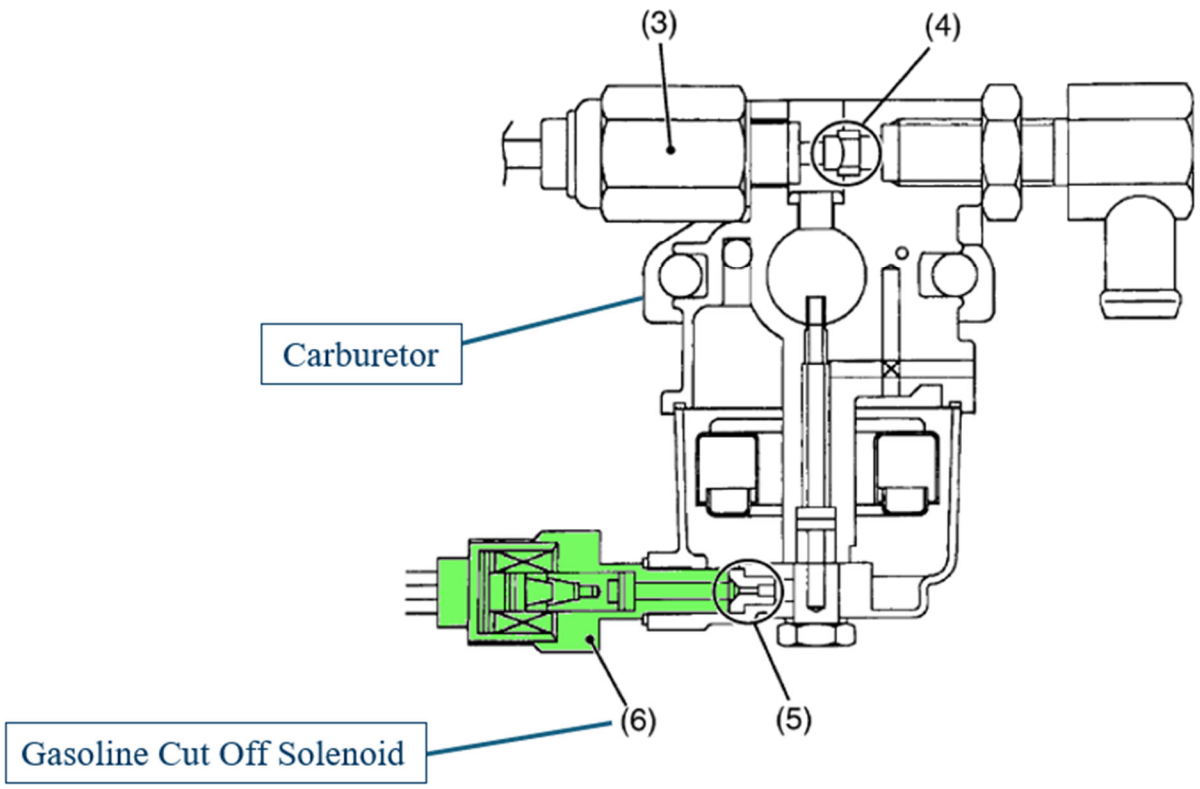
Id., 67 (annotated).[4]



EX1012, 68 (annotated).

101. As shown below, the Gasoline Cutoff Solenoid (6) is incorporated into the carburetor:

[4] 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."

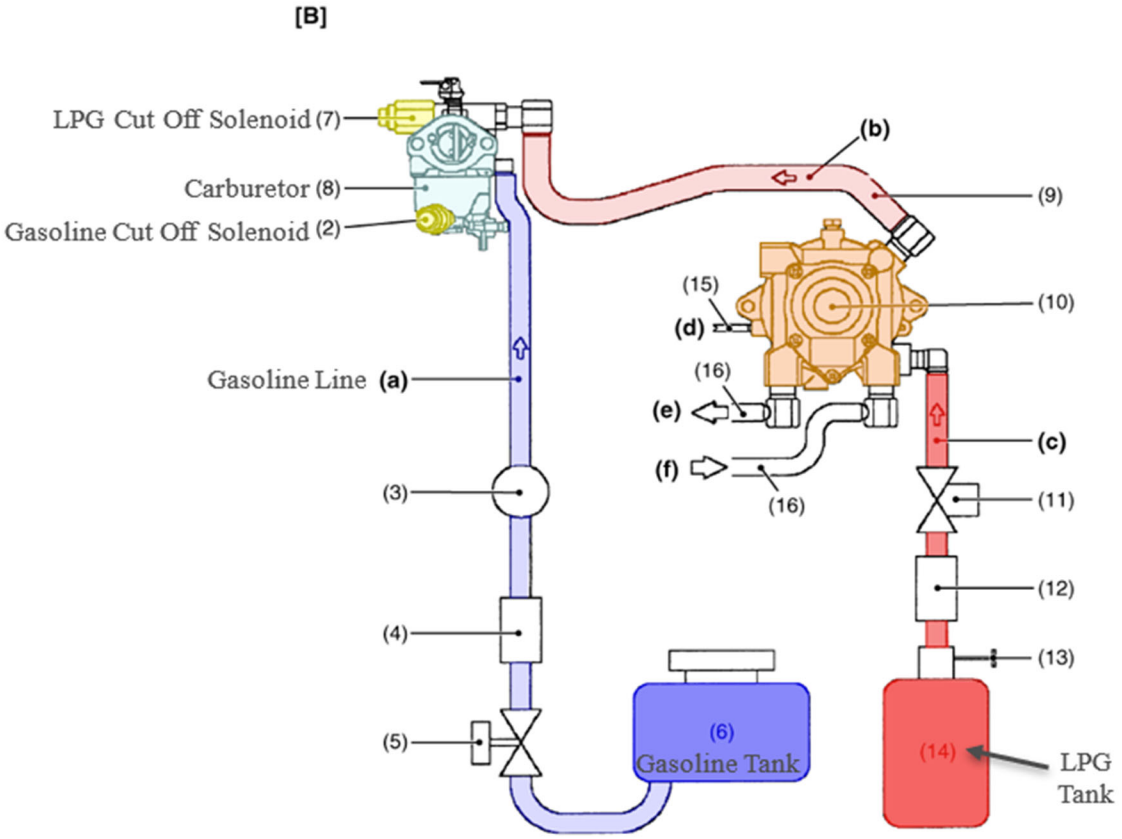


EX1012, 68 (annotated)

2. Claim 3

102. Claim 3 depends from Claim 1, and further recites "wherein the gaseous fuel is LPG and the liquid fuel is gasoline."

103. The Workshop Manual's dual-fuel engine operates on gasoline and LPG:

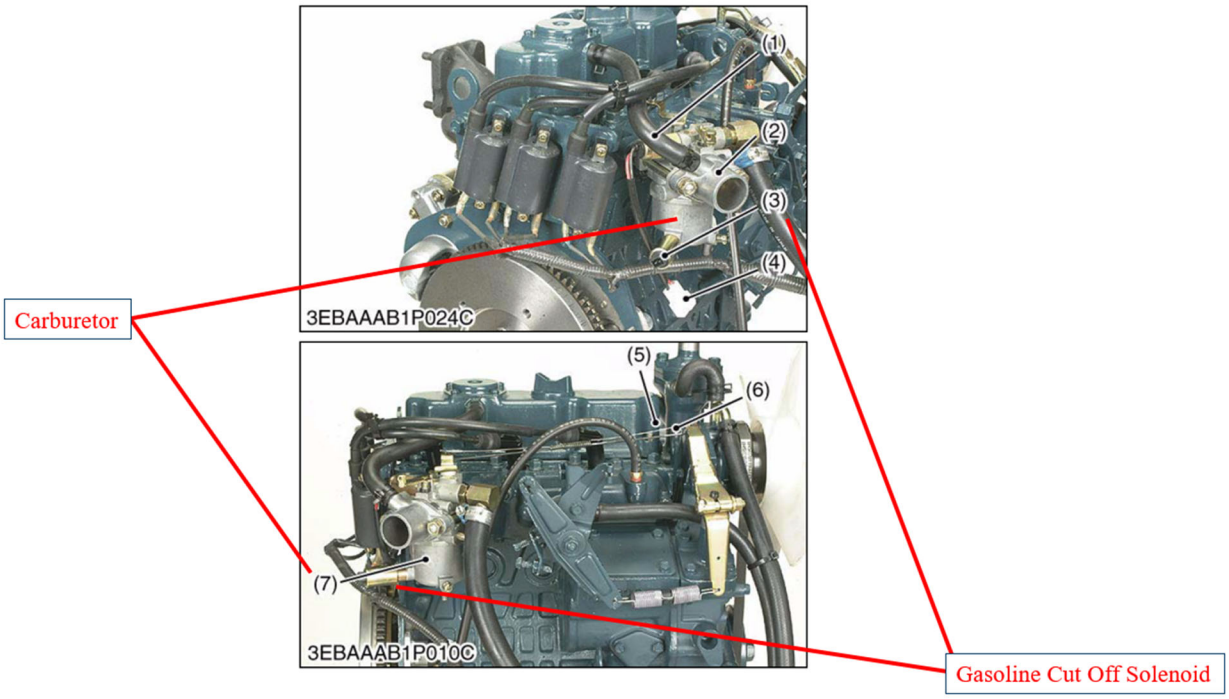


EX1012, 65 (annotated); *see also* §§XII.A.1.a, XII.A.1.b.

3. Claim 22

104. Claim 22 depends from Claim 1, and further recites "wherein the liquid fuel cut-off is physically attached to an outer surface of the carburetor."

105. The Workshop Manual discloses the liquid fuel cut-off (Gasoline Cut Off Solenoid) is physically attached to an outer surface of the carburetor:



EX1012, 115 (annotated).

4. Claim 57

a. Element [57.0]

106. Element [57.0] recites "a method of assembling a dual fuel engine."

107. As discussed (*see* §§XII.A.1.a-XII.A.1.b), the Workshop Manual discloses a dual-fuel engine. It is inherent that the components of the DF972 engine of the Workshop Manual were assembled to form the dual-fuel engine, as their integration into a functional system necessitates assembly steps. A POSA would understand that the Workshop Manual's disclosure of the DF972 inherently includes the method of assembling its components.

b. Element [57.1]

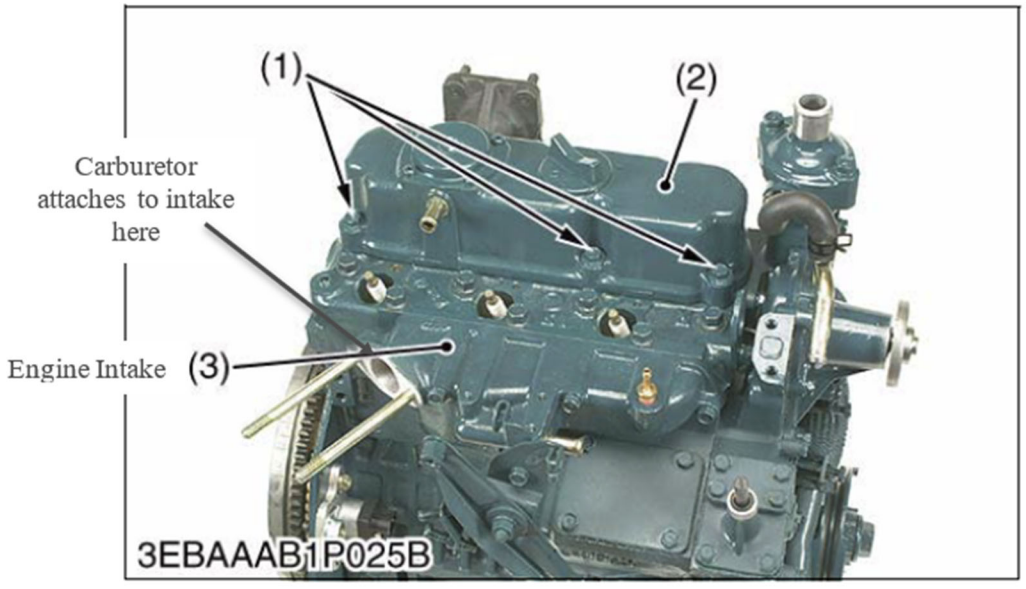
108. Element [57.1] recites "providing an engine operable on a gaseous fuel and a liquid fuel."

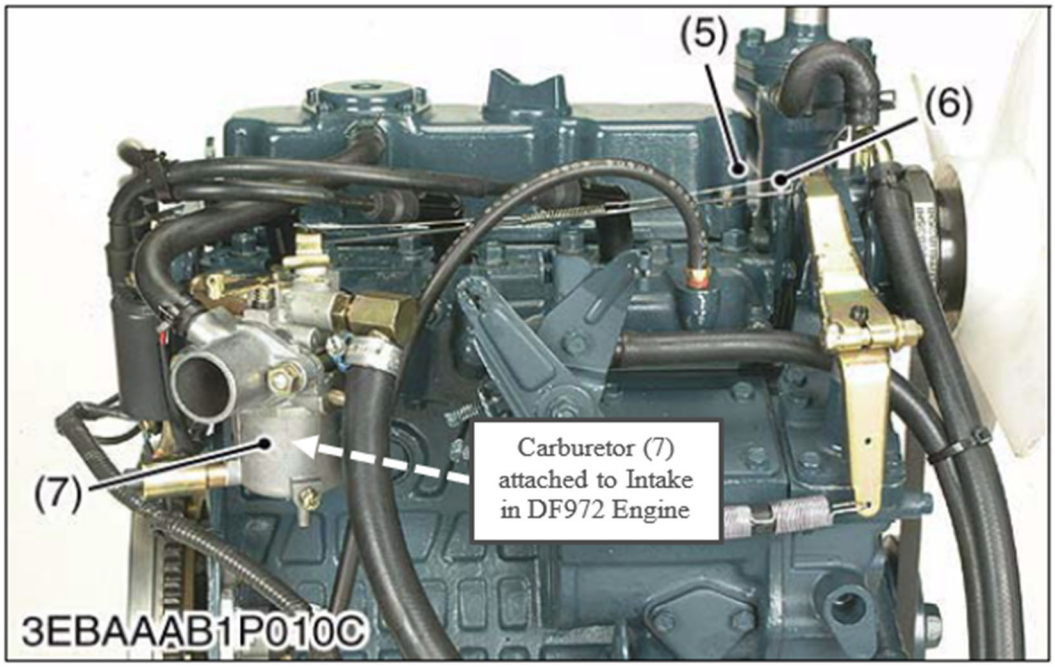
109. As discussed (*see* §XII.A.1.b), the Workshop Manual's DF972 engine selectively uses gasoline or LPG as fuel.

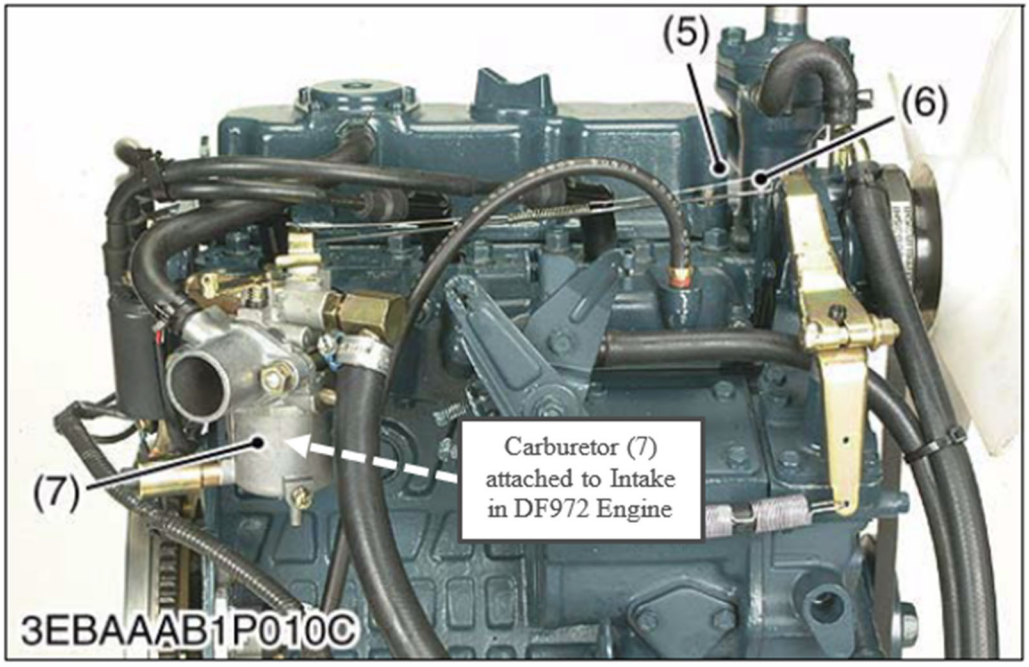
c. Element [57.2]

110. Element [57.2] recites "attaching a carburetor to an intake of the engine."

111. As discussed (*see* §XII.A.1.d), the Workshop Manual discloses attaching a carburetor to an intake of the engine. The Workshop Manual illustrates a carburetor being attached to the engine's intake manifold (part of the engine's intake):







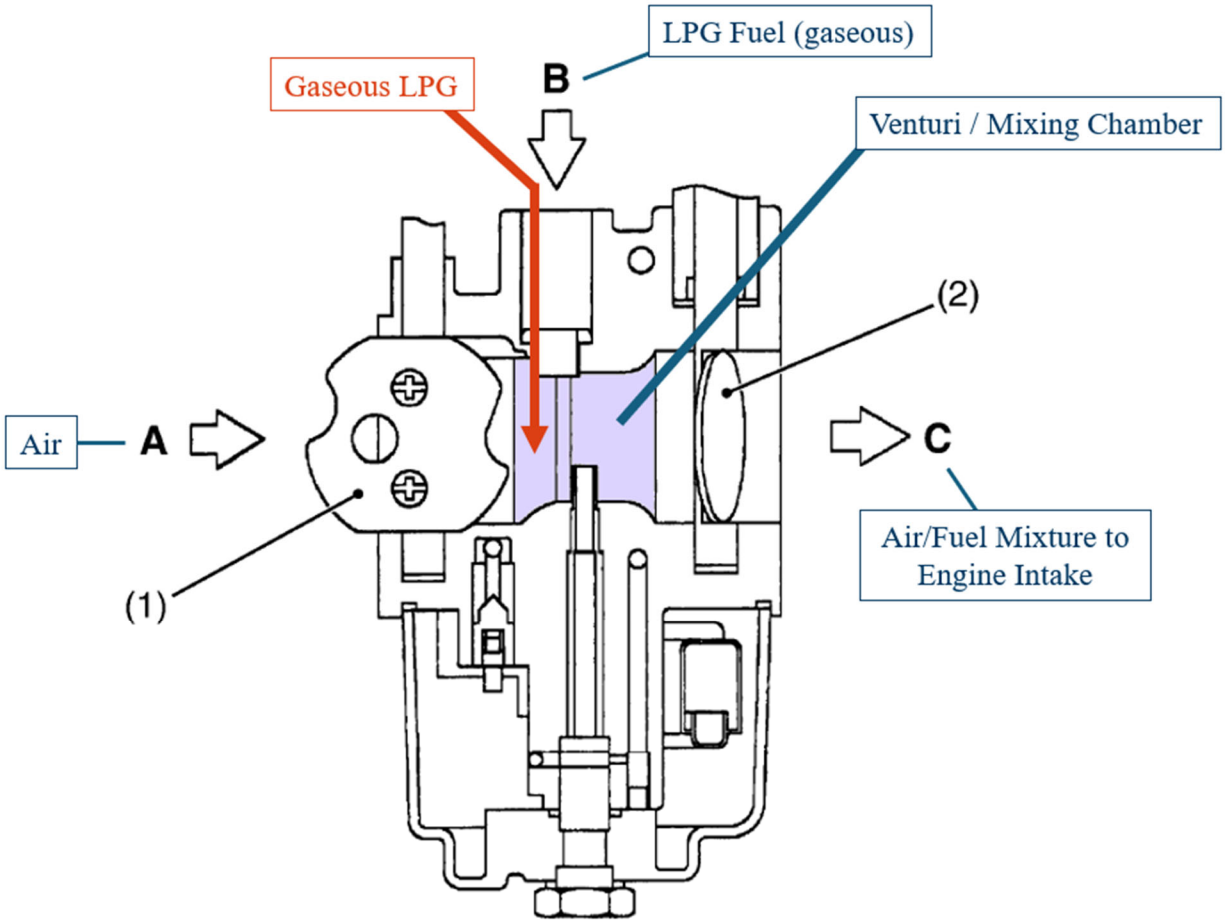
EX1012, 115, 119 (annotated).

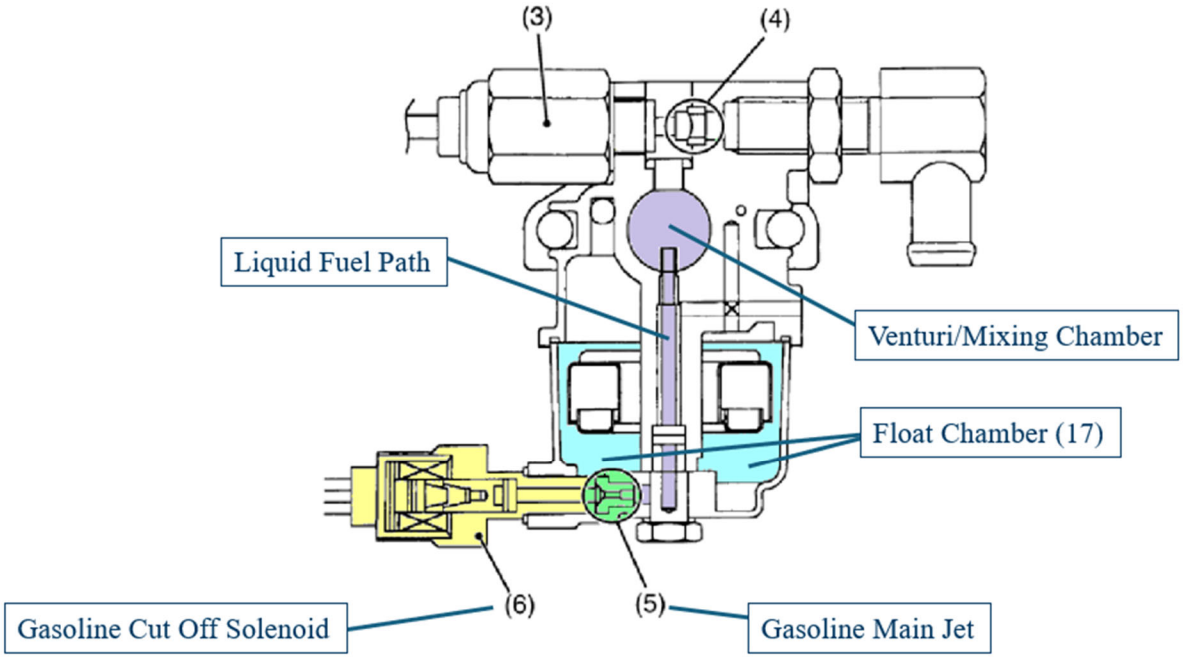
112. Further, a POSA would understand that assembling the DF972 engine of the Workshop Manual involves attaching the carburetor to the engine's intake.

d. Element [57.3]

113. Element [57.3] recites "a throat to mix gaseous fuel with air and liquid fuel with air."

114. The Workshop Manual discloses a carburetor mixing chamber, which a POSA would understand to be a throat of the carburetor in which gaseous fuel and liquid fuel are mixed with air:



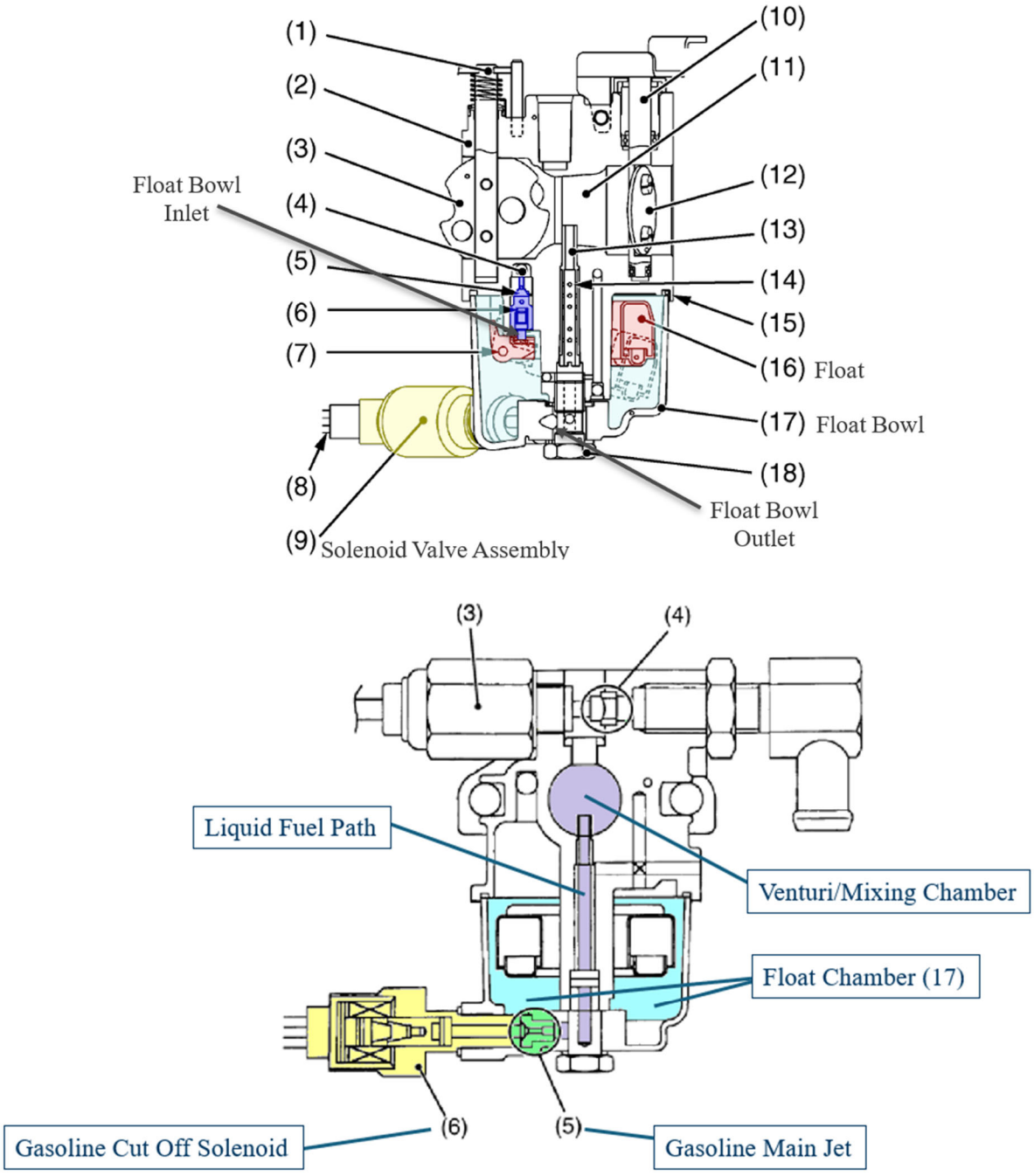


EX1012, 68 (annotated).

e. Element [57.4]

115. Element [57.4] recites "a float bowl."

116. The carburetor for the DF972 engine comprises a float bowl that holds liquid fuel (gasoline), labeled "float chamber (17)" in the Workshop Manual figure for the WG-972 engine (EX1012, 67), which is the same for the DF972 engine (*see id.*, 68 (noting that the DF carburetor operates the same as the gasoline-only carburetor when operating on gasoline)).

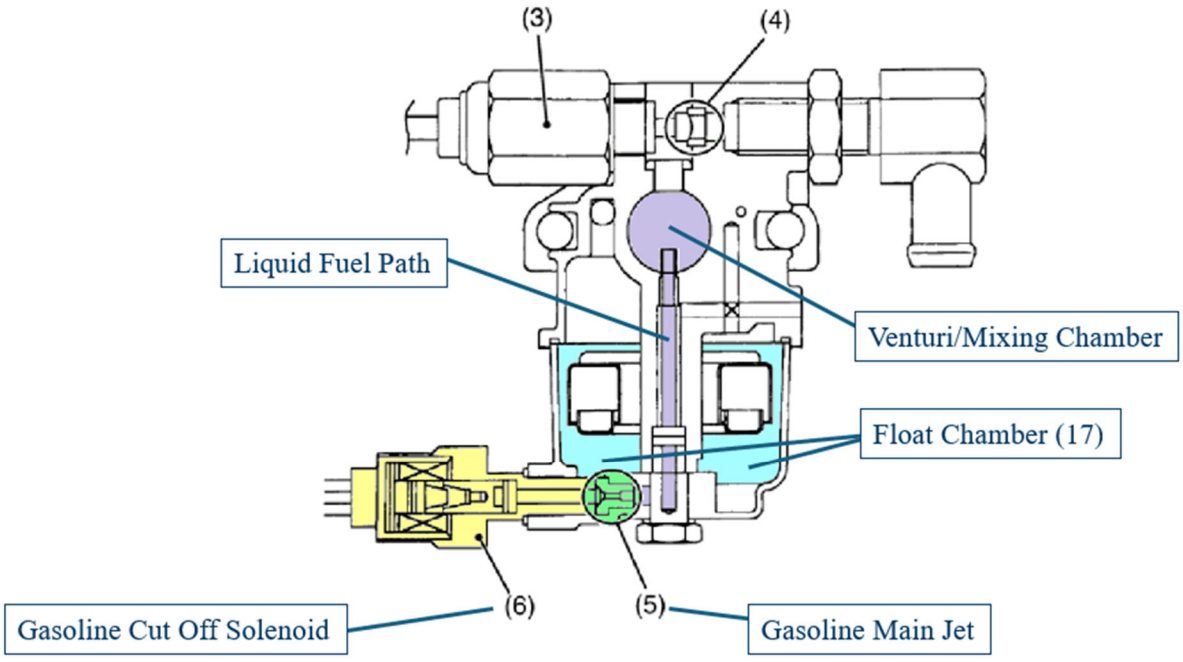


EX1012, 67-68 (annotated).

f. Element [57.5]

117. Element [57.5] recites "a fuel passage extending from the float bowl to the throat to provide liquid fuel."

118. The Workshop Manual discloses a fuel passage positioned downstream from the float bowl (i.e., "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)). A POSA would understand the carburetor mixing chamber to be the throat of the carburetor, as previously discussed (*see* §XII.A.4.d).



EX1012, 68 (annotated).

119. Therefore, the fuel passage (in purple) extends from the float chamber to the throat to provide liquid fuel. *Id*., 67-68.

g. Element [57.6]

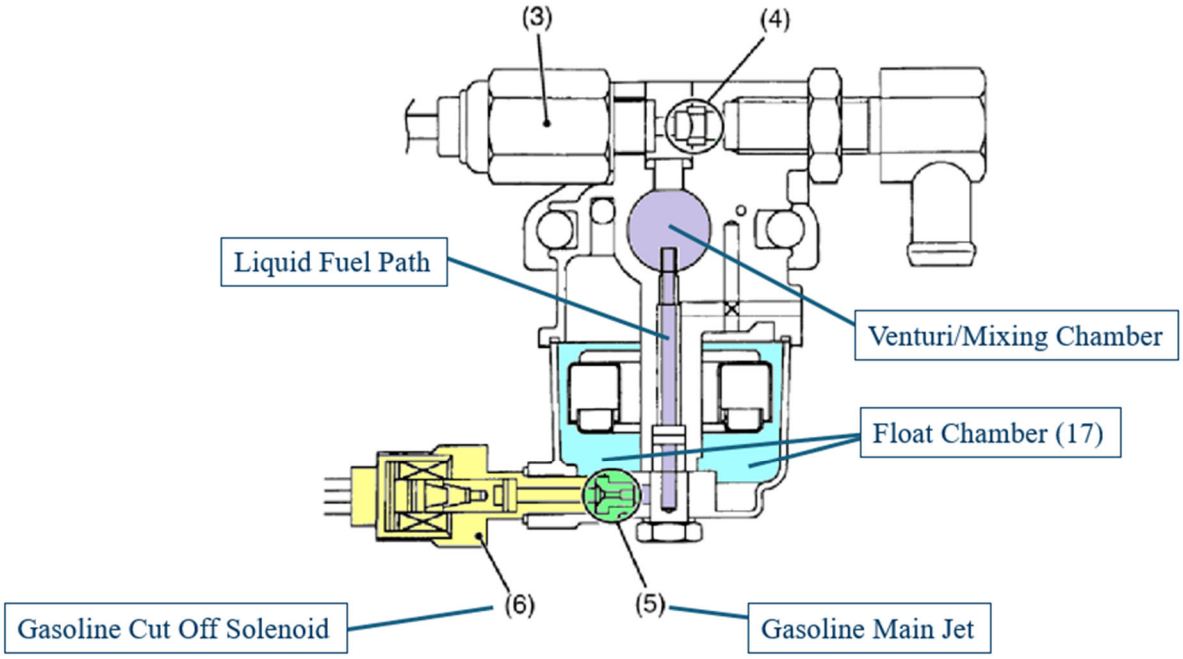
120. Element [57.6] recites "coupling a switch to the engine to change operation of the engine between gaseous fuel and liquid fuel."

121. As discussed (*see* §XII.A.1.c), the Workshop Manual discloses a fuel select switch that changes operation of the engine between gaseous fuel and liquid fuel. It is inherent in the Workshop Manual that the fuel select switch was coupled to the engine's fuel supply system during assembly, as its integration into the electrical circuit is necessary to enable fuel switching. A POSA would understand that assembling the DF972 engine of the Workshop Manual involves coupling fuel select switch to facilitate fuel selection.

h. Element [57.7]

122. Element [57.7] recites "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."

123. As discussed (*see* §XII.A.1.g), the Workshop Manual discloses a Gasoline Cut Off Solenoid that is attached to the carburetor to interrupt liquid fuel upon actuation of fuel select switch from liquid fuel to gaseous fuel. As shown below, the Gasoline Cut Off Solenoid operates by closing the liquid fuel passage:



EX1012, 68 (annotated).

124. It is inherent that the Gasoline Cut Off Solenoid was attached to the carburetor during assembly, as its integration into the fuel system is necessary for operation of the DF972 engine of the Workshop Manual. A POSA would have understood that assembling the DF972 engine involved attaching Gasoline Cut Off Solenoid to the carburetor to close the fuel passage.

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

125. In my opinion, Claims 2, 4-14, 19-21, 23, 32-42, and 58 of the '398 Patent are obvious, as described below.

1. Claim 2

126. Claim 2 depends from Claim 1, and further recites "wherein the engine is a pull start, batteryless engine."

127. It would have been obvious to a POSA to incorporate a pull-start to start the DF972 engine in place of the battery. Matsushima discloses a pull-start for an engine (i.e., a recoil starter 40). EX1029, 2:3-8, 2:46-54, 4:63-66, 5:4-8.

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

a. Motivation/Expectation of Success

129. 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. 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.

130. A POSA would have reasonably expected success in adopting Matsushima's recoil mechanism for use with the Workshop Manual's dual-fuel engine. Because the DF972 engine already incorporates a flywheel and fan shroud analogous to those shown in Matsushima, a POSA would have found it straightforward to mount Matsushima's recoil mechanism on the DF972 engine with

only routine mechanical adaptation. At the time of the invention, the use of recoil starters was ubiquitous on small engines, and their installation required only routine mechanical tasks—attaching the standard recoil housing.

2. Claim 4

131. Claim 4 depends from Claim 1, and further recites "wherein the engine is a pull-start engine having an electrical power generator to supply electrical power."

132. 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 150 W at 12 V. *Id.*, 8. Thus, Workshop Manual discloses an electrical power generator, powered by operation of the DF972 engine.

133. As discussed (*see* §XII.B.1), it would have been obvious to incorporate Matsushima's recoil-starter assembly with the Workshop Manual's DF972 engine.

3. Claim 5

134. Claim 5 depends from Claim 4, and recites two additional elements.

a. Element [5.1]

135. Element [5.1] recites "wherein the switch is an electro-mechanical switch connecting one fuel source to the carburetor and connected to the electrical power generator."

136. As noted for Element [1.2] (*see* §XII.A.1.c), the DF972's fuel select switch changes operation of the engine between gaseous fuel and liquid fuel by selectively powering the Gasoline Cut Off and LPG Cut Off solenoids. Specifically, the fuel select switch uses a mechanical part to control the flow of electrical current, thus making it an electro-mechanical switch. Because operation of fuel select switch dictates which fuel is supplied to the carburetor, it connects one fuel source to the carburetor.

137. As discussed (*see* §XII.B.2), the Workshop Manual discloses an engine with an alternator that provides electrical current to the power consuming circuits in the engine. The fuel select switch is connected to the DF972's generator via the battery. *See* §§XII.A.1.c, XII.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 vale 10). EX1029, Fig. 1, 5:1-48.

b. Element [5.2]

138. Element [5.2] recites "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."

139. As discussed (*see* §XII.B.1), it would have been obvious to incorporate Matsushima's recoil-starter assembly with the Workshop Manual's dual-fuel engine.

140. As noted for Element [1.6] (*see* §XII.A.1.g), the Gasoline Cut Off Solenoid opens and closes the liquid fuel path upon actuation of the fuel select switch. And as noted for Element [1.2] (*see* §XII.A.1.c), fuel select switch selectively powers the Gasoline Cut Off Solenoid via current flow. Thus, the fuel select switch dictates whether the Gasoline Cut Off Solenoid opens or closes a fuel path to the engine.

4. Claim 6

141. Claim 6 depends from Claim 4, and further recites "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."

142. As discussed (*see* §XII.A.1.g), the Gasoline Cut Off Solenoid is incorporated into the carburetor and controls liquid fuel flow. As also discussed (*see* §XII.B.2), current flow is generated by the rotating magnet type generator. Thus, the Gasoline Cut Off Solenoid is powered by the electrical power generator because operation of the Gasoline Cut Off Solenoid depends on current flow generated by the rotating magnet type generator.

5. Claim 7

143. Claim 7 depends from Claim 6, and further recites "wherein the switch selectively powers the solenoid valve by controlling electrical connection between the solenoid valve and the electrical power generator."

144. As discussed (*see* §XII.B.3.b), the Gasoline Cut Off Solenoid opens and closes a fuel path in response to reception of current due to the positioning of the fuel select switch. Thus, because operation of the Gasoline Cut Off Solenoid depends on current generated by the rotating magnet type generator (*see* §XII.B.4), the fuel select switch selectively powers the Gasoline Cut Off Solenoid by controlling the electrical connection between the Gasoline Cut Off Solenoid and the rotating magnet type generator.

6. Claim 8

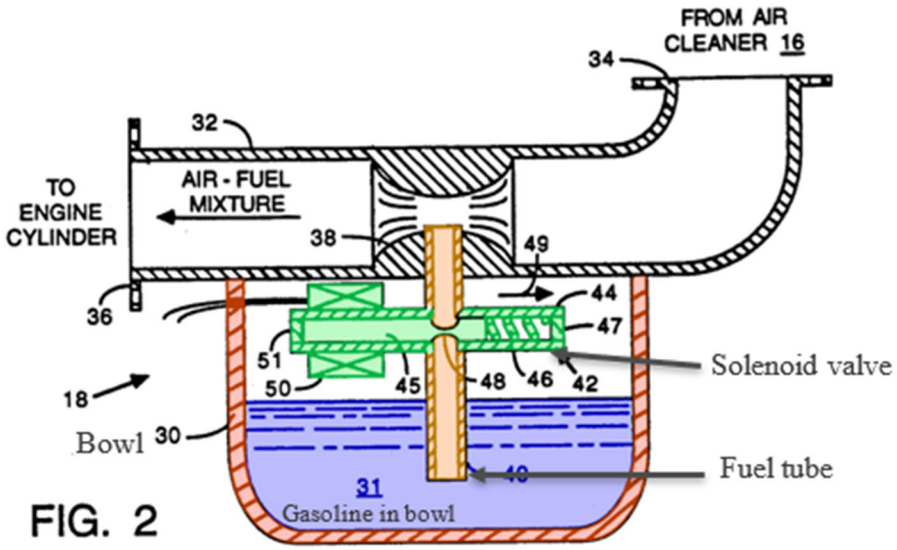
145. Claim 8 depends from Claim 6 and further recites "wherein the solenoid valve is normally open to provide liquid fuel to the engine when the solenoid valve is unpowered."

146. The Gasoline Cut Off Solenoid of the Workshop Manual is normally closed. EX1012, 68. It would have been obvious to a POSA to use a normally open solenoid, instead. Olmr discloses a liquid fuel cut-off solenoid valve in a carburetor that is normally open. EX1007, 3:38-55, Fig. 2.

a. Motivation/Expectation of Success

147. 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. The Gasoline Cutoff Solenoid of the DF972 engine cuts the gasoline flow from the float bowl when the operation of

the engine is switched from gasoline to LPG. 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 82. EX1007, 2:30-68, 4:11-27. Olmr's Figure 2 shows:



Id., Fig. 2 (annotated).

148. Olmr's valve 42 is a solenoid connected to open and close a fuel path to the venturi 38 of the [pull-start] engine. 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.,* 2:30-68, 4:11-27.

149. 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.

Id., 3:43-52. Although the DF972 engine had 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.

150. 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.

7. Claim 9

151. Claim 9 depends from Claim 8 and further recites "wherein a pull-starter drives the electrical power generator to power and close the solenoid valve while starting the engine on gaseous fuel."

152. Matsushima's pull-starter drives an electrical power generator to power various components while starting its engine (including its fuel pump, spark plug

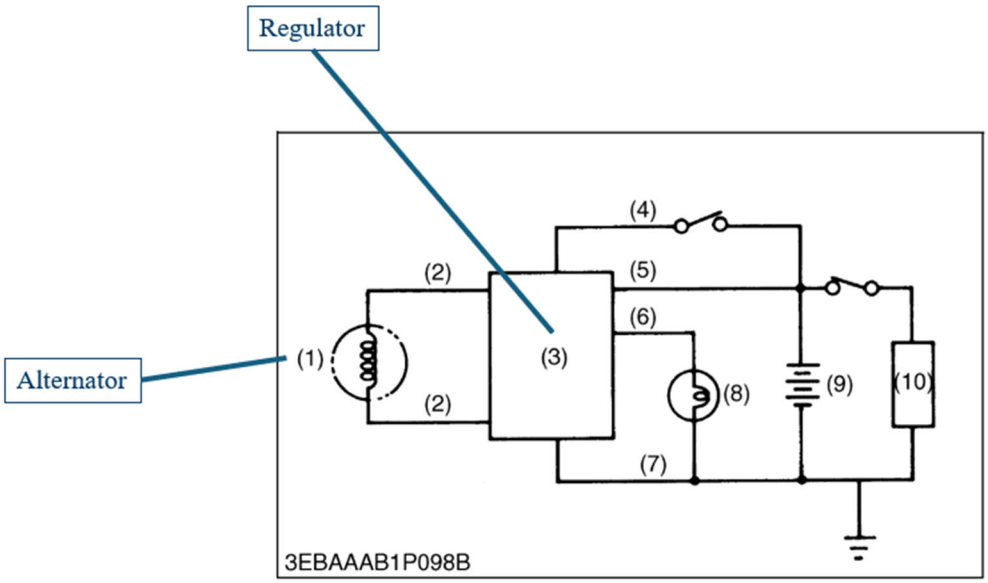
and fuel injection valve). EX1029, Abstract, 5:1-48. Incorporating Matsushima's pull-starter assembly with the DF972 engine would similarly allow the pull-starter assembly to drive the DF972's generator to power and close the DF972's solenoid valve while starting the engine on gaseous fuel.

8. Claim 10

153. Claim 10 depends from Claim 6, and further recites "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."

154. As discussed (*see* §XII.B.2), the Workshop Manual teaches that the DF972 engine includes an electrical power generator (i.e. a "rotating magnet type generator"). This rotating magnet type generator is an alternator. EX1012, 77.

155. The Workshop Manual further discloses that the alternator is coupled to a voltage regulator:



Id. (annotated).

156. The Workshop Manual teaches the "regulator converts AC into DC which flows through the power consuming circuits and the battery, and also charges the battery." EX1012, 77. As discussed (*see* §XII.B.4), the Gasoline Cut Off Solenoid is powered by the rotating magnet type generator because operation of the solenoid depends on current flow generated by the rotating magnet type generator. Thus, the voltage regulator provides a regulated voltage to the Gasoline Cut Off Solenoid because the rotating magnet type generator generates current, which is converted to DC by the regulator, which is then used to power the solenoid.

9. Claim 11

157. Claim 11 depends from Claim 6, and further recites "wherein the solenoid valve is open to provide liquid fuel to the engine when the solenoid valve is powered."

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

10. Claim 12

159. Claim 12 depends from Claim 11, and further recites "wherein a pull-starter drives the electrical power generator to power and open the solenoid valve while starting the engine on liquid fuel."

160. 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. 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 liquid fuel.

11. Claim 13

161. Claim 13 depends from Claim 6, and further recites "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."

162. 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. Matsushima discloses an electronic control unit (ECU 30) that controls the timing for opening its fuel injection valve 10 and the duration over which the fuel injection valve is opened. *Id*. A POSA would understand Matsushima's ECU to be a microcontroller.

a. Motivation/Expectation of Success

163. A POSA would have been motivated to use a microcontroller to help prevent the engine from stalling when switching from gasoline to LPG. 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. 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).

164. A POSA would have appreciated the benefits of achieving a balanced fuel-air ratio, including when switching between fuels on the fly. 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 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.

12. Claim 14

165. Claim 14 depends from Claim 13, and further recites "wherein the microcontroller closes the solenoid valve during engine shutdown from operation on liquid fuel."

166. As discussed (*see* §XII.B.11), it would have been obvious to use a microcontroller to control the DF972's solenoid valves. With this modification, the microcontroller would also close the Gasoline Cut Off Solenoid of the DF972 engine during engine shutdown to stop the flow of gasoline at the desired time.

13. Claim 19

167. Claim 19 depends from Claim 1, and further recites "wherein the liquid fuel cut-off is magnetically actuated to selectively interrupt liquid fuel."

168. As discussed (*see* §XII.B.3.b), the Workshop Manual discloses a Gasoline Cut Off Solenoid as the liquid fuel cut-off, which is a magnetically actuated valve.

14. Claim 20

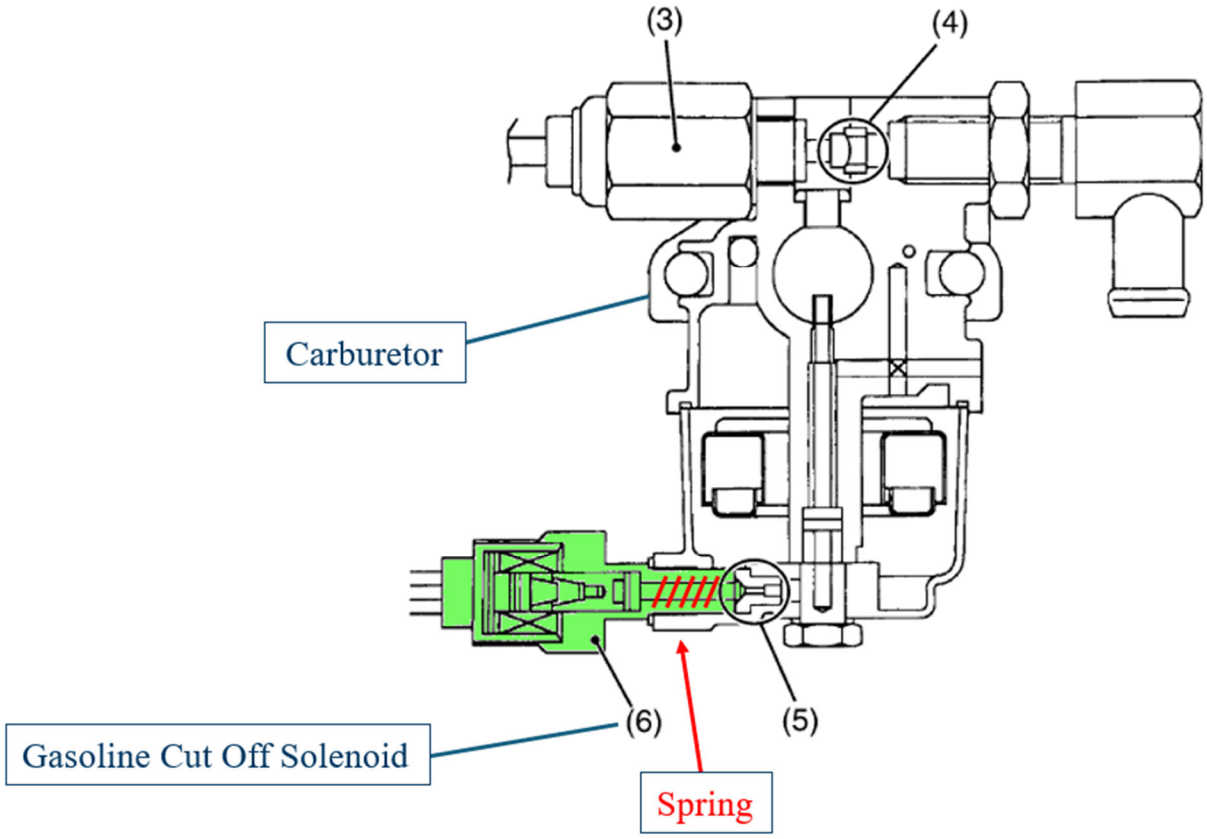
169. Claim 20 depends from Claim 1, and further recites two additional elements.

a. Element [20.1]

170. Element [20.1] recites "a spring pushing the liquid fuel cut-off to interrupt liquid fuel."

171. 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.").

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



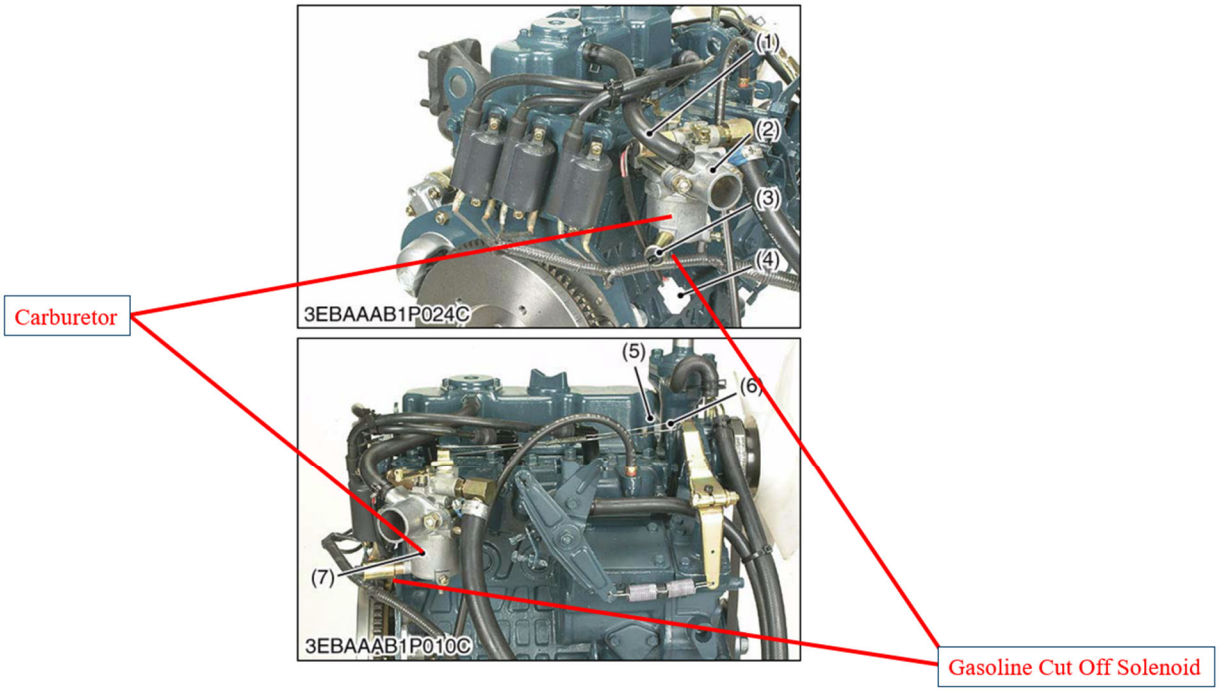
173. Alternatively, it would have been obvious to use a solenoid with a spring that biases the plunger given the starter solenoid for the DF972 engine works in this manner, as does as Olmr's cutoff solenoid. EX1012, 76; EX1007, 2:43-68, Fig. 2; *see also* EX1038, 3 (Fig. 4.1x). In addition, solenoids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

b. Element [20.2]

174. Element [20.2] recites "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."

175. A solenoid, by definition, utilizes a magnetic field to induce plunger movement to open or close a flow path. 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"). In this open position, the plunger would be pressed against the spring used to bias the plunger to its normally closed position.

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



EX1012, 115 (annotated); *see also id.*, 67-68.

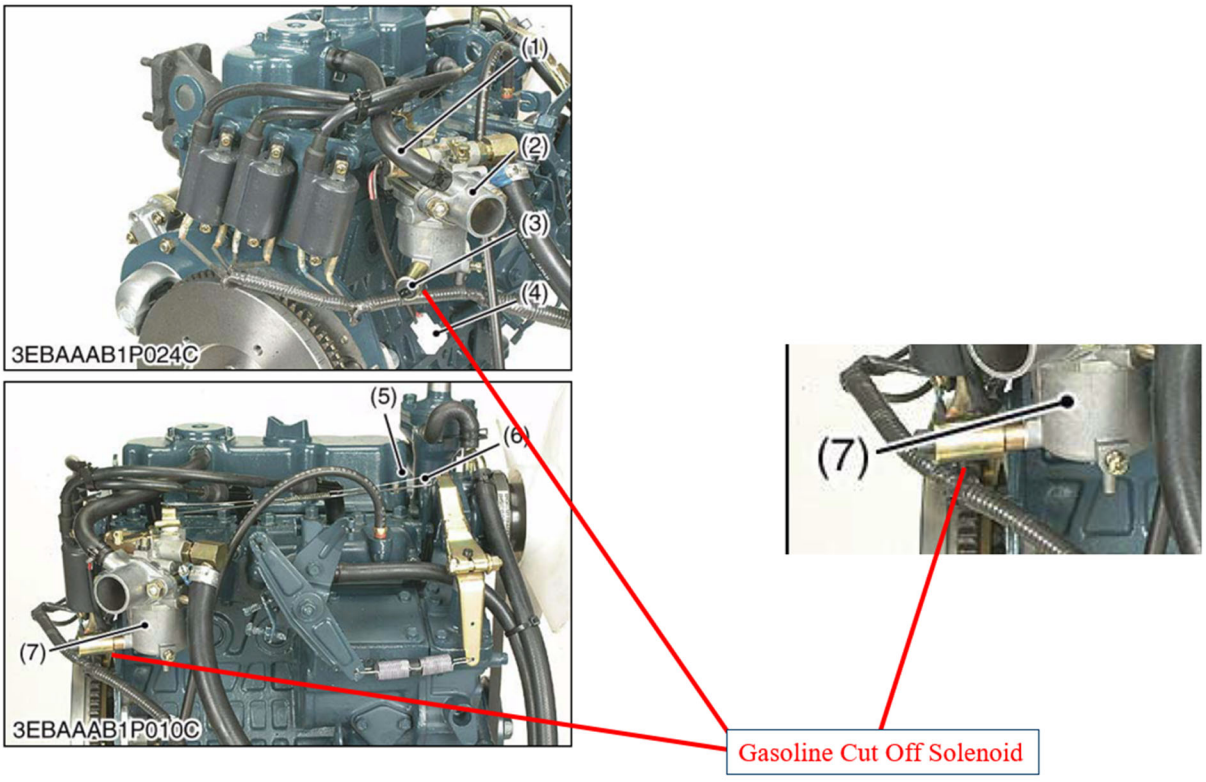
15. Claim 21

177. Claim 21 depends from Claim 20, and further recites three additional elements.

a. Element [21.1]

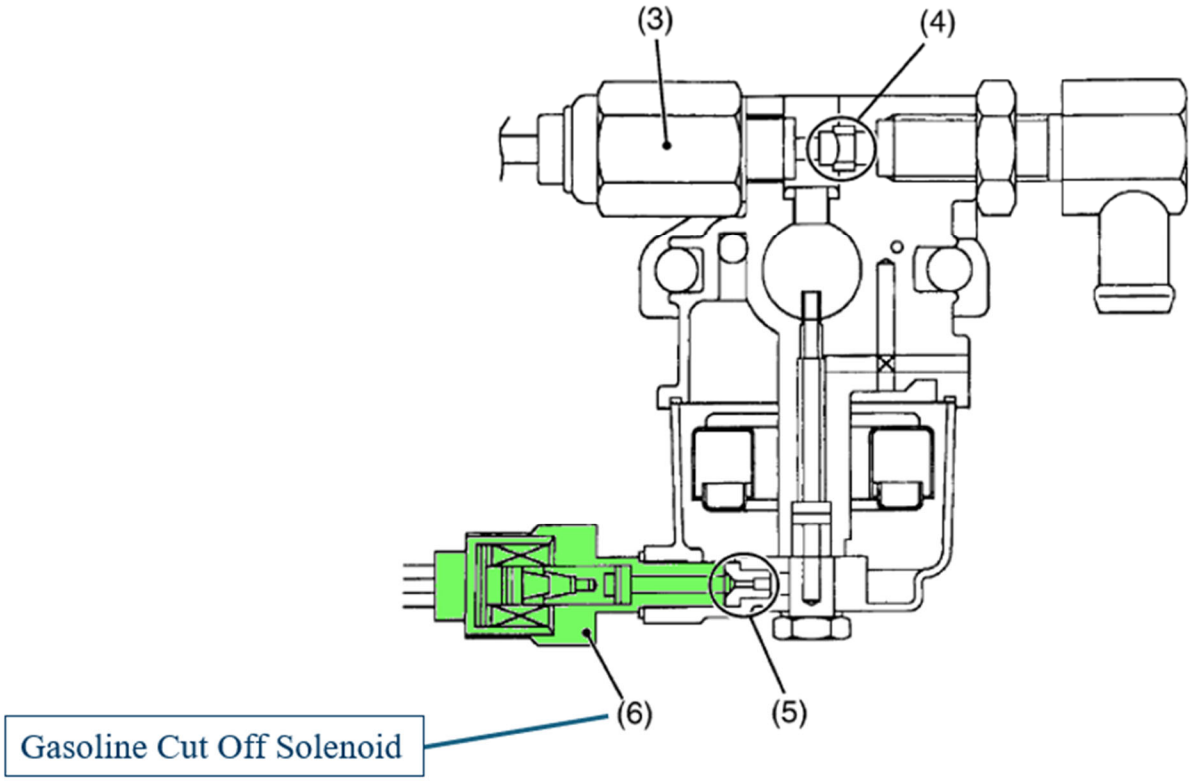
178. Element [21.1] recites "a housing at least partially enclosing the liquid fuel cutoff."

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



EX1012, 115 (annotated); *see also id.*, 67-68.

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

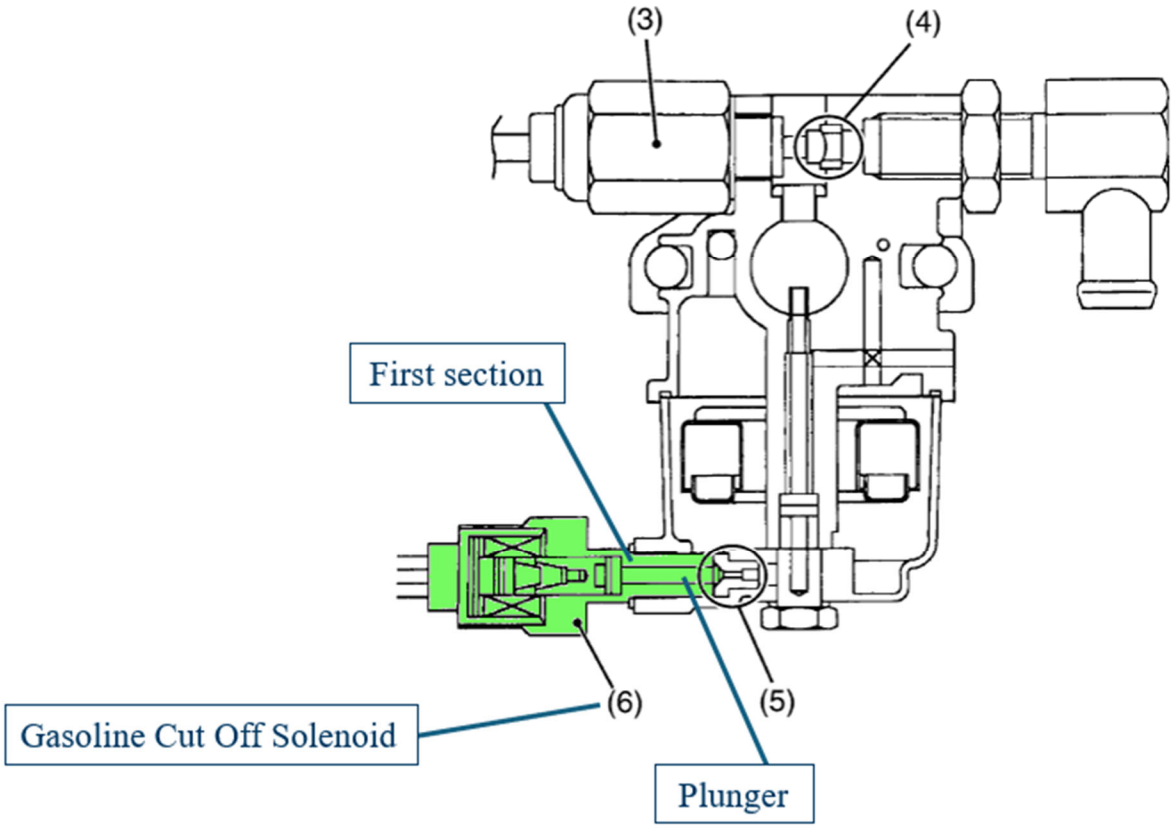


EX1012, 68 (annotated).

b. Element [21.2]

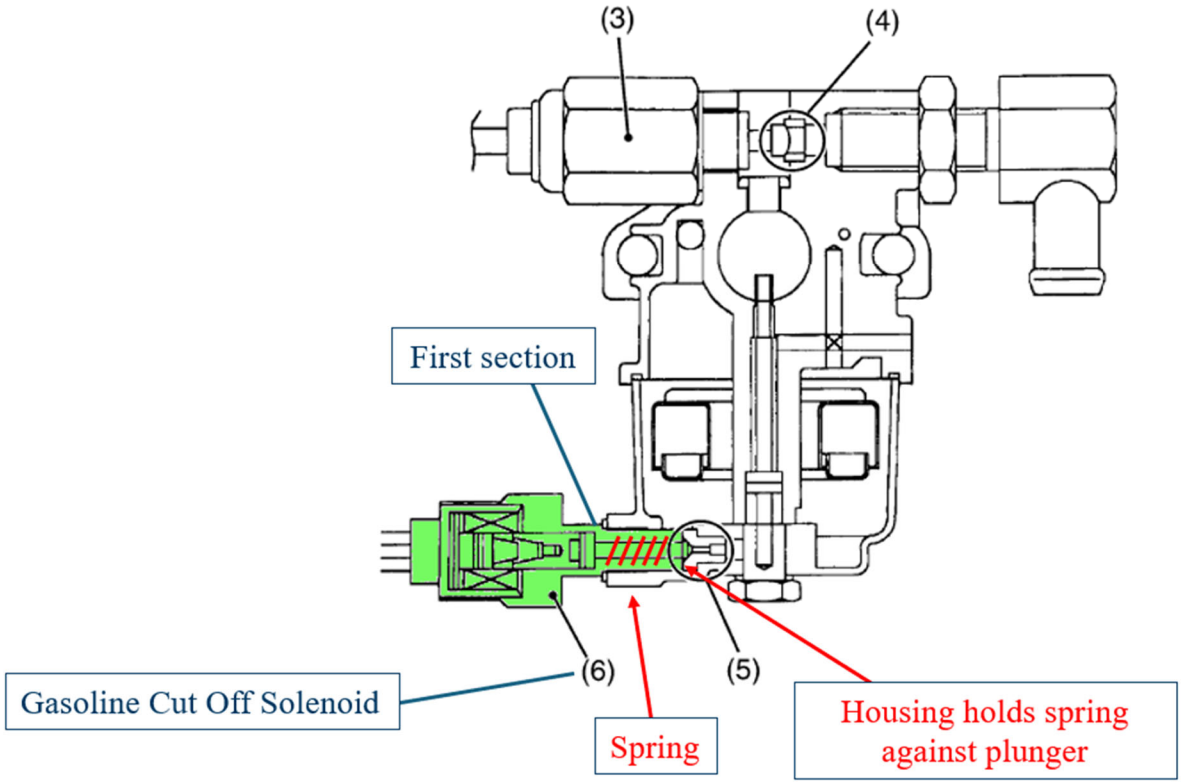
181. Element [21.2] recites "a first section enclosing a plunger of the liquid fuel cut-off to the carburetor and holding the spring against the plunger."

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



EX1012, 68 (annotated).

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

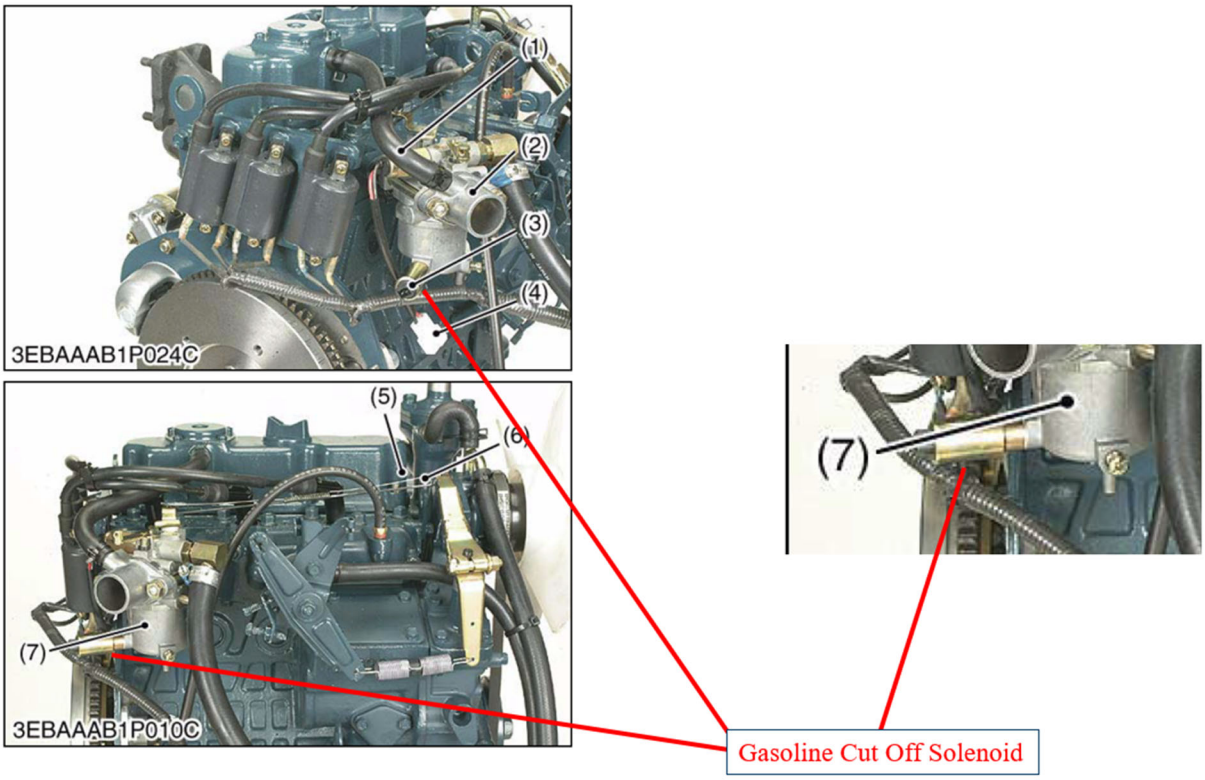


EX1012, 68 (annotated/modified).

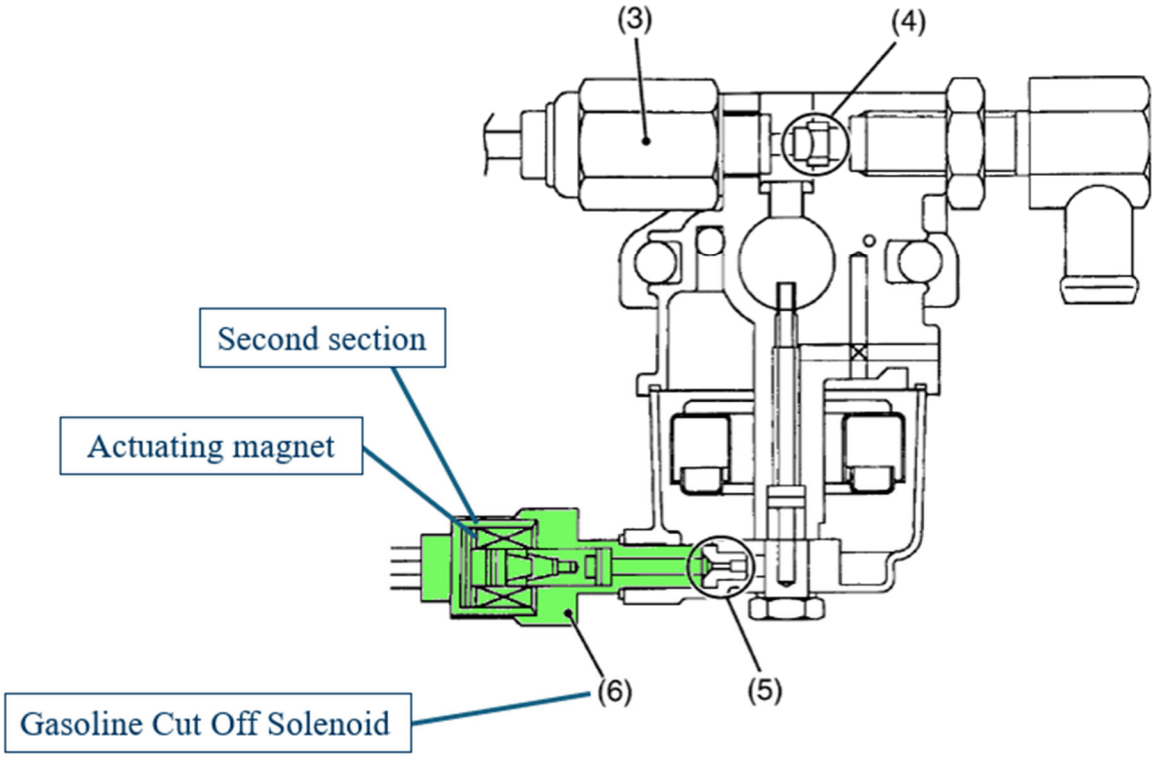
c. Element [21.3]

184. Element [21.3] recites "a second section coupled to the first section and enclosing the actuating magnet."

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



EX1012, 115 (annotated).



Id., 68 (annotated).

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

16. Claim 23

a. Element [23.0]

187. Element [23.0] recites "a batteryless dual fuel generator."

188. As discussed (*see* §XII.B.1), it would have been obvious to replace the battery of the Workshop Manual's dual-fuel engine with Matsushima's recoil-starter assembly. As also discussed (*see* §XII.B.2), the Workshop Manual's dual-fuel engine

has an electrical power generator. Thus, the Workshop Manual's DF972 engine modified in light of Matsushima discloses Element [23.0].

b. Element [23.1]

189. Element [23.1] recites "a housing containing a pull start engine coupled to drive an alternator, the engine operable on a gaseous fuel and a liquid fuel."

190. As discussed (*see* §§XII.A.1.a, XII.A.1.b, XII.B.2), the Workshop Manual's DF972 engine is coupled to drive an alternator and is operable on gaseous fuel and liquid fuel. 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.

i. Motivation/Expectation of Success

192. A POSA would have been motivated to enclose the engine/generator in 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 exposure to weather, and to prevent injury by making the engine components inaccessible while running. Yamamoto discloses one example of the type of housing that could be used for an engine with a pull start (recoil knob 26):

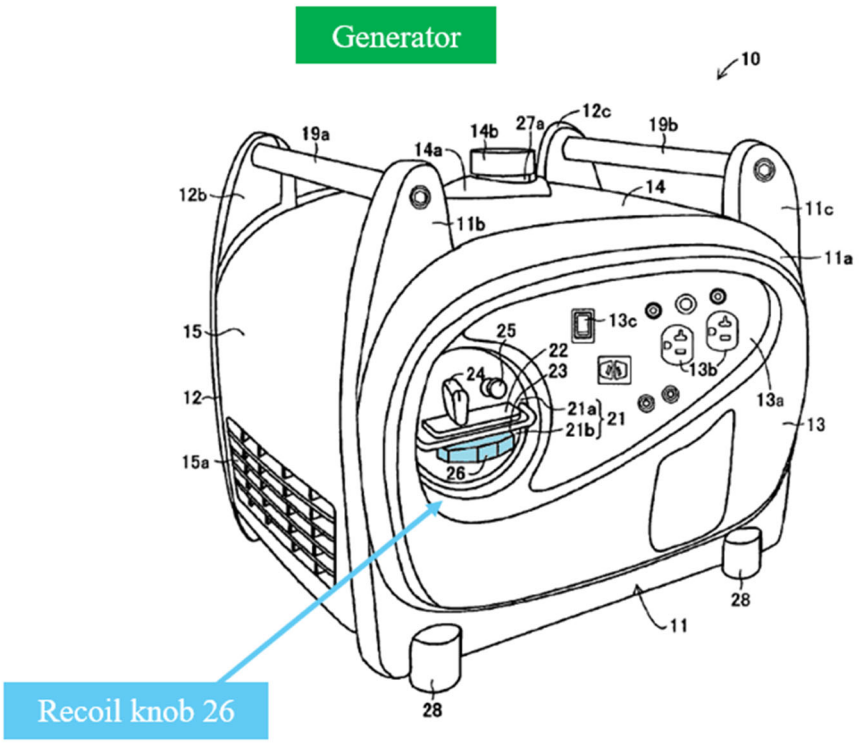


Figure 1

EX1030, Fig. 1 (annotated).

193. A POSA would have had a reasonable expectation of success based on the teachings of Yamamoto, and the fact that similar housings for generators with a pull-start engine were widely used at the time of the invention.

c. Element [23.2]

194. Element [23.2] recites "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."

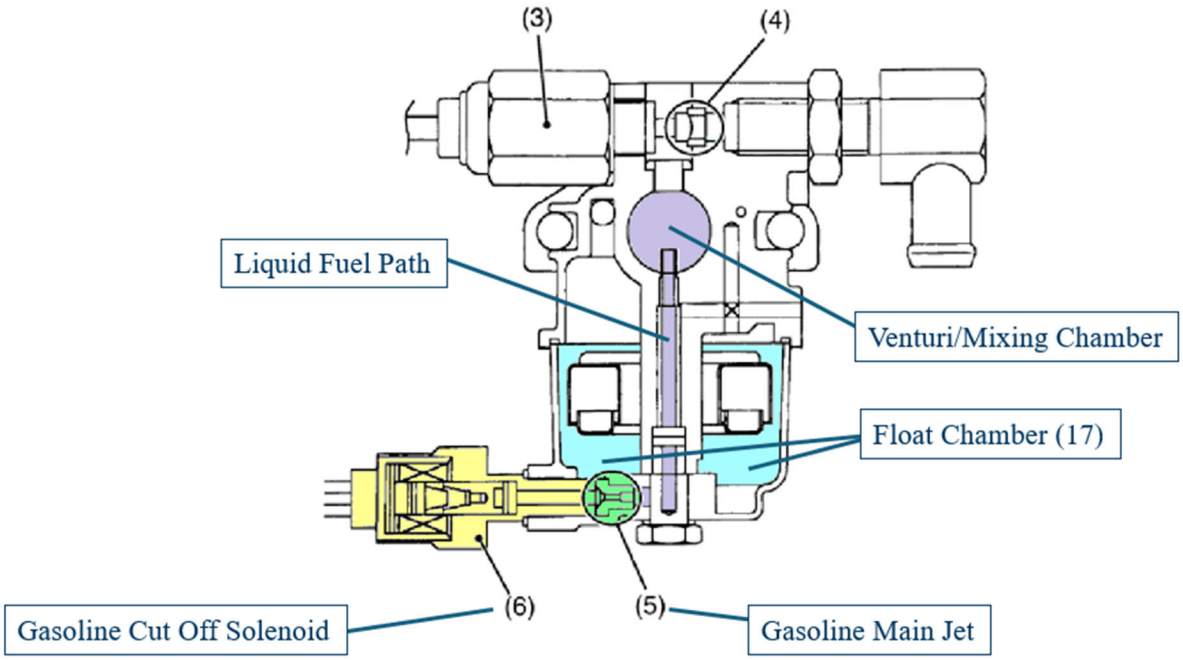
195. As discussed (*see* §§XII.A.1.d, XII.A.4.d-XII.A.4.f), the Workshop Manual discloses a carburetor attached to an intake of the engine which includes a

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.

d. Element [23.3]

196. Element [23.3] recites "a fuel shutoff attached to the carburetor to close the fuel passage upon selection of engine operation to gaseous fuel."

197. As discussed (*see* §XII.A.1.g), the Gasoline Cut Off Solenoid is attached to the carburetor to interrupt liquid fuel upon selection of engine operation to gaseous fuel. The Gasoline Cut Off Solenoid interrupts liquid fuel by closing the fuel passage:



EX1012, 68 (annotated).

17. Claim 32

198. Claim 32 depends from Claim 23, and recites two additional elements.

a. Element [32.1]

199. Element [32.1] recites "a spring pushing the fuel shutoff to close the fuel passage."

200. As discussed (*see* §XII.B.14.a), it is inherent that a spring pushes the Gasoline Cut Off Solenoid to interrupt liquid fuel by closing the fuel passage or, alternatively, it would have been obvious to use a spring to do so.

b. Element [32.2]

201. Element [32.2] recites "an actuating magnet coupled to the carburetor to selectively pull the fuel shutoff against the spring to open the fuel passage."

202. As discussed (*see* §XII.B.14.b), the Workshop Manual discloses Gasoline Cut Off Solenoid coupled to the carburetor, which uses a magnetic field to selectively pull the solenoid against the spring away from a position interrupting liquid fuel, i.e. to a position opening the fuel passage.

18. Claim 33

203. Claim 33 depends from Claim 32, and recites three additional elements.

a. Element [33.1]

204. Element [33.1] recites "a housing at least partially enclosing the fuel shutoff, the housing including."

205. As discussed (*see* §XII.B.15.a), the Workshop Manual discloses a housing at least partially enclosing the Gasoline Cut Off Solenoid.

b. Element [33.2]

206. Element [33.2] recites "a first section enclosing a plunger of the fuel shutoff to the carburetor and holding the spring against the plunger."

207. As discussed (*see* §XII.B.15.b), the Workshop Manual discloses a housing including a first section enclosing a plunger of the Gasoline Cut Off Solenoid and it would have been obvious to use a configuration wherein this first section also holds a spring against the plunger.

c. Element [33.3]

208. Element [33.3] recites "a second section coupled to the first section and enclosing the actuating magnet."

209. As discussed (*see* §XII.B.15.c), the Workshop Manual discloses a housing including a second section coupled to the first section and enclosing the actuating magnet.

19. Claim 34

210. Claim 34 depends from Claim 23, and recites three additional elements.

a. Element [34.1]

211. Element [34.1] recites "wherein the fuel shutoff is a carburetor cutoff solenoid."

212. As discussed (*see* §§XII.A.1.g, XII.B.16.d), the Workshop Manual discloses Gasoline Cut Off Solenoid attached to the carburetor. The Gasoline Cut Off Solenoid is a "carburetor cutoff solenoid" for purposes of Element [34.1].

b. Element [34.2]

213. Element [34.2] recites "wherein the generator further comprises a charge winding to generate electrical power to operate the carburetor cutoff solenoid."

214. As discussed (*see* §XII.B.2), the DF972 engine has an alternator to supply electrical power. 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" for purposes of Element [34.2]. EX1012, 77. The Workshop Manual states:

> **Alternator**
>
> This alternator is an 8-8 pole rotating magnet type generator. It is simple in construction, consisting of a stator and rotor. The rotor is made up of eight permanent magnet pole pieces assembled on a shaft and rotates on the center of the stator around which eight electromagnetic coils are provided for. This alternator produces higher voltage in slow speed rotation, and charges electric current to the battery during engine idling.

Id.

215. The charge winding powers the Gasoline Cut Off Solenoid. *See* §XII.B.4.

c. Element [34.3]

216. Element [34.3] recites "a switch to selectively power the carburetor cutoff solenoid by controlling electrical connection between the carburetor cutoff solenoid and the charge winding."

217. As discussed (*see* §§XII.A.1.c, XII.B.5), 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). *See also* §XII.B.19.b.

20. Claim 35

218. Claim 35 depends from Claim 34, and further recites "wherein the carburetor cutoff solenoid is normally open to provide liquid fuel to the engine when the carburetor cutoff solenoid is unpowered."

219. As discussed (*see* §XII.B.6), it would have been obvious to use a normally-open Gasoline Cut Off Solenoid in view of Olmr to provide liquid fuel to the engine when the Gasoline Cut Off Solenoid is unpowered.

21. Claim 36

220. Claim 36 depends from Claim 35, and further recites "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."

221. As discussed (*see* §XII.B.7), combining Matsushima's pull-starter assembly with the DF972 engine of the Workshop Manual would allow the pull-

starter assembly to drive the DF972's charge winding (i.e., alternator) to power and close the DF972's Gasoline Cut Off Solenoid while starting the engine on gaseous fuel. *See also* §XII.B.19.b.

22. Claim 37

222. Claim 37 depends from Claim 34, and further recites "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."

223. As discussed (*see* §XII.B.3.a), the fuel select switch is an electro-mechanical switch connected to the charge winding (i.e., the alternator) and connecting at least one fuel source to the carburetor. The DF972's electrical power generator includes a charge winding. *See also* §XII.B.19.b. As also discussed (*see* §XII.A.1.c), the fuel select switch changes operation of the engine between gaseous fuel and liquid fuel, thereby selectively controlling fuel flow from at least one fuel source to the carburetor.

23. Claim 38

224. Claim 38 depends from Claim 34, and further recites "wherein the charge winding is coupled to a voltage regulator to provide a regulated voltage to the carburetor cutoff solenoid."

225. As discussed (*see* §XII.B.8), the charge winding (i.e., the alternator) is coupled to a voltage regulator to provide a regulated voltage to the Gasoline Cut Off Solenoid. *See also* §XII.B.19.b.

24. Claim 39

226. Claim 39 depends from Claim 34, and further recites "wherein the carburetor cutoff solenoid is open to provide liquid fuel to the engine when the carburetor cutoff solenoid is powered."

227. As discussed (*see* §XII.B.9), the Gasoline Cut Off Solenoid is open to provide liquid fuel to the engine when the Gasoline Cut Off Solenoid is powered.

25. Claim 40

228. Claim 40 depends from Claim 39, and further recites "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."

229. As discussed (*see* §XII.B.10), incorporating Matsushima's pull-starter assembly with the Workshop Manual's DF972 engine would allow the pull-starter assembly to drive the DF972's charge winding (i.e., alternator) to power and open to the Gasoline Cut Off Solenoid while starting the engine on liquid fuel. *See also* §XII.B.19.b.

26. Claim 41

230. Claim 41 depends from Claim 34, and further recites "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."

231. As discussed (*see* §XII.B.11), the obvious use of a microcontroller to close the DF972's Gasoline Cut Off Solenoid, as shown by Matsushima, would close the Gasoline Cut Off Solenoid when the engine operates on gaseous fuel and would open the Gasoline Cut Off Solenoid to operate the engine on liquid fuel.

27. Claim 42

232. Claim 42 depends from Claim 41, and further recites "wherein the microcontroller closes the carburetor cutoff solenoid during engine shutdown from operation on liquid fuel."

233. As discussed (*see* §XII.B.12), the obvious use of a microcontroller to control the DF972's Gasoline Cut Off Solenoid, as shown by Matsushima, would also close the Gasoline Cut Off Solenoid of the DF972 engine during engine shutdown to stop the flow of gasoline at the desired time.

28. Claim 58

234. Claim 58 depends from Claim 57, and further recites "coupling a manually operated control operatively to the liquid fuel cut-off."

235. The Workshop Manual discloses a fuel-select switch to operatively control the Gasoline Cut Off Solenoid. *See* §XII.A.4.g.

236. A POSA would understand that fuel select switch is manually operated and, as such, would have a manually operated control, such as a control knob. 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. 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. 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.

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

237. In my opinion, Claims 1, 3, 22, and 57 are anticipated for at least the reasons described below.

1. Claim 1

a. Element [1.0]

238. Element [1.0] recites "a dual fuel engine."

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

b. Element [1.1]

240. Element [1.1] recites "an engine operable on a gaseous fuel and a liquid fuel."

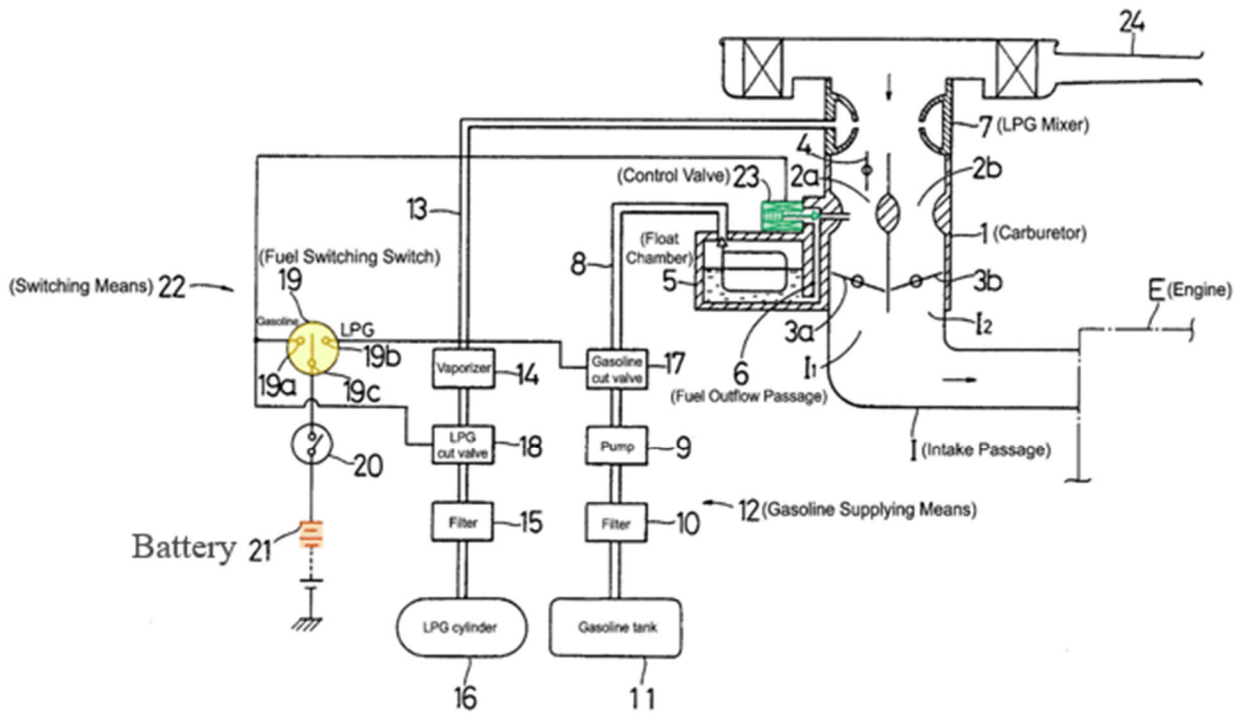
241. Nakafushi's engine selectively uses gasoline or LPG as fuel. *Id.*; *see also*, ¶¶82-85 above (explaining that LPG is a "gaseous fuel" as claimed, even if it is stored under pressure as a liquid and gets vaporized on the way to the carburetor).

c. Element [1.2]

242. Element [1.2] recites "a switch to change operation of the engine between gaseous fuel and liquid fuel."

243. Nakafushi discloses a "fuel switching switch 19" that changes operation of the engine between gaseous fuel and liquid fuel. EX1005, ¶¶[0013]-[0014]. Specifically, the switch 19 has a "gasoline-side contact point 19a and an LPG side contact point 19b," and Nakafushi teaches that "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



Id., Fig. 1 (annotated).

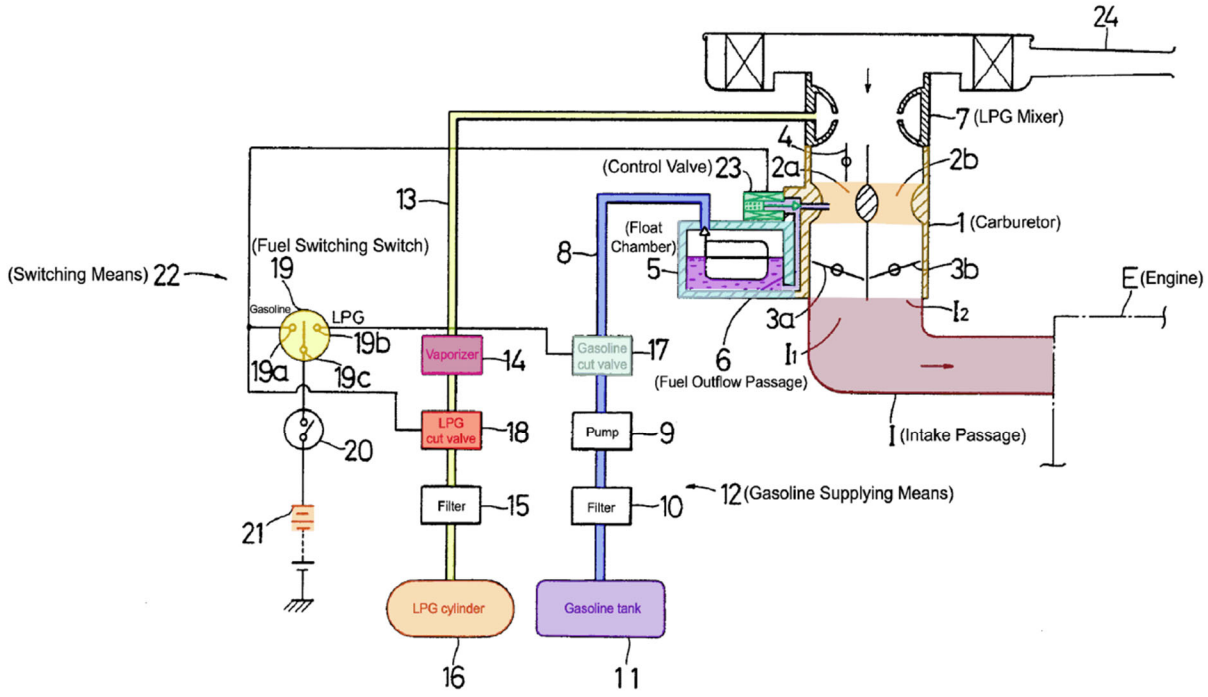
244. Nakafushi discloses that when switch 19 is switched to the gasoline contact point 19a side, a cut signal is sent to the LPG cut valve 18 and simultaneously, control valve 23 receives a signal to open. *Id.*, ¶¶[0013]-[0014]. In contrast, when fuel switch 19 is switched to the LPG contact point 19b side, the reverse occurs where a cut signal is sent to the gasoline cut valve 17 to stop gasoline flow while the LPG valve 18 is opened. *Id.* 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]

245. Element [1.3] recites "a carburetor attached to an intake of the engine to mix air and fuel and connect a gaseous fuel source and a liquid fuel source."

246. Nakafushi discloses a carburetor 1 attached to the intake of the engine E, as seen in Figure 1 below:

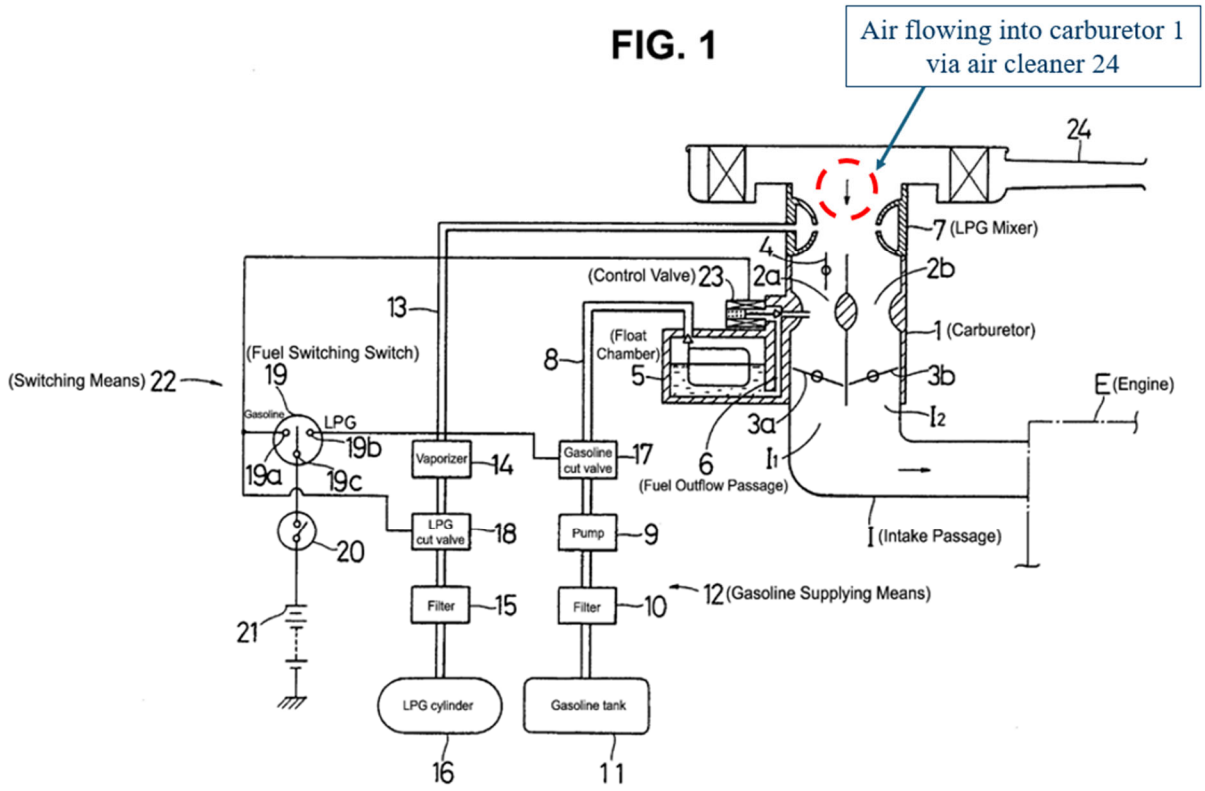
FIG. 1



EX1005, Fig. 1 (annotated).

247. 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.*

248. 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 (annotated), ¶[0015].

249. A POSA would have understood that engines such as those disclosed in Nakafushi operated by mixing fuel (either gasoline or LPG in the case of Nakafushi) with air prior to combustion in the engine, as confirmed by Nakafushi's numerous references to the "air-fuel ratio" and "air-fuel mixture" in regard to gasoline (and/or LPG) being mixed with air. *Id.*, ¶¶[0004]-[0005], [0008], [0016], [0019]. A POSA would have recognized Nakafushi's disclosure of a dual-fuel engine that mixed air

with the gaseous fuel (i.e., LPG) or liquid fuel (i.e., gasoline) in the carburetor, which is attached to the intake for delivery to the engine.

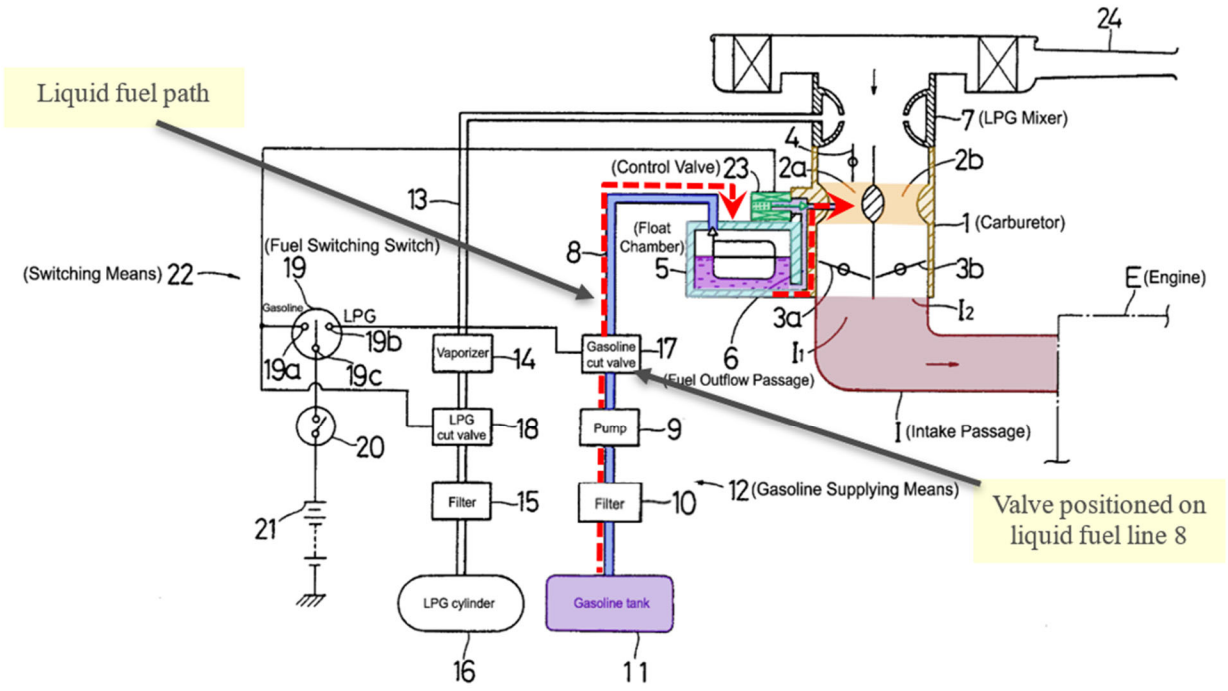
250. Accordingly, Nakafushi teaches a carburetor, attached to an engine, that mixes air and fuel and via connections to the gaseous and liquid fuel sources, as recited in Element [1.3].

e. Element [1.4]

251. Element [1.4] recites "a liquid fuel valve positioned along a liquid fuel line coupling the liquid fuel source to the carburetor."

252. 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]. Figure 1 shows gasoline cut valve 17 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, as illustrated below:

FIG. 1



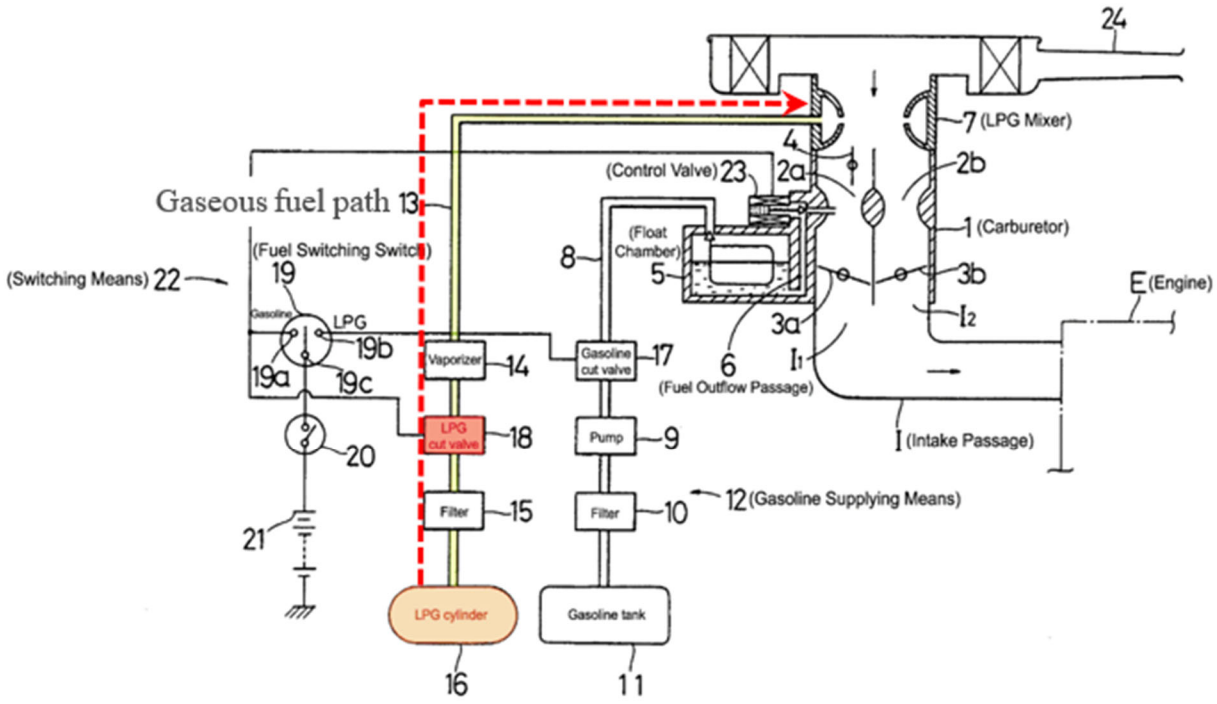
Id., Fig. 1 (annotated).

f. Element [1.5]

253. Element [1.5] recites "a gaseous fuel valve positioned along a gaseous fuel line coupling the gaseous fuel source to the carburetor."

254. 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]. Figure 1 shows LPG cut valve 18 positioned on the LPG supplying passage 13, which begins at the LPG cylinder 16, leading to vaporizer 14, which in turn is connected to carburetor 1, as illustrated below:

FIG. 1



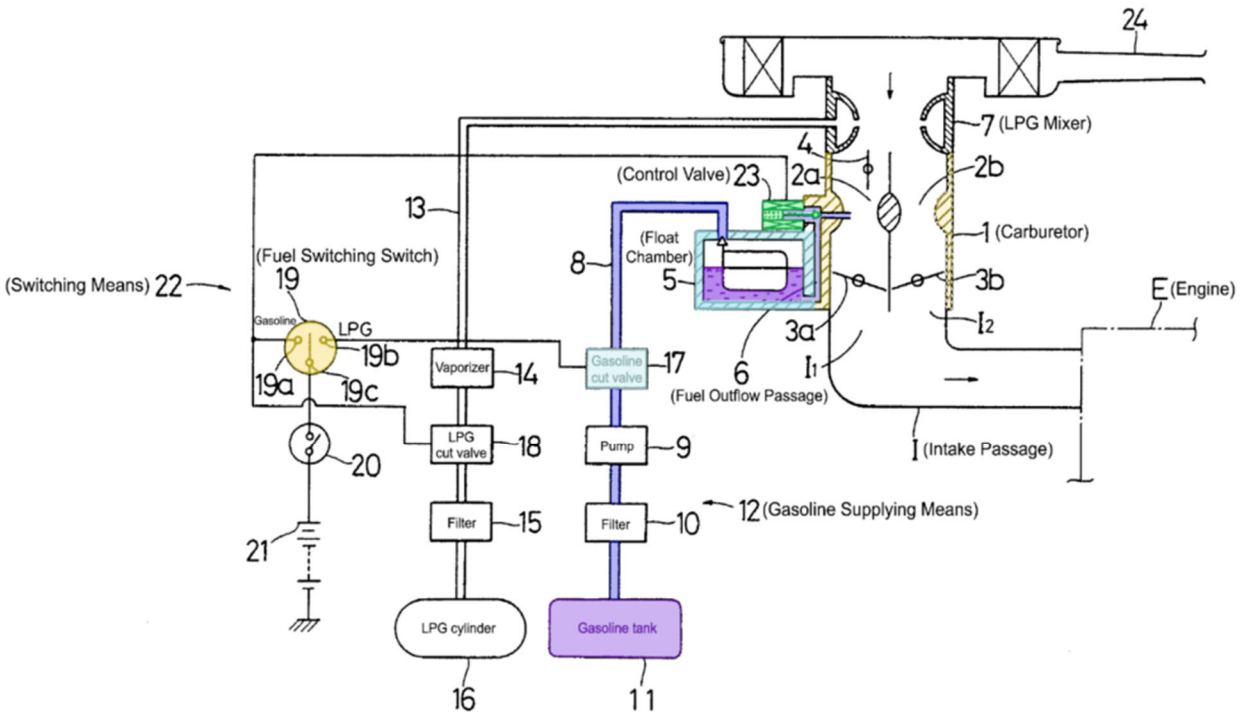
Id., Fig. 1 (annotated). As explained previously (¶¶82-85 above), based on the specification, claims, and prosecution history of the '398 Patent, a POSA would have considered LPG to be a "gaseous fuel" regardless of whether it is stored and/or sent to the first pressure regulator/vaporizer in liquid form. Whether LPG passes through Nakafushi's valve 18 as a liquid or gas is irrelevant since LPG is the claimed "gaseous fuel" regardless of whether it is a liquid prior to being vaporized. Thus, Nakafushi's LPG cut valve 18 is a "gaseous fuel valve" that is positioned on the "gaseous fuel line" between LPG tank and the carburetor to allow or block the flow of LPG.

g. Element [1.6]

255. Element [1.6] recites "a liquid fuel cut-off incorporated into the carburetor to interrupt liquid fuel upon actuation of the switch from liquid fuel to gaseous fuel."

256. Nakafushi discloses control valve 23 (EX1005, ¶[0014], Fig. 1), which is a "liquid fuel cut-off" for purposes of Element [1.6]. Specifically, Nakafushi explains that "a control valve 23 configured to open and close the fuel outflow passage 6 is disposed so as to intervene in the fuel outflow passage 6." 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. *Id.*, ¶[0010]. This arrangement is shown in Figure 1:

FIG. 1



Id., Fig. 1 (annotated).

257. Figure 1 shows that control valve 23 is "incorporated into the carburetor."

258. As noted for Element [1.2] (*see* §XII.C.1.c), the fuel switching switch 19 changes operation of the engine between gaseous fuel and liquid fuel by selectively powering control valve 23 and LPG cut valve 18, or gasoline cut valve 17. Specifically, the switch opens control valve 23 and gasoline cut valve 17, and closes the LPG valve 18 during gasoline operation, and vice versa for LPG operation. EX1005, ¶¶[0013]-[0014]. Thus, upon actuation of the switch from liquid fuel to gaseous fuel, control valve 23 closes to interrupt liquid fuel. *Id.*

2. Claim 3

259. Claim 3 depends from Claim 1, and further recites "wherein the gaseous fuel is LPG and the liquid fuel is gasoline."

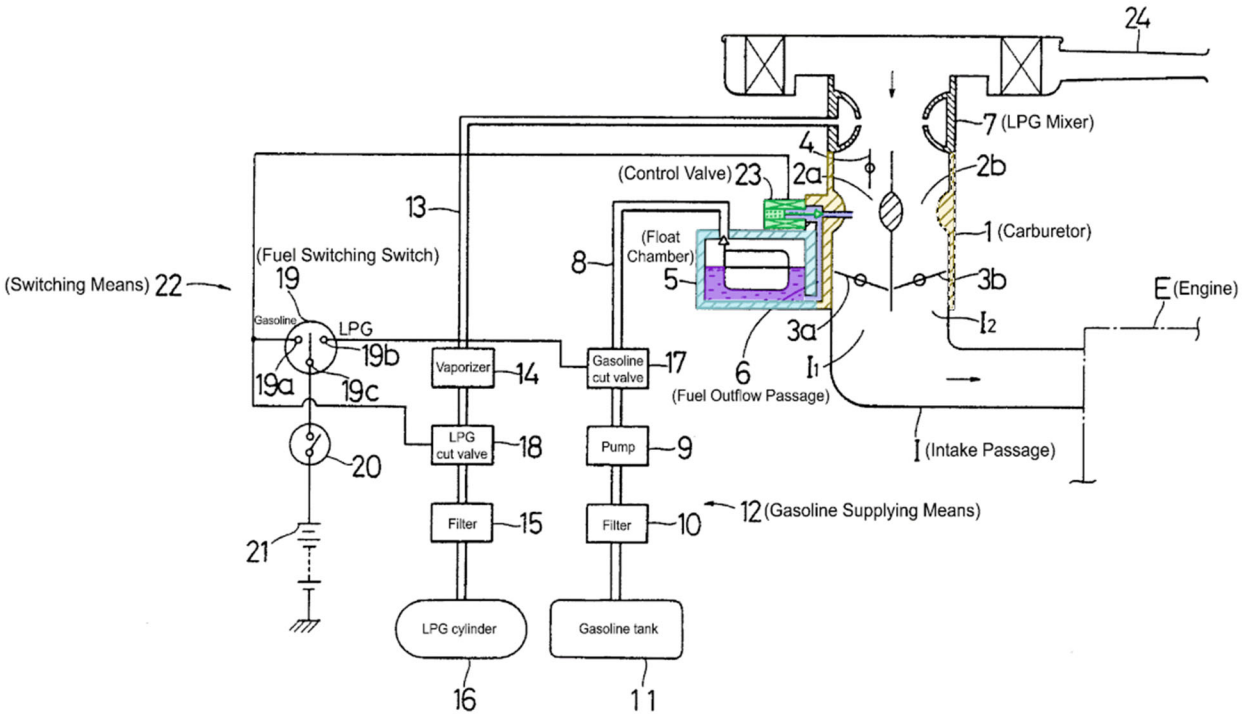
260. Nakafushi discloses "[t]he present invention relates to a gasoline-LPG combined engine configured to selectively use gasoline or LPG as a fuel." EX1005, ¶[0001].

3. Claim 22

261. Claim 22 depends from Claim 1, and further recites "wherein the liquid fuel cut-off is physically attached to an outer surface of the carburetor."

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

FIG. 1



EX1005, Fig. 1 (annotated).

4. Claim 57

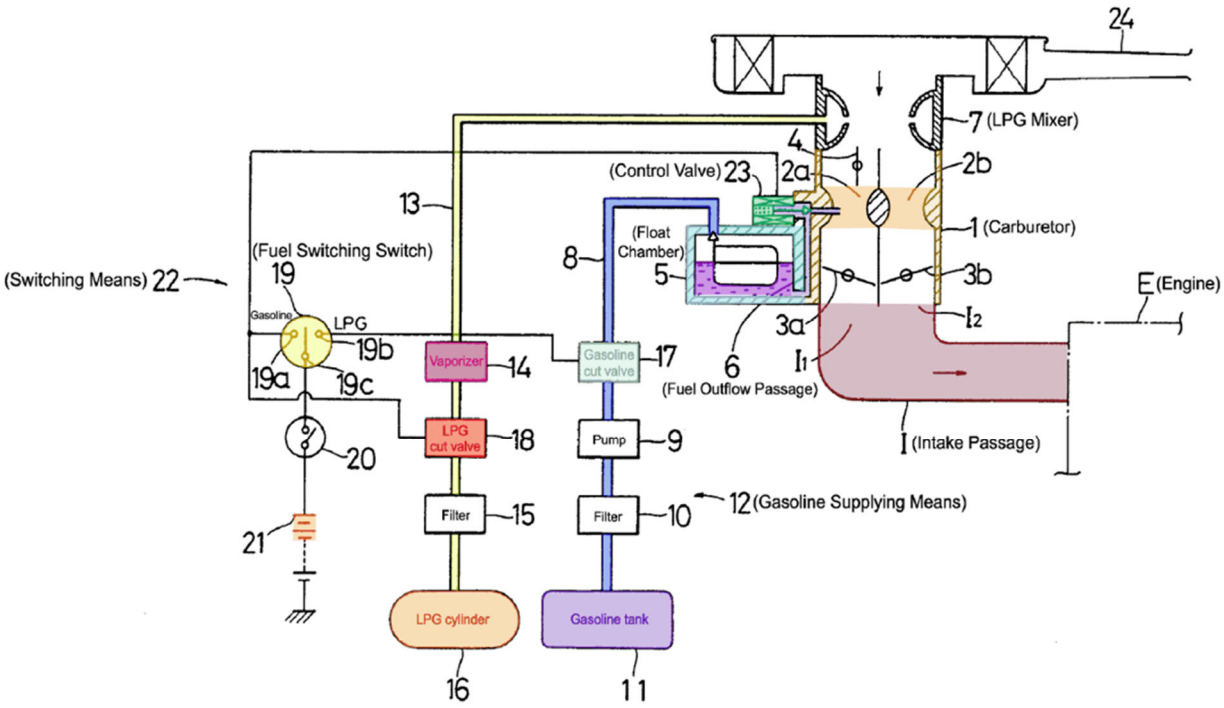
a. Element [57.0]

263. Element [57.0] recites "a method of assembling a dual fuel engine."

264. As discussed (*see* §§XII.C.1.a-XII.C.1.b), Nakafushi discloses a dual-fuel engine. Figure 1 illustrates the assembly of an engine system with components

such as a carburetor, LPG mixer, and fuel supply systems:

FIG. 1



EX1005, Fig. 1 (annotated).

265. 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. A POSA would have understood that Nakafushi's disclosure of a fully configured engine system inherently included the method of assembling these components.

b. Element [57.1]

266. Element [57.1] recites "providing an engine operable on a gaseous fuel and a liquid fuel."

267. As discussed (*see* §XII.C.1.b), Nakafushi's engine selectively uses gasoline or LPG as fuel.

c. Element [57.2]

268. Element [57.2] recites "attaching a carburetor to an intake of the engine."

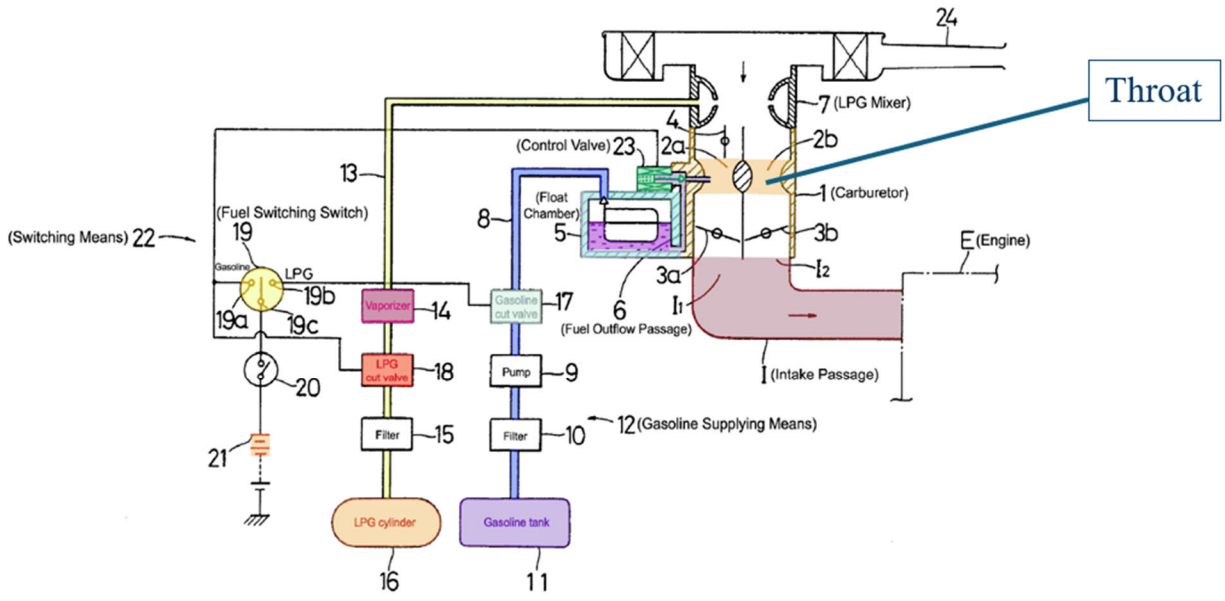
269. As discussed (*see* §XII.C.1.d), Nakafushi discloses a carburetor attached to an intake of the engine. It is inherent in Nakafushi that the carburetor 1 was attached to the intake passage I during assembly, as its described placement in the intake system requires such an attachment step. A POSA would have understood that assembling Nakafushi's engine involved attaching the carburetor to the engine's intake.

d. Element [57.3]

270. Element [57.3] recites "a throat to mix gaseous fuel with air and liquid fuel with air."

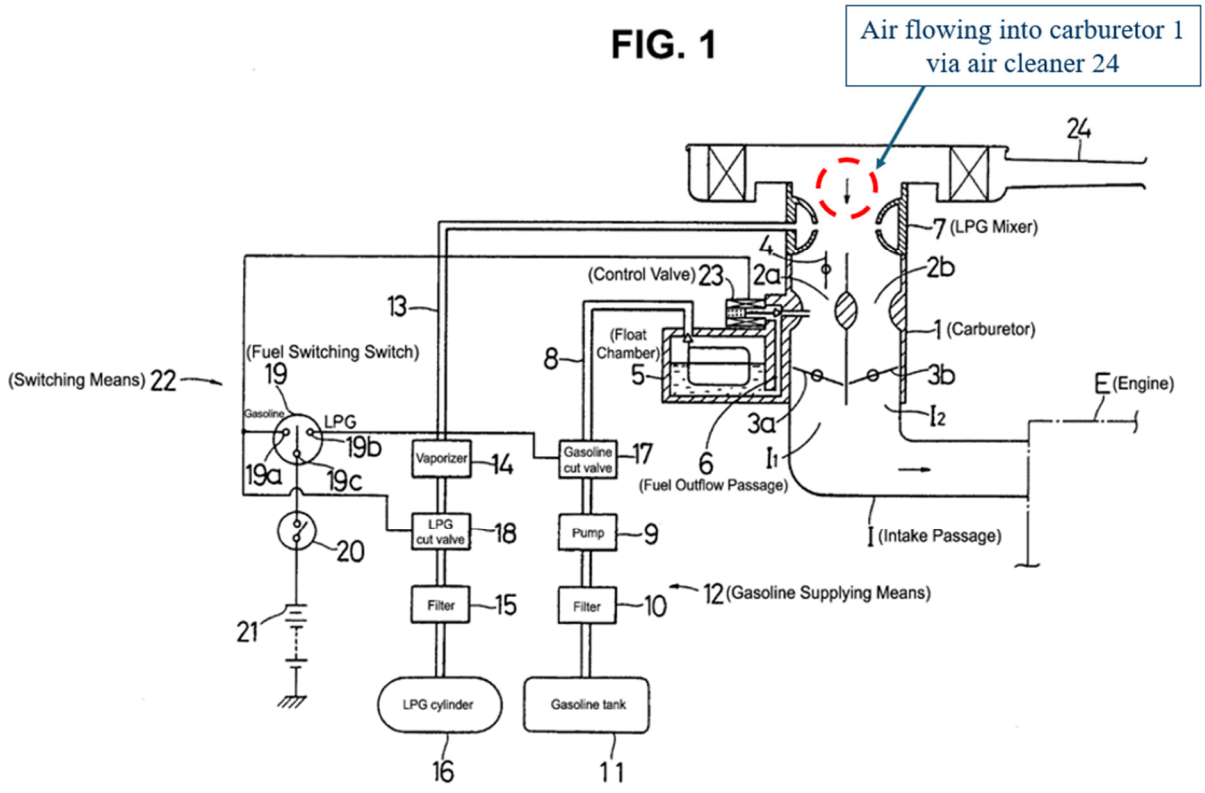
271. Nakafushi discloses a throat of the carburetor 1 to mix gaseous fuel with air and liquid fuel with air:

FIG. 1



EX1005, Fig. 1 (annotated).

272. 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 (annotated), ¶[0015].

273. 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." *Id.*, ¶[0010]. Nakafushi further states "5 denotes a float chamber in which gasoline is stored…." *Id.*

274. A POSA would have understood that engines such as Nakafushi's operated by mixing fuel (either gasoline or LPG in Nakafushi's case) with air prior to combustion in the engine, as confirmed by Nakafushi's numerous references to

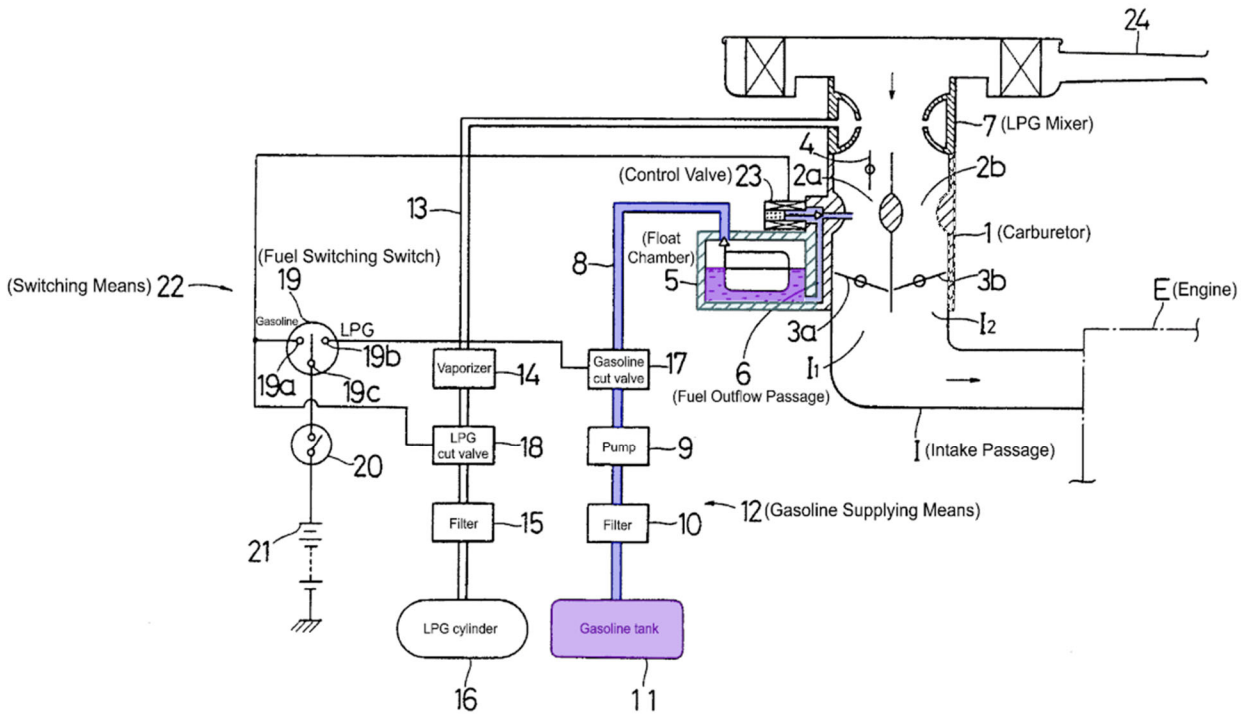
the "air-fuel ratio" and "air-fuel mixture" with regard to gasoline (and/or LPG) being mixed with air. *Id*., ¶¶[0004]-[0005], [0008], [0016], [0019]. A POSA thus would have recognized Nakafushi's disclosure of a throat that mixes gaseous fuel with air and liquid fuel with air.

e. Element [57.4]

275. Element [57.4] recites "a float bowl."

276. 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." *Id.*, ¶[0010].

FIG. 1



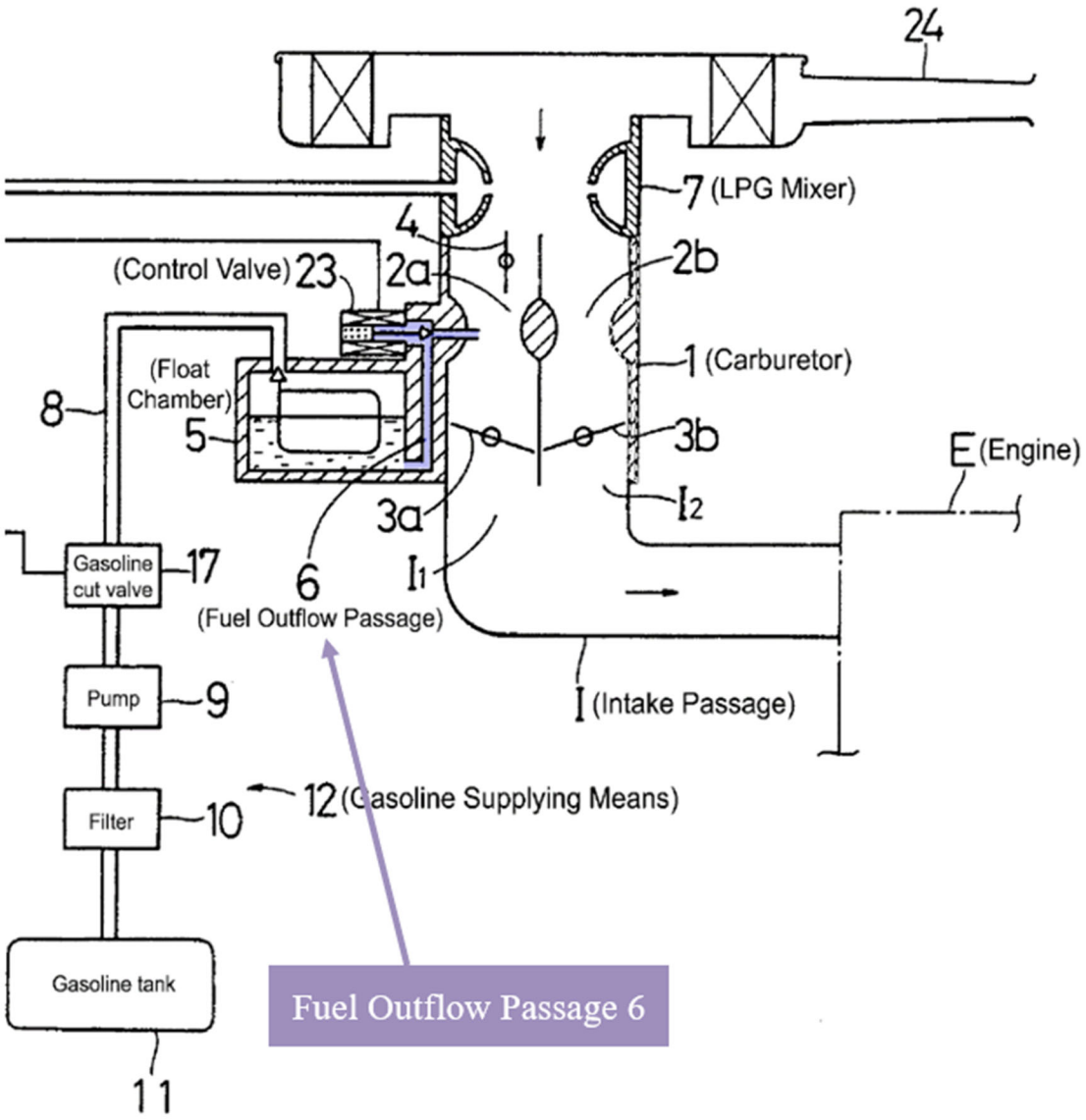
EX1005, Fig. 1 (annotated).

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

f. Element [57.5]

278. Element [57.5] recites "a fuel passage extending from the float bowl to the throat to provide liquid fuel."

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



Id., Fig. 1 (annotated).

280. The fuel outflow passage 6 is a "fuel passage" for purposes of Element [57.5] because it is positioned downstream from the float bowl and extends from the float bowl to the throat. *Id.*, ¶[0010], Fig. 1.

g. Element [57.6]

281. Element [57.6] recites "coupling a switch to the engine to change operation of the engine between gaseous fuel and liquid fuel."

282. As discussed (*see* §XII.C.1.c), Nakafushi discloses fuel switch 19 that changes operation of the engine between gaseous fuel and liquid fuel. It is inherent in Nakafushi that the fuel switch 19 was coupled to the engine's fuel supply system during assembly, as its integration into the electrical circuit, as shown in Figure 1, necessarily requires such a coupling step to enable fuel selection. EX1005, Fig. 1. A POSA would have understood that assembling Nakafushi's engine involves coupling the fuel switch 19 to the engine's control system to facilitate switching between gasoline and LPG.

h. Element [57.7]

283. Element [57.7] recites "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."

284. As discussed (*see* §XII.C.1.g), Nakafushi discloses control valve 23 that is attached to the carburetor to intervene in the fuel outflow passage 6 upon actuation of the switch 19 from liquid fuel to gaseous fuel. It is inherent in Nakafushi that control valve 23 was attached to the carburetor during assembly, as its placement within the fuel outflow passage 6, as shown in Figure 1, necessitated such an

attachment step. EX1005, Fig. 1. A POSA would have understood that assembling Nakafushi's engine involves attaching control valve 23 to the carburetor.

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

285. In my opinion, Claims 2, 4-14, 19-21, 23, 32-42, and 58 of the '398 Patent are obvious as described below.

1. Claim 2

286. Claim 2 depends from Claim 1, and further recites "wherein the engine is a pull start, batteryless engine."

287. 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. Matsushima discloses a pull-start and generator for an engine. EX1029, 2:3-8, 2:46-54, 4:63-66, 5:4-8.

288. 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. *See* §XII.B.1.

2. Claim 4

289. Claim 4 depends from Claim 1, and further recites "wherein the engine is a pull-start engine having an electrical power generator to supply electrical power."

290. As discussed (*see* §XII.D.1), it would have been obvious to incorporate Matsushima's recoil-starter assembly and electrical power generator with Nakafushi's engine.

3. Claim 5

291. Claim 5 depends from Claim 4, and recites two additional elements.

a. Element [5.1]

292. Element [5.1] recites "wherein the switch is an electro-mechanical switch connecting one fuel source to the carburetor and connected to the electrical power generator."

293. As noted for Element [1.2] (*see* §XII.C.1.c), the fuel switching switch 19 changes operation of the engine between gaseous fuel and liquid fuel by selectively powering control valve 23 and LPG cut valve 18, or gasoline cut valve 17. Specifically, the switch 19 moves mechanically between contacts 19a and 19b, and operates by altering cut signals (i.e., electrical currents), thus making it an electro-mechanical switch. Because operation of switch 19 dictates which fuel is supplied to the carburetor, it connects one fuel source to the carburetor. *See* §XII.C.1.c.

294. As discussed (*see* §XII.D.1), it would have been obvious to incorporate Matsushima's flywheel generator for use with Nakafushi's engine. In doing so, Matsushima's generator would supply electrical current for Nakafushi's valves 17,

18, or 23 via switch 19 in the same way as Nakafushi's battery. The switch 19 would then be connected to the electrical power generator and would alternatively connect gasoline or LPG to the carburetor.

b. Element [5.2]

295. Element [5.2] recites "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."

296. As discussed (*see* §XII.D.1), it would have been obvious to incorporate Matsushima's recoil-starter assembly for use with Nakafushi's dual-fuel engine.

297. As noted for Element [1.6] (*see* §XII.C.1.g), the control valve 23 opens and closes the fuel outflow passage 6 upon actuation of the fuel switching switch 19. And as noted for Element [1.2] (*see* §XII.C.1.c), switch 19 selectively powers control valve 23 via a cut signal (i.e., electrical power).

298. To the extent Nakafushi does not disclose a "solenoid," it would have been obvious to a POSA to use a solenoid in view of Olmr. Olmr discloses a gasoline engine having solenoid 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. Olmr's Figure 2 shows:

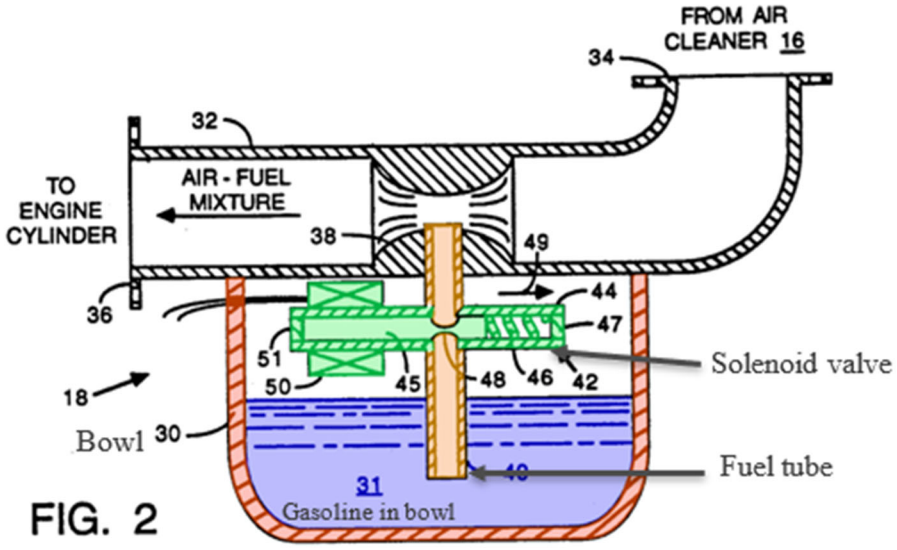


FIG. 2

Id., Fig. 2 (annotated).

299. Thus, Olmr's valve 42 is a solenoid connected to open and close a fuel path to the [pull-start] engine via venturi 38.

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

i. Motivation to Combine

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

2:30-56; *see also id.*, 1:33-40, 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.

ii. Reasonable Expectation of Success

302. 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.

303. 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 42, to open and close the fuel pathway. Indeed, Olmr teaches an essentially identical electrical circuit for operating its solenoid valve. EX1007, 2:57-4:27, Figures 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.

4. Claim 6

304. Claim 6 depends from Claim 4, and further recites "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."

305. As discussed (*see* §XII.C.1.g), Nakafushi's control valve 23 is incorporated into the carburetor and interrupts liquid fuel flow. As also discussed (*see* §XII.D.3.b), it would have been obvious for a POSA to use Olmr's solenoid valve 42 as Nakafushi's control valve 23. As further discussed (*see* §XII.D.1), it would have been obvious to incorporate Matsushima's flywheel generator for use with Nakafushi's engine. Thus, Nakafushi's control valve 23 (a solenoid valve when combined with Olmr) would be powered by Matsushima's flywheel generator as an alternative to being powered by Nakafushi's battery.

5. Claim 7

306. Claim 7 depends from Claim 6, and further recites "wherein the switch selectively powers the solenoid valve by controlling electrical connection between the solenoid valve and the electrical power generator."

307. As discussed (*see* §XII.D.3.b), Nakafushi's control valve 23 (a solenoid when combined with Olmr) opens and closes a fuel path in response to reception of electrical current from the fuel switching switch 19. As also discussed (*see* §XII.D.4), operation of Nakafushi's control valve 23 would be powered by

Matsushima's generator as an alternative to Nakafushi's battery. Thus, Nakafushi's switch 19 would selectively power control valve 23 by controlling the electrical current between the control valve 23 and Matsushima's generator in the same way the switch 19 controls current between the control valve 23 and Nakafushi's battery.

6. Claim 8

308. Claim 8 depends from Claim 6 and further recites "wherein the solenoid valve is normally open to provide liquid fuel to the engine when the solenoid valve is unpowered."

309. The control valve 23 of Nakafushi is normally closed. EX1005, ¶[0014], Fig. 1. As discussed (*see* §XII.D.3.b), it would have been obvious to use Olmr's solenoid valve 42 as Nakafushi's control valve 23. 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. It would have been obvious to a POSA to configure it as normally open for the same reasons discussed above. *See* §XII.B.6.

7. Claim 9

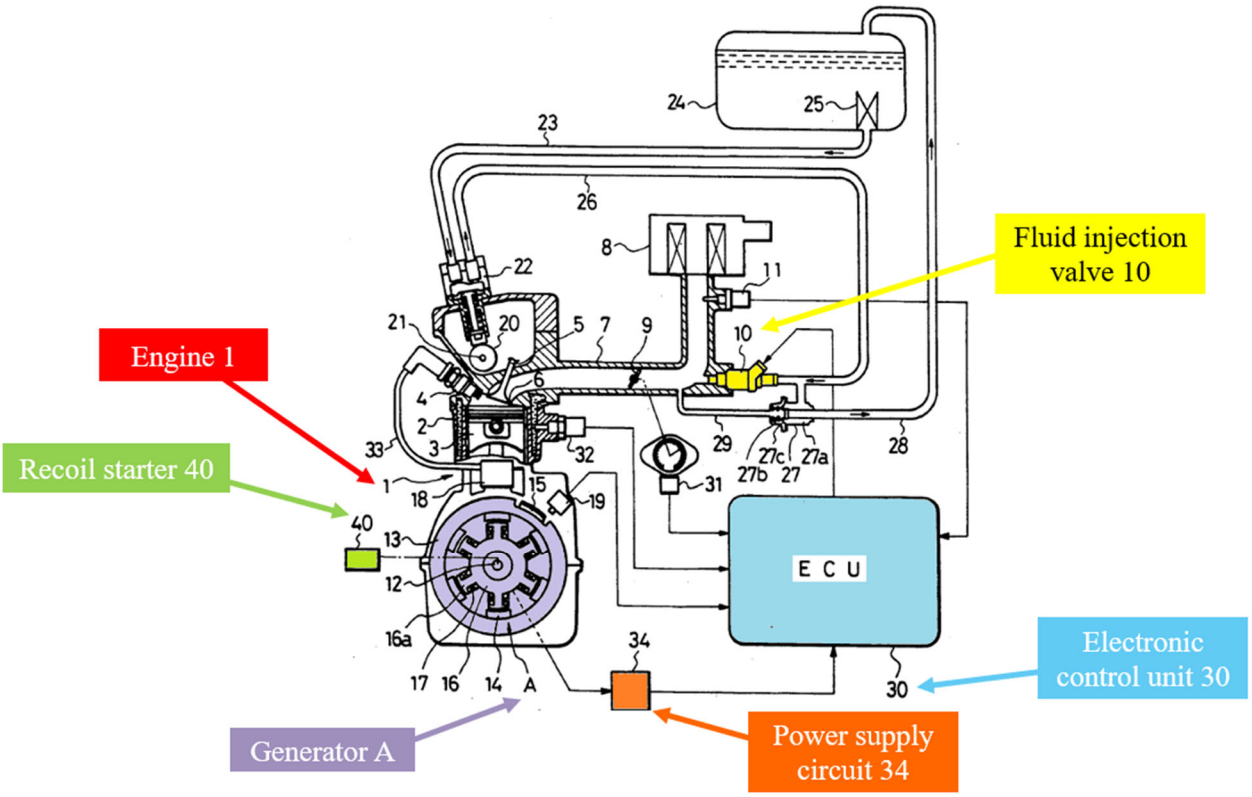
310. Claim 9 depends from Claim 8 and further recites "wherein a pull-starter drives the electrical power generator to power and close the solenoid valve while starting the engine on gaseous fuel."

311. 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. Incorporating Matsushima's pull-starter assembly with Nakafushi's engine would similarly allow the pull-starter assembly to drive a generator to power and close Nakafushi's control valve 23 (a solenoid when combined with Olmr) while starting the engine on gaseous fuel.

8. Claim 10

312. Claim 10 depends from Claim 6, and further recites "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."

313. 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. Matsushima discloses generator A 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, 4:43-62; Fig. 1.



EX1029, Fig. 1 (annotated).

314. Because the power supply stabilizes the output voltage from the alternator, it is a voltage regulator. 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).

9. Claim 11

315. Claim 11 depends from Claim 6, and further recites "wherein the solenoid valve is open to provide liquid fuel to the engine when the solenoid valve is powered."

316. Nakafushi's control valve 23 is normally closed and, as such, is open to provide gasoline to the engine when it is powered. EX1005, ¶[0014], Fig. 1. As discussed (*see* §XII.D.3.b), it would have been obvious to use a solenoid for Nakafushi's control valve 23.

10. Claim 12

317. Claim 12 depends from Claim 11, and further recites "wherein a pull-starter drives the electrical power generator to power and open the solenoid valve while starting the engine on liquid fuel."

318. 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. 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 liquid fuel.

11. Claim 13

319. Claim 13 depends from Claim 6, and further recites "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."

320. As discussed (*see* §XII.D.3.b), it would have been obvious to use Olmr's solenoid valve 42 as Nakafushi's control valve 23.

321. 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. *See* §XII.B.11.

12. Claim 14

322. Claim 14 depends from Claim 13, and further recites "wherein the microcontroller closes the solenoid valve during engine shutdown from operation on liquid fuel."

323. As discussed (*see* §XII.D.11), it would have been obvious to use a microcontroller to control Nakafushi's control valve 23 (a solenoid when combined with Olmr). With this modification, the microcontroller would also close Nakafushi's control valve 23 (a solenoid when combined with Olmr) during engine shutdown to stop the flow of gasoline at the desired time.

13. Claim 19

324. Claim 19 depends from Claim 1, and further recites "wherein the liquid fuel cut-off is magnetically actuated to selectively interrupt liquid fuel."

325. As discussed (*see* §XII.D.3.b), it would have been obvious to use a solenoid for Nakafushi's control valve 23. By making this substitution, the solenoid valve, which operates via magnetic actuation, selectively interrupts liquid fuel.

14. Claim 20

326. Claim 20 depends from Claim 1, and further recites two additional elements.

a. Element [20.1]

327. Element 20.1 recites "a spring pushing the liquid fuel cut-off to interrupt liquid fuel."

328. As discussed (*see* §§XII.D.3.b, XII.D.6), it would have been obvious to use Olmr's solenoid valve 42 as Nakafushi's control valve 23; Nakafushi's control valve 23 is normally closed. 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.

b. Element [20.2]

329. Element 20.2 recites "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."

330. As discussed (*see* §§XII.D.3.b, XII.D.6), it would have been obvious to use Olmr's solenoid valve 42 as Nakafushi's control valve 23; Nakafushi's control valve 23 is normally closed. 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 gas 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.

331. Nakafushi's control valve 23 is physically attached to an outer surface of the carburetor (*see* §XII.C.3). Thus, when using a solenoid as Nakafushi's control valve 23, the actuating magnet would be coupled to the carburetor.

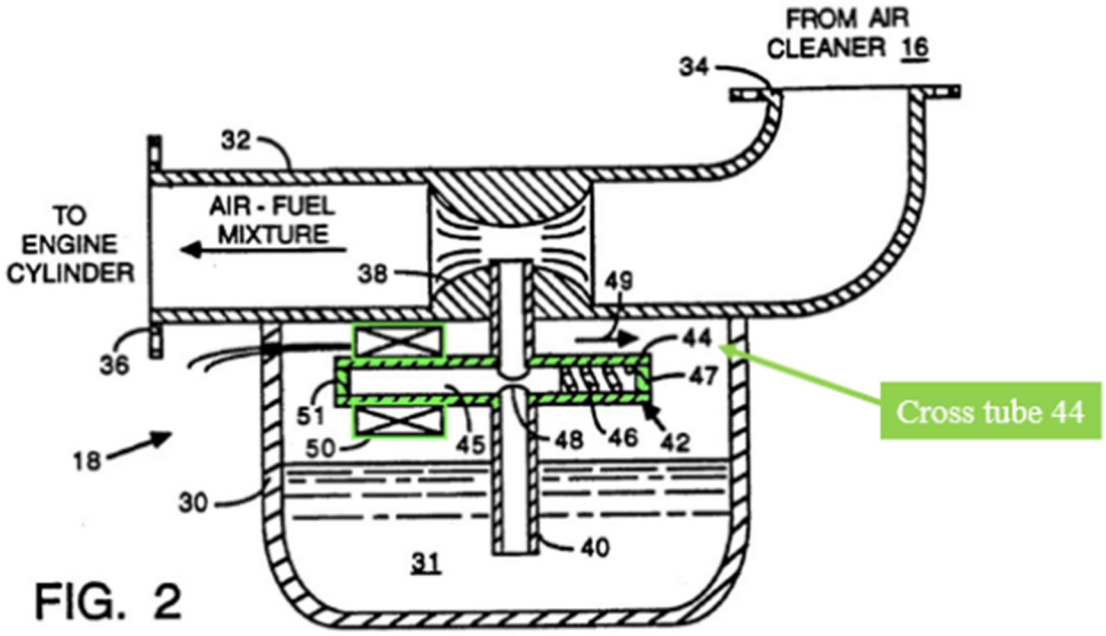
15. Claim 21

332. Claim 21 depends from Claim 20, and recites additional elements.

a. Element [21.1]

333. Element [21.1] recites "a housing at least partially enclosing the liquid fuel cutoff, the housing including."

334. As discussed (*see* §XII.D.3.b), it would have been obvious to use Olmr's solenoid valve 42 as Nakafushi's control valve 23. Olmr's solenoid valve 42 has a housing, including cross tube 44 (EX1007, 2:43-44):



Id., Fig. 2 (annotated).

b. Element [21.2]

335. Element [21.2] recites "a first section enclosing a plunger of the liquid fuel cut-off to the carburetor and holding the spring against the plunger."

336. The housing of Olmr's solenoid valve 42 has a first section enclosing a plunger (cross tube 44), which holds the spring 46 against the plunger 45 (*id.*, 2:43–68):

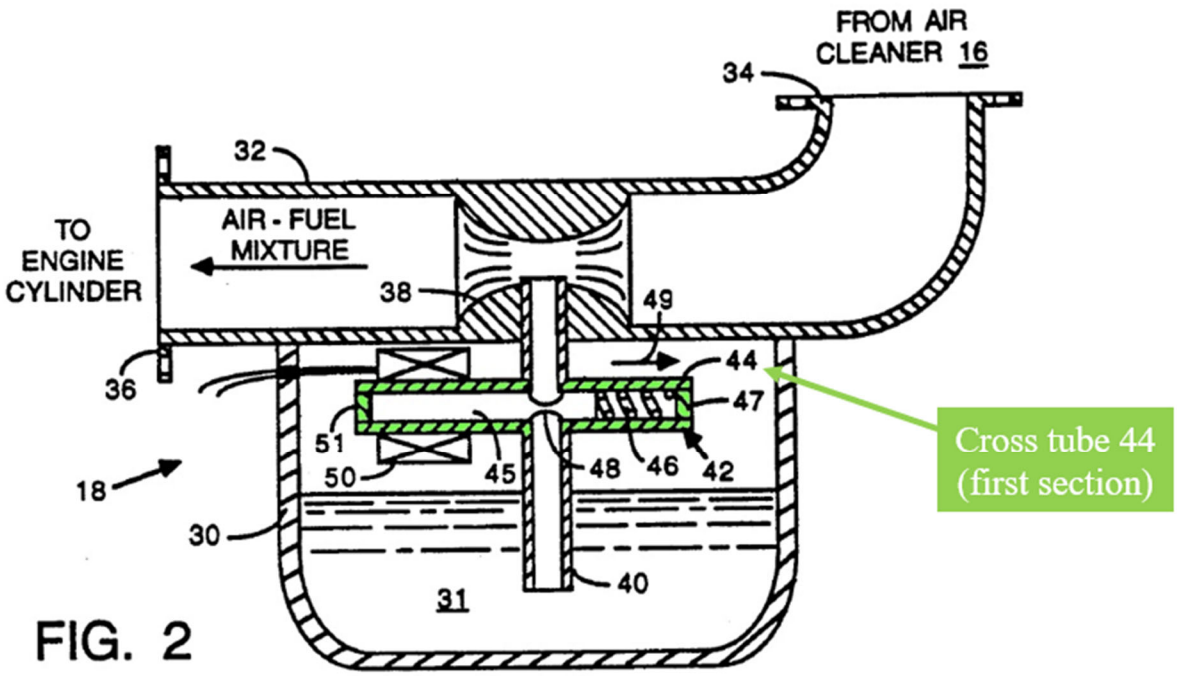


FIG. 2

Id., Fig. 2 (annotated).

c. Element [21.3]

337. Element [21.3] recites "a second section coupled to the first section and enclosing the actuating magnet."

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

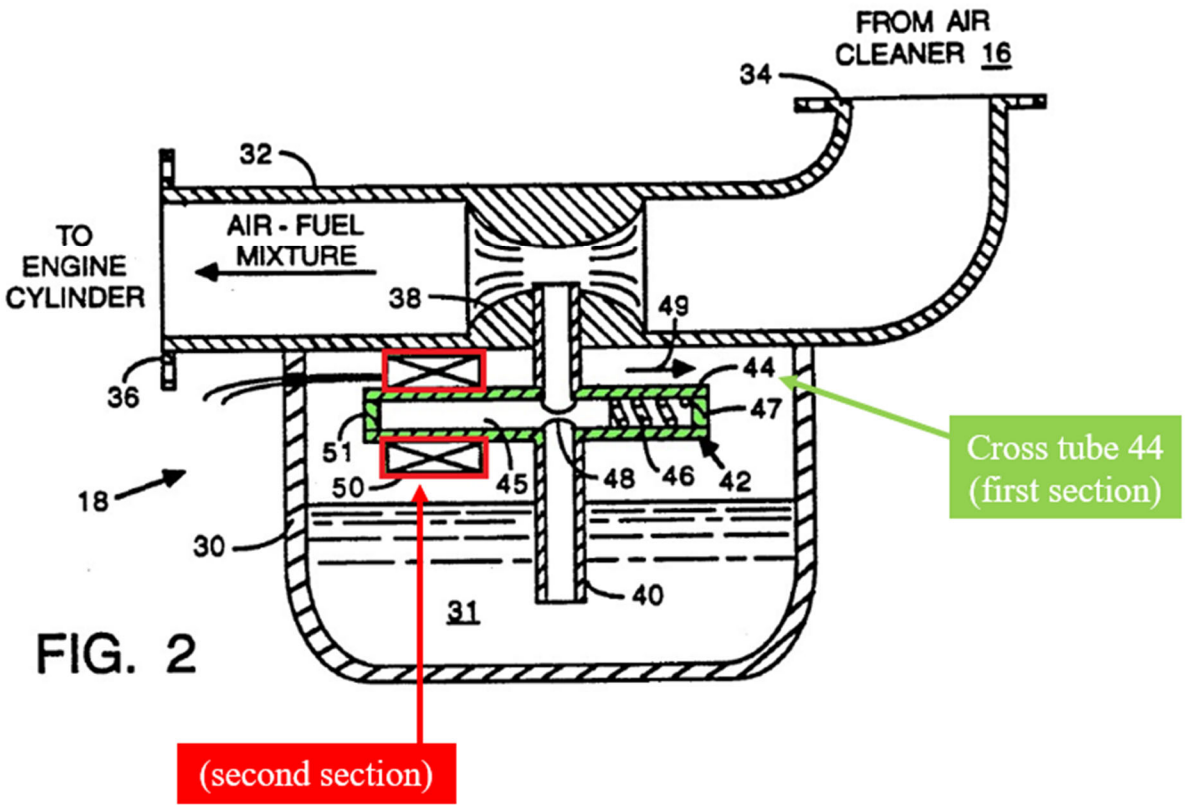


FIG. 2

Id., Fig. 2 (annotated).

339. As shown in Figure 2 in Olmr, this second section is coupled to the first section, as recited in Element [21.2]. *See* §XII.D.15.b.

340. 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).

341. A POSA would have been motivated to use a solenoid valve with a housing to protect the components of the valve. 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.

16. Claim 23

a. Element [23.0]

342. Element [23.0] recites "a batteryless dual fuel generator."

343. As discussed (*see* §XII.D.1, XII.D.2), it would have been obvious to replace Nakafushi's battery with Matsushima's recoil-starter assembly and generator. Thus, Nakafushi's engine modified in light of Matsushima discloses Element [23.0].

b. Element [23.1]

344. Element [23.1] recites "a housing containing a pull start engine coupled to drive an alternator, the engine operable on a gaseous fuel and a liquid fuel."

345. As discussed (*see* §XII.C.1.b), Nakafushi discloses an engine operable on a gaseous fuel and a liquid fuel. As also discussed (*see* §XII.D.1), it would have been obvious to replace Nakafushi's battery with Matsushima's recoil-starter assembly and generator. Nakafushi's engine, using Matsushima's pull start, would drive Matsushima's generator (which is an alternator).

346. 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. *See* §XII.B.16.b.

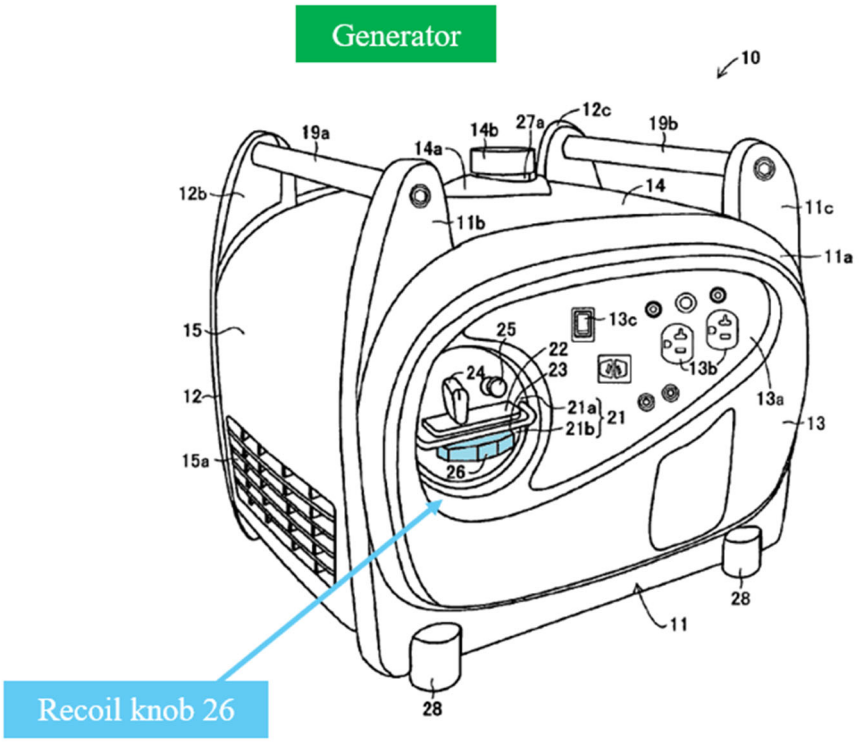


Figure 1

EX1030, Fig. 1 (annotated).

c. Element [23.2]

347. Element [23.2] recites "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."

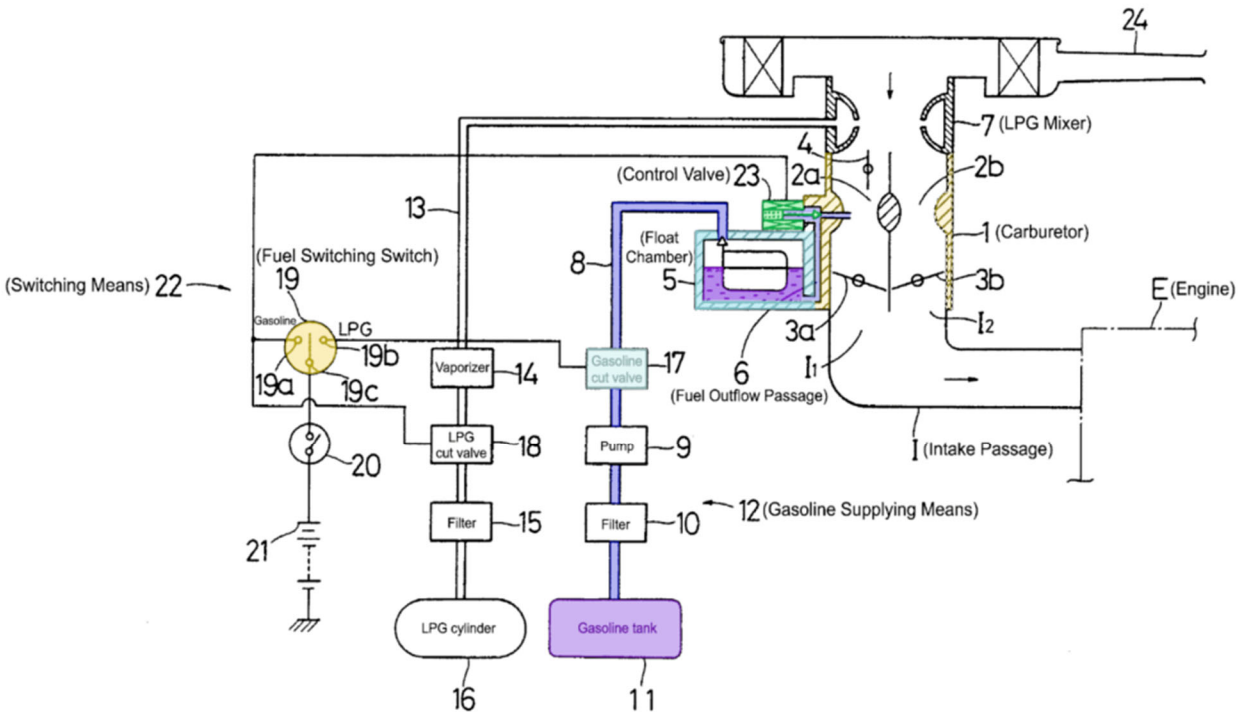
348. As discussed (*see* §XII.C.1.d, XII.C.4.d-XII.C.4.f), Nakafushi discloses a carburetor attached to an intake of the engine which includes a throat to mix fuel with air, a float bowl, and a fuel passage extending from the float bowl to the throat to provide liquid fuel.

d. Element [23.3]

349. Element [23.3] recites "a fuel shutoff attached to the carburetor to close the fuel passage upon selection of engine operation to gaseous fuel."

350. As discussed (*see* §XII.C.1.g), Nakafushi's control valve 23 is attached to the carburetor to interrupt liquid fuel upon selection of engine operation to gaseous fuel. Control valve 23 interrupts liquid fuel by closing fuel outflow passage 6, which is part of the fuel passage (EX1005, ¶[0014]):

FIG. 1



Id., Fig. 1 (annotated).

17. Claim 32

351. Claim 32 depends from Claim 23, and recites two additional elements.

a. Element [32.1]

352. Element [32.1] recites "a spring pushing the fuel shutoff to close the fuel passage."

353. As discussed (*see* §XII.D.14.a), the obvious use of Olmr's solenoid valve 42 as Nakafushi's control valve 23 would operate by the spring pushing the valve plunger to close the fuel passage.

b. Element [32.2]

354. Element [32.2] recites "an actuating magnet coupled to the carburetor to selectively pull the fuel shutoff against the spring to open the fuel passage."

355. As discussed (*see* §XII.D.14.b), the obvious use of Olmr's solenoid valve 42 as Nakafushi's control valve 23 would result in an actuating magnet coupled to the carburetor to selectively pull the solenoid valve against the spring away from a position interrupting liquid fuel, i.e., the opening of fuel outflow passage 6.

18. Claim 33

356. Claim 33 depends from Claim 32, and recites three additional elements.

a. Element [33.1]

357. Element [33.1] recites "a housing at least partially enclosing the fuel shutoff, the housing including."

358. As discussed (*see* §XII.D.15.a), the obvious use of Olmr's solenoid valve 42 as Nakafushi's control valve 23 would result in a housing at least partially enclosing the solenoid valve.

b. Element [33.2]

359. Element [33.2] recites "a first section enclosing a plunger of the fuel shutoff to the carburetor and holding the spring against the plunger."

360. As discussed (*see* §XII.D.15.b), the obvious use of Olmr's solenoid valve 42 as Nakafushi's control valve 23 would result in a housing including a first

section enclosing a plunger of the solenoid valve to the carburetor and holding the spring against the plunger.

c. Element [33.3]

361. Element [33.3] recites "a second section coupled to the first section and enclosing the actuating magnet."

362. As discussed (*see* §XII.D.15.c), the obvious use of Olmr's solenoid valve 42 as Nakafushi's control valve 23 would result in a housing including a second section coupled to the first section and enclosing the actuating magnet.

19. Claim 34

363. Claim 34 depends from Claim 23, and recites three additional elements.

a. Element [34.1]

364. Element [34.1] recites "wherein the fuel shutoff is a carburetor cutoff solenoid."

365. As discussed (*see* §§XII.D.3.b, XII.D.16.d), Nakafushi discloses control valve 23 attached to the carburetor, which would be a solenoid when combined with Olmr. Thus, the combination of Nakafushi and Olmr teaches a "carburetor cutoff solenoid" for purposes of Element [34.1].

b. Element [34.2]

366. Element [34.2] recites "wherein the generator further comprises a charge winding to generate electrical power to operate the carburetor cutoff solenoid."

367. As discussed (*see* §XII.D.1), it would have been obvious to combine Matsushima's recoil starter assembly and generator with Nakafushi's engine. As also discussed (*see* §XII.D.16.b), 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" for purposes of Element [34.2]. Nakafushi's control valve 23 (a solenoid when combined with Olmr) would be powered by Matsushima's charge winding. *See* §XII.D.4.

c. Element [34.3]

368. Element [34.3] recites "a switch to selectively power the carburetor cutoff solenoid by controlling electrical connection between the carburetor cutoff solenoid and the charge winding."

369. As discussed (*see* §XII.D.5), Nakafushi discloses fuel switching switch 19 that 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). *See also* §XII.D.19.b.

20. Claim 35

370. Claim 35 depends from Claim 34, and further recites "wherein the carburetor cutoff solenoid is normally open to provide liquid fuel to the engine when the carburetor cutoff solenoid is unpowered."

371. As discussed (*see* §XII.D.6), it would have been obvious to use a normally-open control valve 23 (a solenoid when combined with Olmr) in view of Olmr to provide liquid fuel to the engine when the solenoid valve is unpowered.

21. Claim 36

372. Claim 36 depends from Claim 35, and further recites "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."

373. As discussed (*see* §XII.D.7), incorporating Matsushima's pull-starter assembly and generator with Nakafushi's engine would allow the pull-starter assembly to drive the charge winding (i.e., the alternator) to power and close Nakafushi's control valve 23 (a solenoid when combined with Olmr) while starting the engine on gaseous fuel. *See also* §XII.D.19.b.

22. Claim 37

374. Claim 37 depends from Claim 34, and further recites "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."

375. As discussed (*see* §XII.D.3.a), the fuel switch 19 is an electro-mechanical switch connected to the charge winding (i.e., the alternator, when combined with Matsushima) and connecting one fuel source to the carburetor. *See*

also §XII.D.19.b. As also discussed (*see* §XII.C.1.c), the fuel switch 19 changes operation of the engine between gaseous fuel and liquid fuel, thereby selectively controlling fuel flow from at least one fuel source to the carburetor.

23. Claim 38

376. Claim 38 depends from Claim 34, and further recites "wherein the charge winding is coupled to a voltage regulator to provide a regulated voltage to the carburetor cutoff solenoid."

377. As discussed (*see* §XII.D.8), the obvious combination of Matsushima's generator A and power supply circuit 34 with Nakafushi's engine would provide a regulated voltage to Nakafushi's control valve 23 (a solenoid when combined with Olmr). Matsushima's generator includes charge windings 17. EX1029, 3:54-60; Fig. 1.

24. Claim 39

378. Claim 39 depends from Claim 34, and further recites "wherein the carburetor cutoff solenoid is open to provide liquid fuel to the engine when the carburetor cutoff solenoid is powered."

379. As discussed (*see* §XII.D.9), control valve 23 (a solenoid when combined with Olmr) is open to provide liquid fuel to the engine when the valve is powered.

25. Claim 40

380. Claim 40 depends from Claim 39, and further recites "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."

381. As discussed (*see* §XII.D.10), incorporating Matsushima's pull-starter assembly and generator with Nakafushi's engine would allow the pull-starter to drive the charge winding (i.e., the alternator) to power and open control valve 23 (a solenoid when combined with Olmr) while starting the engine on liquid fuel. *See also* §XII.D.19.b.

26. Claim 41

382. Claim 41 depends from Claim 34, and further recites "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."

383. As discussed (*see* §XII.D.11), the obvious use of a microcontroller to close Nakafushi's control valve 23 (a solenoid when combined with Olmr), as shown by Matsushima, would close the solenoid valve when the engine operates on gaseous fuel and would open the solenoid valve to operate the engine on liquid fuel.

27. Claim 42

384. Claim 42 depends from Claim 41, and further recites "wherein the microcontroller closes the carburetor cutoff solenoid during engine shutdown from operation on liquid fuel."

385. As discussed (*see* §XII.D.12), the obvious use of a microcontroller to control Nakafushi's control valve 23 (a solenoid when combined with Olmr), as shown by Matsushima, would close the solenoid valve during engine shutdown to stop the flow of gasoline at the desired time.

28. Claim 58

386. Claim 58 depends from Claim 57, and further recites "coupling a manually operated control operatively to the liquid fuel cut-off."

387. Nakafushi discloses switch 19 to operatively control valve 23. *See* §XII.C.4.g.

388. 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. 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. *See* §XII.B.28.

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

389. In my opinion, Claims 1, 15-16, and 43-44 are anticipated for at least the reasons described below.

1. Claim 1

a. Element [1.0]

390. Element [1.0] recites "a dual fuel engine."

391. 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]

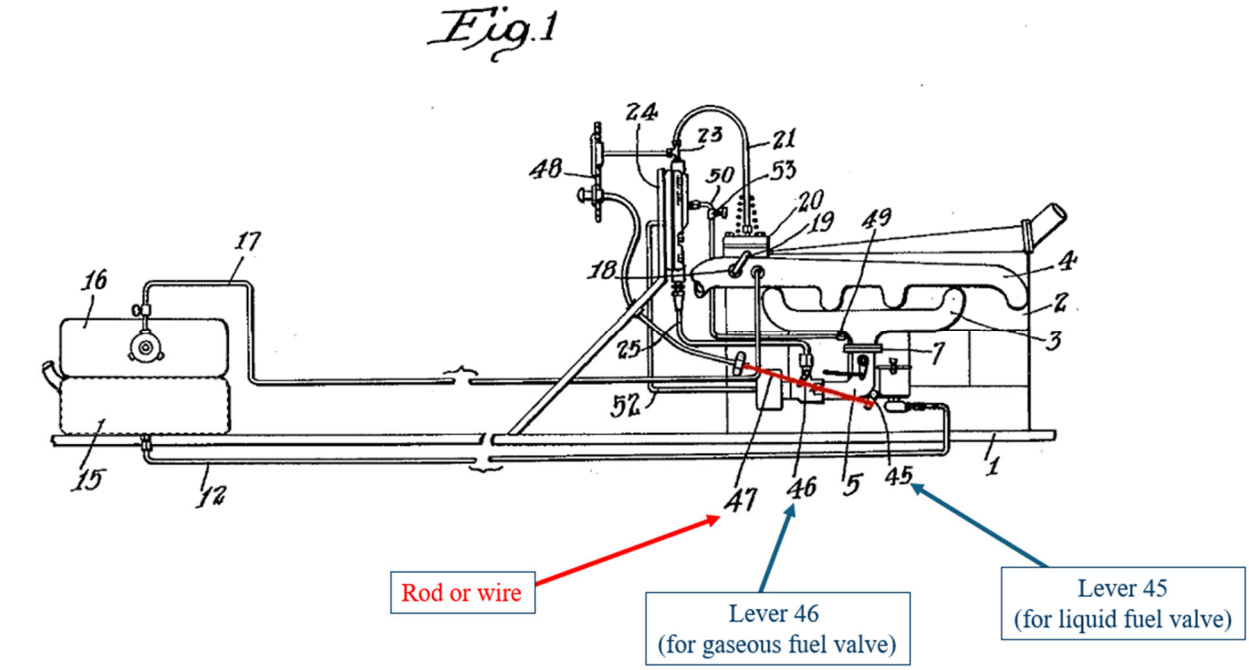
392. Element [1.1] recites "an engine operable on a gaseous fuel and a liquid fuel."

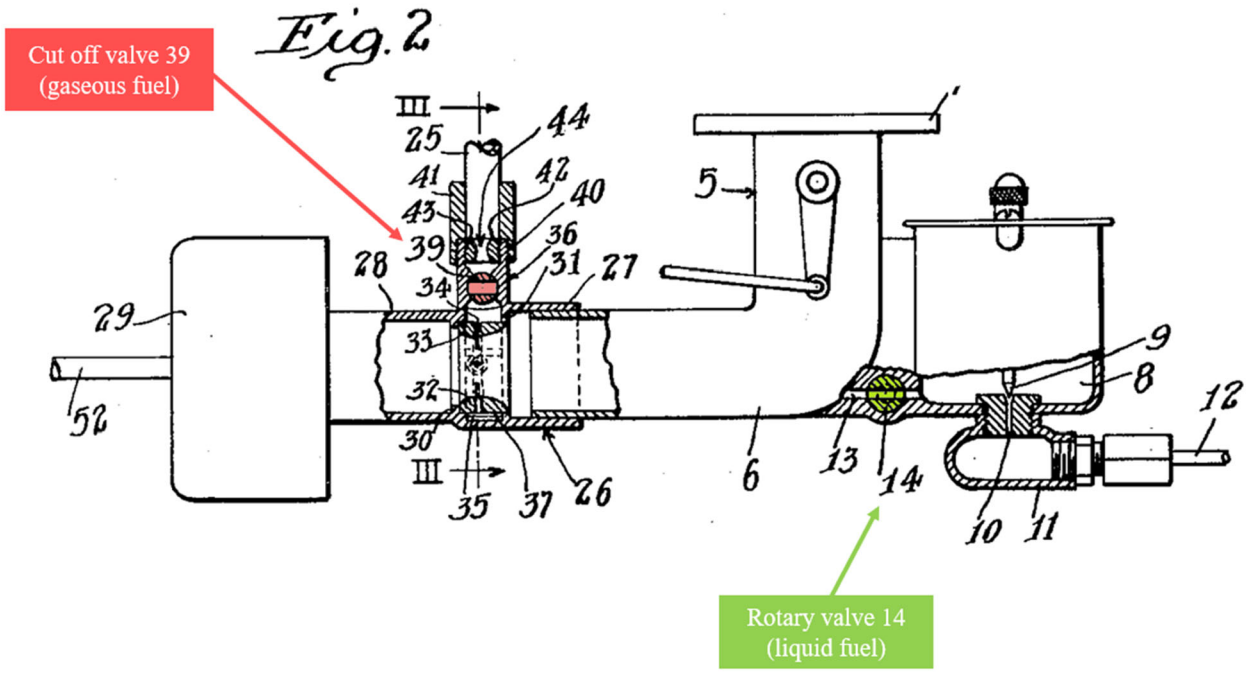
393. The engine of Holzapfel is configured to operate on a gaseous fuel and on a liquid fuel. EX1009, 1:1-5.

c. Element [1.2]

394. Element [1.2] recites "a switch to change operation of the engine between gaseous fuel and liquid fuel."

395. 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. Specifically, the rod or wire 47 simultaneously controls valves 14 and 39 by control of operating levers 45 and 46 for liquid and gaseous fuel supply, respectively:





EX1009, Figures 1-2 (annotated), 2:100-123.

396. When starting the engine, Holzapfel states that "valve 14 is closed and the valve 39 is open" such that "gaseous fuel will be supplied to the carburetor 5."

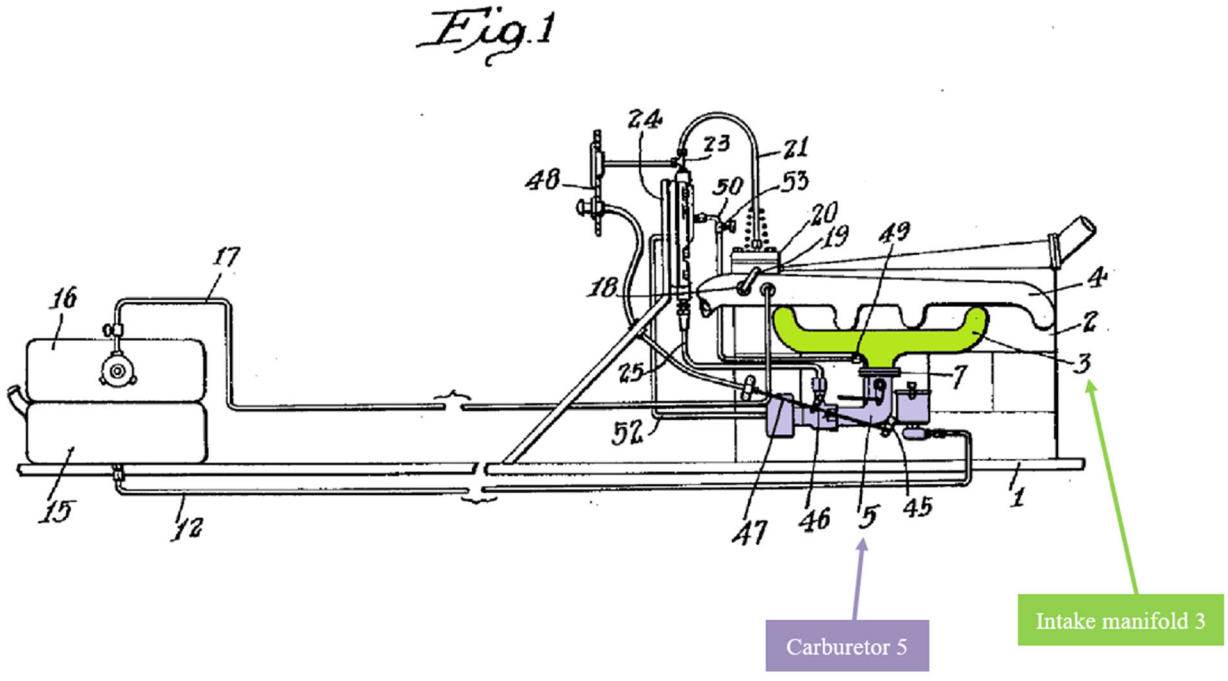
EX1009, 2:111-115. Then, "as soon as the engine is started it may be switched over to the liquid fuel by manipulating the rod or wire 47." EX1009, 2:118-120. This action "reverse[s] the valves 14 and 39 so that the gaseous fuel supply is cut off and the liquid fuel supply connected to feed the carburetor." EX1009, 2:121-123.

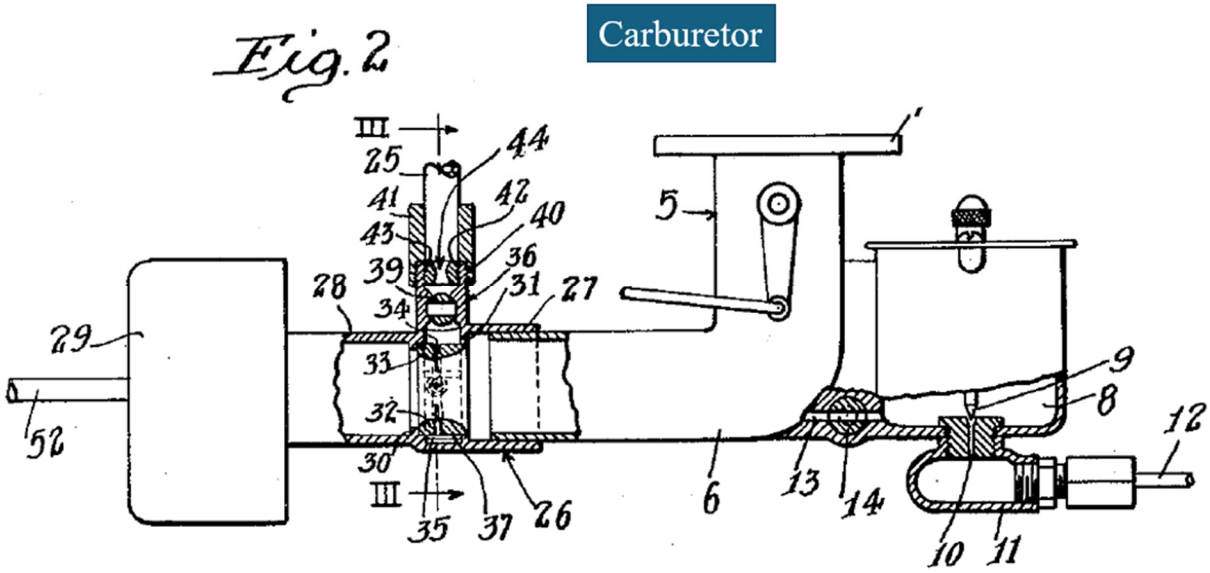
397. Thus, movement of rod or wire 47 allows for simultaneous operation of valves 14 and 39 which in turn changes operation of the engine between liquid and gaseous fuel, respectively. *Id.*

d. Element [1.3]

398. Element [1.3] recites "a carburetor attached to an intake of the engine to mix air and fuel and connect a gaseous fuel source and a liquid fuel source."

399. Holzapfel discloses a carburetor 5 that is connected to the intake manifold 3, as seen in Figures 1-2 below:





EX1009, Fig. 1-2 (*see also* 1:84-86).

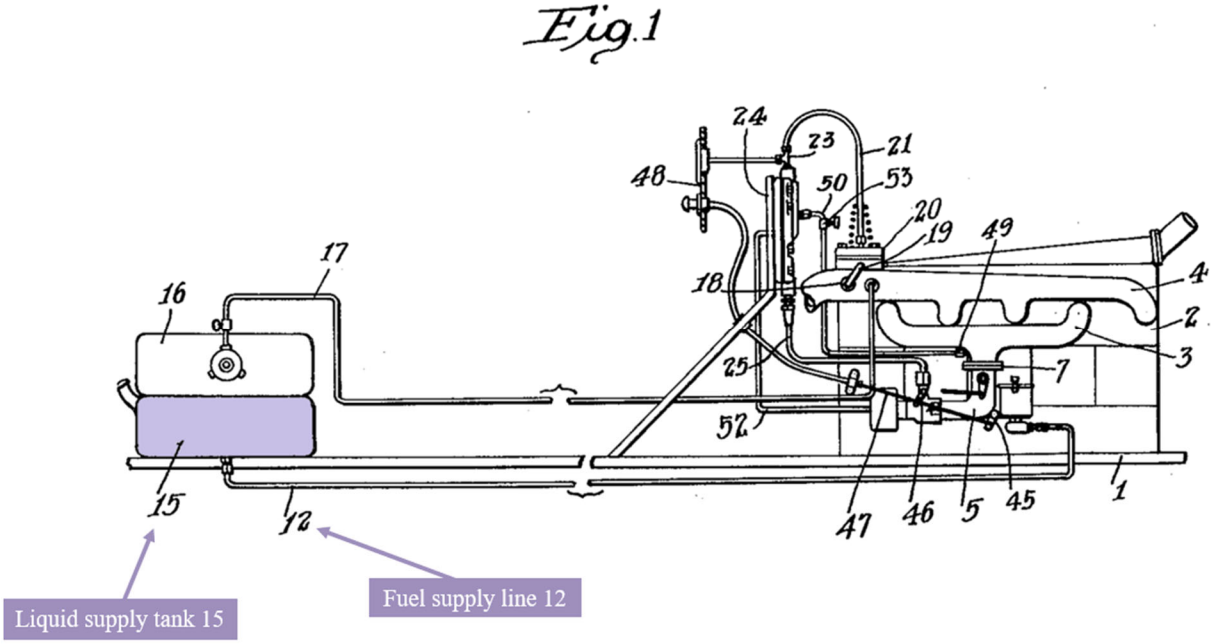
400. Holzapfel states the other end of the carburetor constitutes an "inlet opening through which air may be sucked for mixing with the fuel injected into the carburetor." EX1009, 1:87-89. The carburetor is "equipped with a float chamber or fuel reservoir 8 which may be of any suitable construction to 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.

401. Thus, Holzapfel teaches a carburetor, attached to an engine that mixes air and fuel via gaseous and liquid fuel sources, as recited in Element [1.3].

e. Element [1.4]

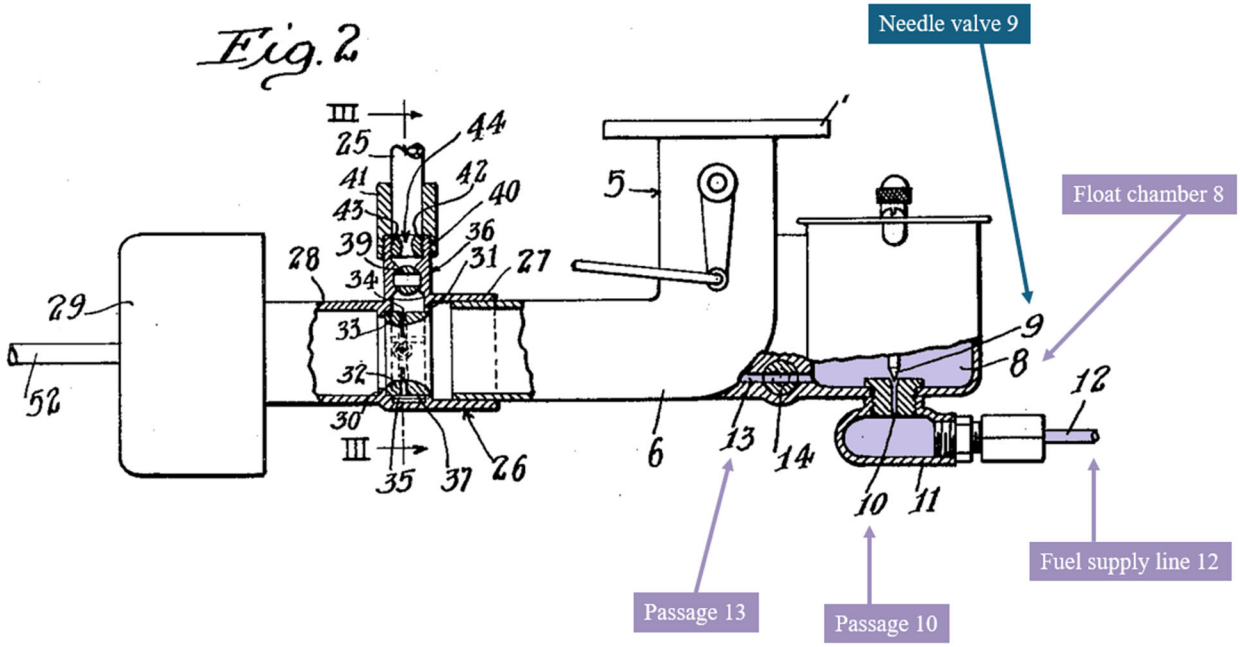
402. Element [1.4] recites "a liquid fuel valve positioned along a liquid fuel line coupling the liquid fuel source to the carburetor."

403. Holzapfel discloses "needle valve 9 [i.e., a "liquid fuel valve"] which obstructs the entrance of fuel into the [float] chamber 8 by closing off the passage 10." EX1009, 1:95-99. Figure 1 shows fuel supply line 12 is attached to liquid supply tank 15 through which fuel from the tank 15 may be passed to the float chamber 8 of the carburetor via inlet connection:



EX1009, Fig. 1. (*see also* 1:108-2:2).

404. Figure 2 shows that 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; *see also id.*, 1:84-99.

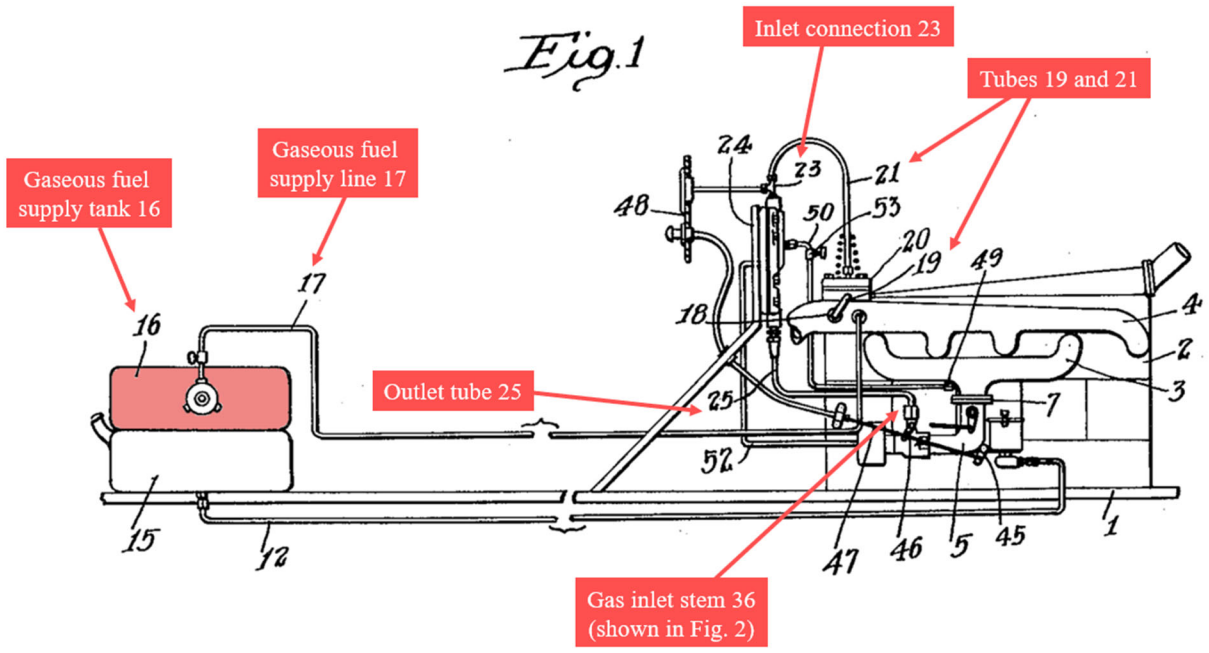
405. Thus, needle valve 9 is positioned on the gasoline fuel line, which begins at liquid supply tank 15, leads to float chamber 8, and eventually to passage 13 for delivery to the carburetor.

f. Element [1.5]

406. Element [1.5] recites "a gaseous fuel valve positioned along a gaseous fuel line coupling the gaseous fuel source to the carburetor."

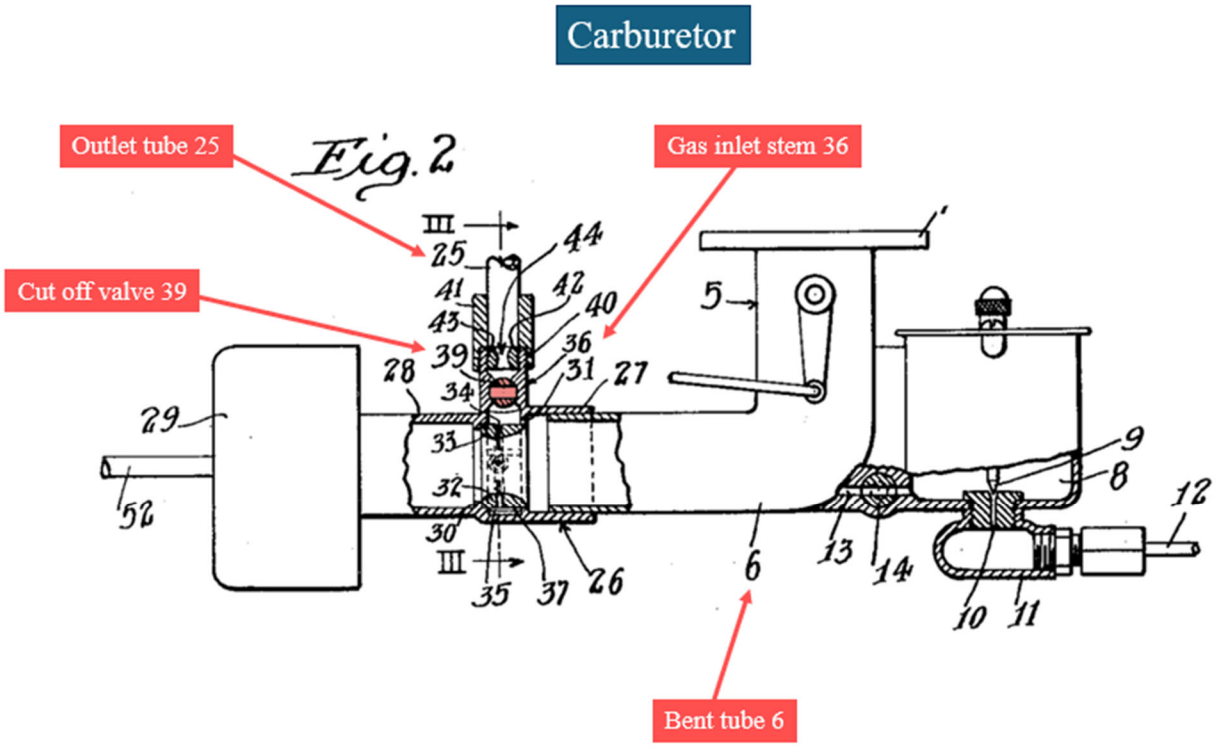
407. Holzapfel discloses "cut off valve 39" [i.e., a gaseous fuel valve] which may be operated to either open the inlet passage 36 to the passage of gas therethrough, or to close the same so that gas cannot pass therethrough." EX1009, 2:86-90. Figure 1 shows gaseous fuel supply line 17 is attached to gaseous fuel supply tank 16 through which fuel from the tank 16 may be passed 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; *see also id.*, 2:8-27 and 2:86-90.

408. Figure 2 shows that 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 (*see also* 2:39-44 and 2:84-90).

409. Thus, cut off valve 39 is positioned on the gaseous fuel line, which begins at gaseous fuel supply tank 16, leading to gas inlet stem 36, which in turn is connected to carburetor 5 via tube 6.

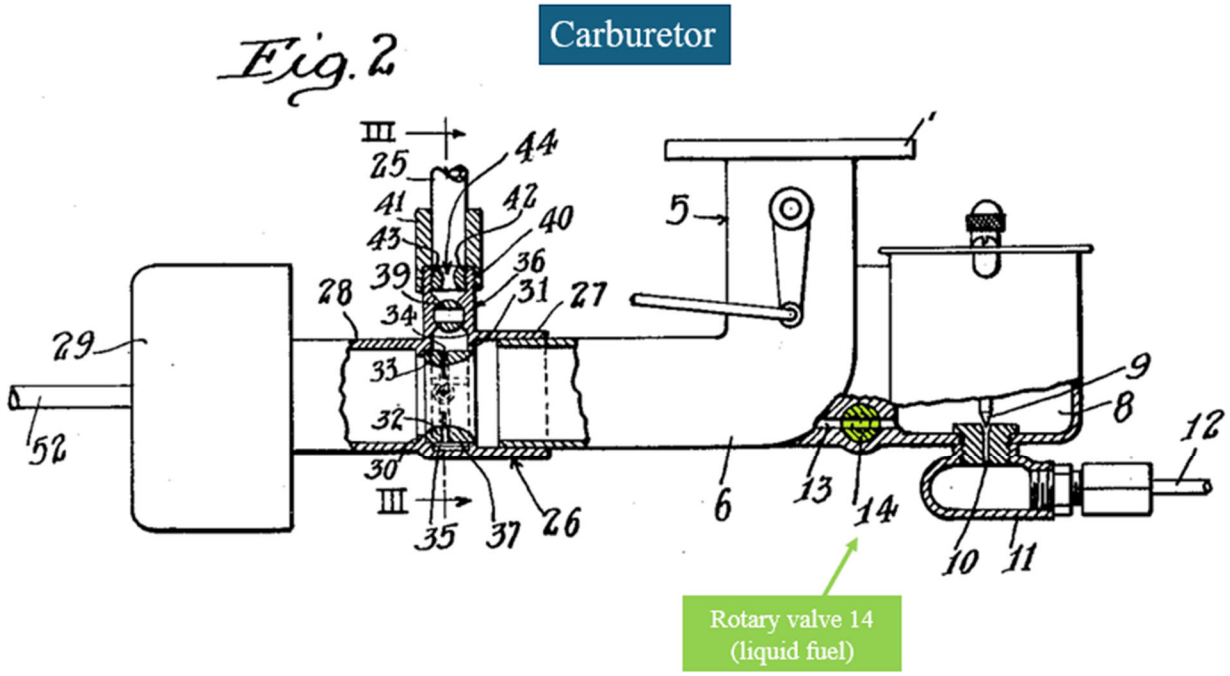
g. Element [1.6]

410. Element [1.6] recites "a liquid fuel cut-off incorporated into the carburetor to interrupt liquid fuel upon actuation of the switch from liquid fuel to gaseous fuel."

411. Holzapfel discloses rotary valve 14, lever 45, and rod or wire 47, which is a "liquid fuel cut-off" for purposes of Element [1.6]. EX1009, 1:100-107, Fig. 2. As noted for Element [1.2] (*see* §XII.E.1.c), the rod or wire 47 controls valve 14

such that the switching from gaseous fuel to liquid fuel results in the opening of valve 14. *Id*., 2:108-123.

412. Holzapfel discloses that when rod or 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 Figure 2 also shows that valve 14 is incorporated into the carburetor (*see* EX1009, 1:58, "Figure 2 is a detailed view of a carburetor"):



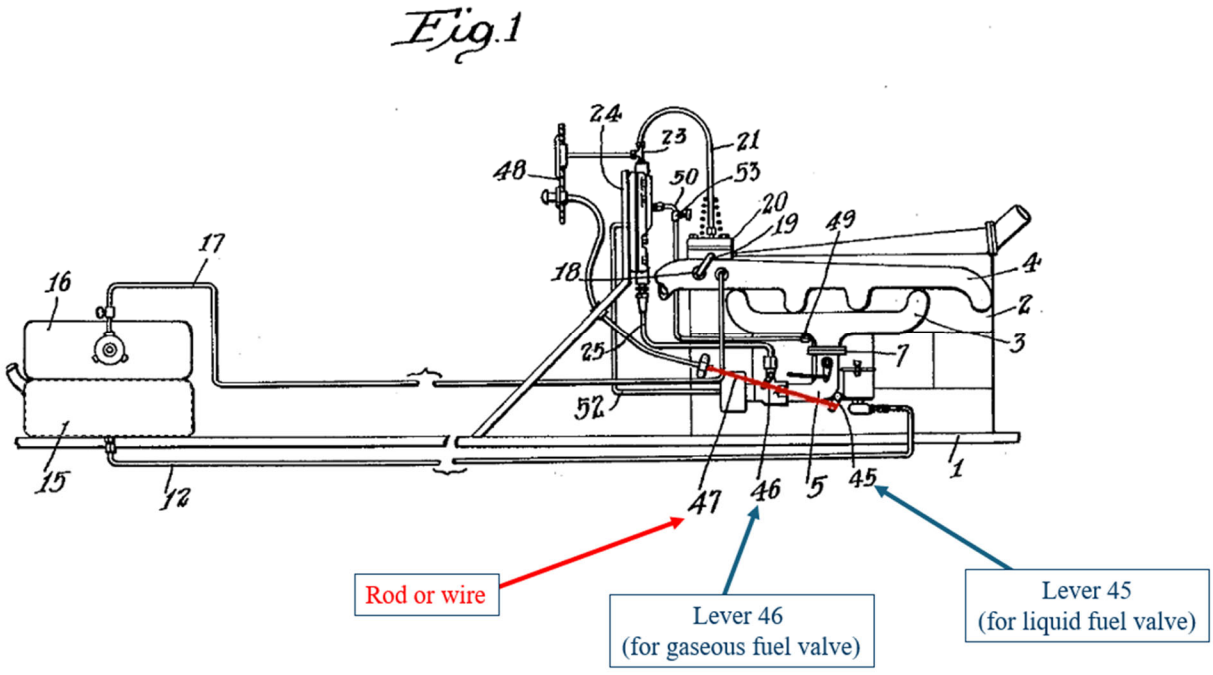
EX1009, Fig. 2 (annotated).

413. Thus, rotary valve 14 is incorporated into the carburetor to interrupt liquid fuel upon actuation of the rod or wire 47 from liquid fuel to gaseous fuel.

2. Claim 15

414. Claim 15 depends from Claim 1, and further recites "wherein the liquid fuel cut-off is manually actuated to interrupt liquid fuel."

415. As discussed (*see* §XII.E.1.g), rotary valve 14 interrupts liquid fuel upon actuation of rod or wire 47. Holzapfel discloses rod or wire 47 coupled to the levers 45 and 46 of valves 14 and 39. EX1009, 2:100-123, Fig. 1. As such, valve 14 is manually actuated because the operator may manipulate the rod or wire 47 to control valve 14 (*see id.*: "…a rod or wire 47 … extends to a point of convenient access to the operator…").



Id., Figure 1 (annotated).

3. Claim 16

416. Claim 16 depends from Claim 1, and further recites "wherein the liquid fuel cut-off actuates to interrupt fuel free from linear motion."

417. As discussed (*see* §XII.E.1.g), rotary valve 14 interrupts liquid fuel upon actuation of rod or wire 47. By definition, a rotary valve uses a rotating component, free from linear motion, to open and close a flow path.

4. Claim 43

a. Element [43.0]

418. Element [43.0] recites "a carburetor having a fuel shutoff."

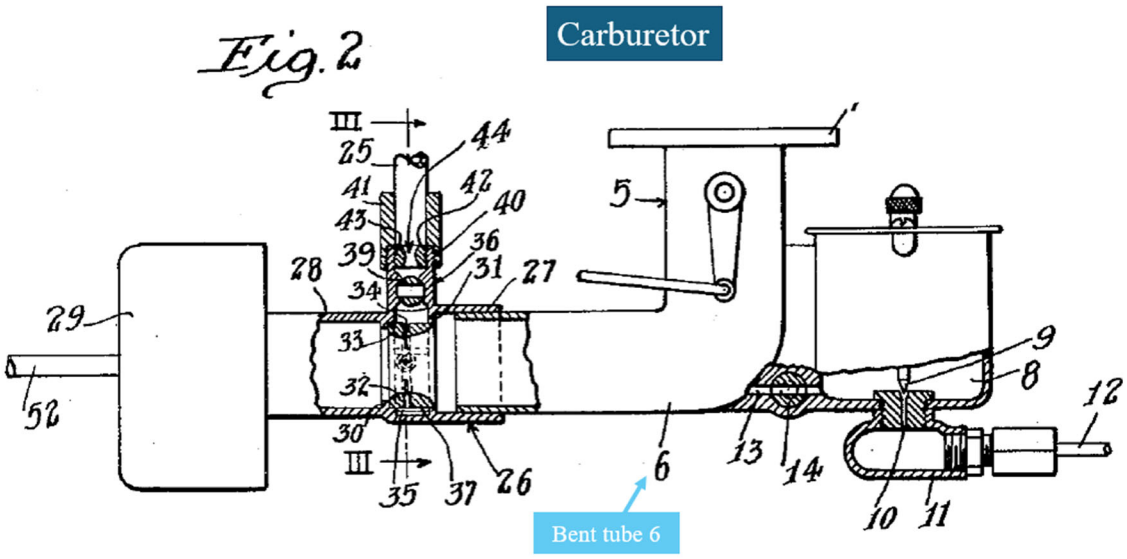
419. As discussed, Holzapfel discloses a carburetor. *See* §XII.E.1.d.

420. Holzapfel discloses a rotary valve 14, lever 45, and rod or wire 47 (EX1009, 1:104-107, 2:100-123, Fig. 2), which is a "fuel shutoff" for purposes of Element [43.0].

b. Element [43.1]

421. Element [43.1] recites "a carburetor comprising: a float bowl, a throat, and a fuel passage extending from the float bowl to the throat."

422. As discussed (*see* §XII.E.1.d), Holzapfel's carburetor includes float chamber or fuel reservoir 8 (i.e., float bowl) that communicates with the carburetor by means of passage 13. As seen in Figure 2, the fuel passage extends from the float bowl to the throat, which includes bent tube 6:

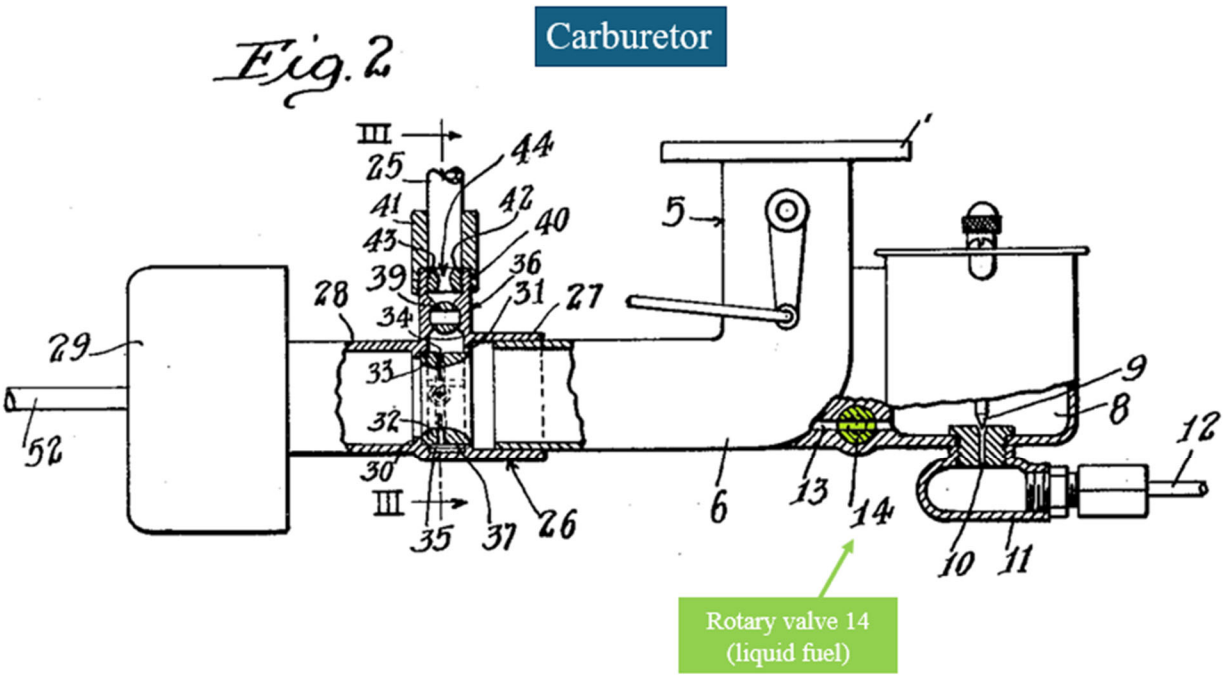


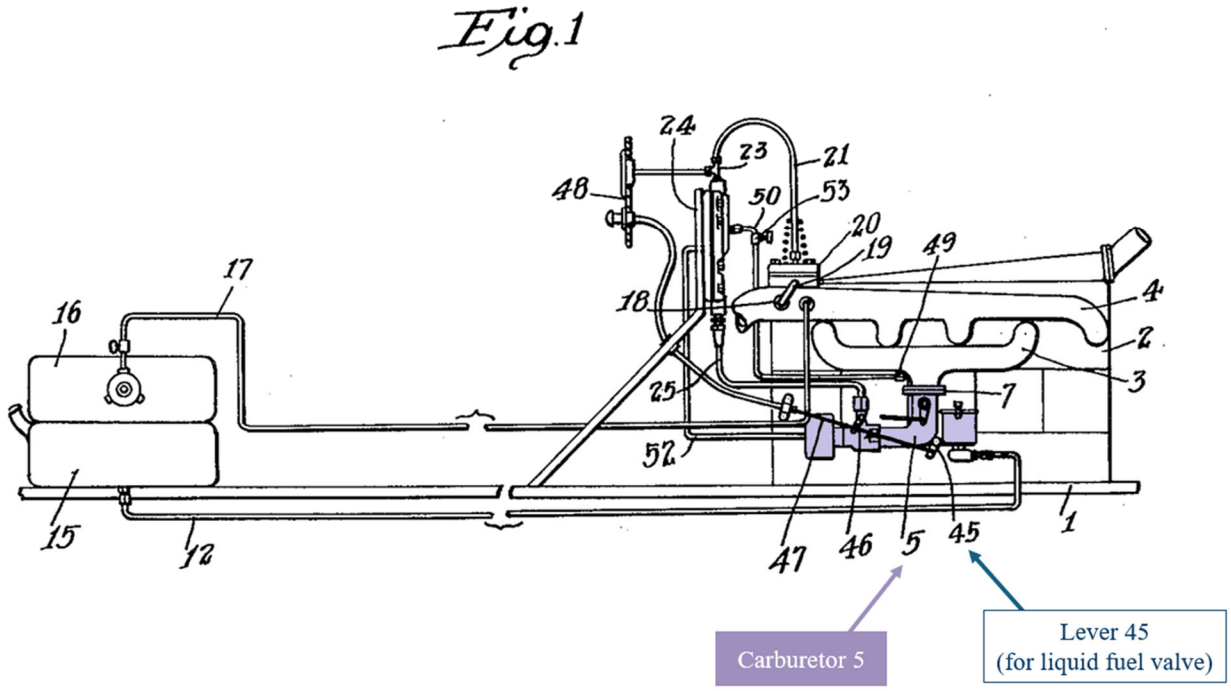
EX1009, Fig. 2 (annotated). This is consistent with the '398 Patent's discussion of a "throat": "A venturi 98 is located in throat 92 with a choke valve 100 located upstream from the venturi and a throttle valve 102 located downstream from the venturi." EX1001, 11:31-34.

c. Element [43.2]

423. Element [43.2] recites "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."

424. As discussed (*see* §XII.E.4.a), rotary valve 14, lever 45, and rod or wire 47 are a "fuel shutoff." As seen in Figures 1 and 2, rotary valve 14, lever 45, and rod or wire 47 are coupled to carburetor 5:





EX1009, Figures 1-2 (annotated).

425. Rotary valve 14 defines the first end of the fuel shutoff, which operates in carburetor 5, and lever 45 (in combination with a rod or wire 47) defines the second end of the fuel shutoff, which operates external to carburetor 5.

d. Element [43.3]

426. Element [43.3] recites "wherein the fuel shutoff actuates free from linear motion."

427. As discussed (*see* §XII.E.4.a), rotary valve 14, lever 45, and rod or wire 47 are the "fuel shutoff." A rotary valve uses a rotating component free from linear motion to open and close a flow path.

5. Claim 44

428. Claim 44 depends from Claim 43, and further recites "wherein the fuel shutoff is a manually actuated fuel shutoff."

429. As discussed (*see* §XII.E.2), rotary valve 14 is manually actuated to interrupt liquid fuel via a rod or wire 47. Because rotary valve 14 is part of the fuel shutoff (*see* §XII.E.4.a), the fuel shutoff is manually actuated.

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

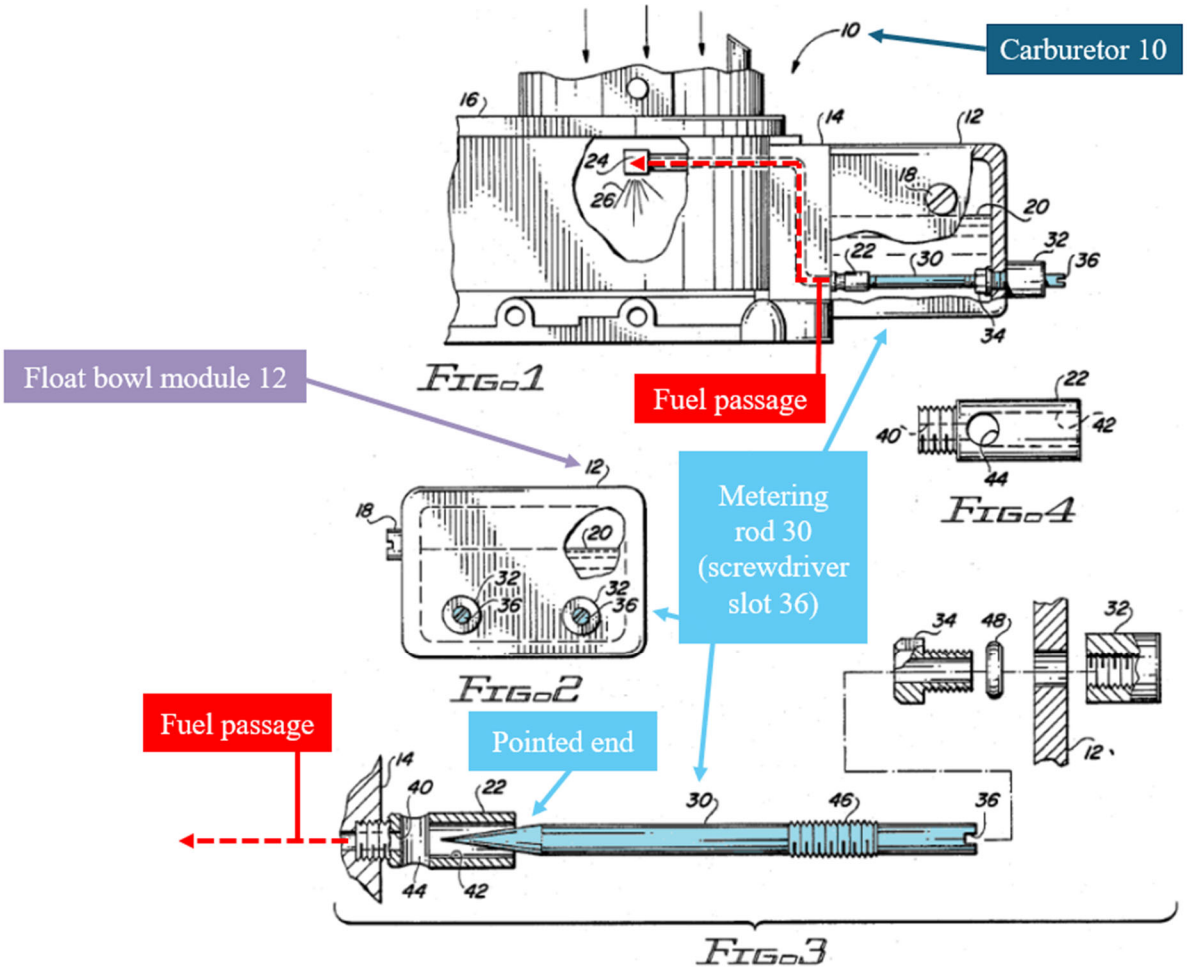
430. In my opinion, Claims 43-46 and 56 of the '398 Patent are anticipated for at least the reasons described below.

1. Claim 43

a. Element [43.0]

431. Element [43.0] recites "a carburetor having a fuel shutoff."

432. Neal discloses an engine with a carburetor 10 that has a metering rod 30 in float bowl module 12 (EX1031, 4:25-51, 6:15-42):



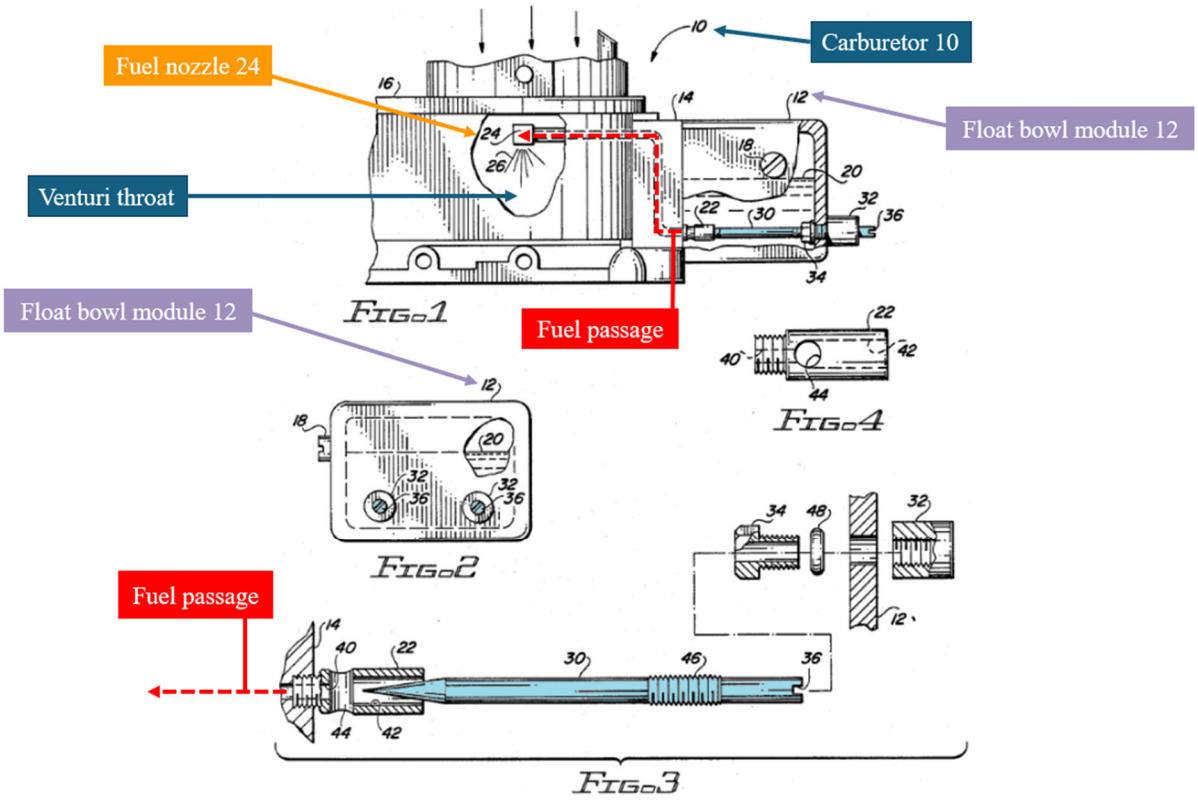
EX1031, Figures 1-4 (annotated).

433. 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.

b. Element [43.1]

434. Element [43.1] recites "a carburetor comprising: a float bowl, a throat, and a fuel passage extending from the float bowl to the throat."

435. Neal discloses the carburetor has a float bowl (i.e., float bowl module 12) and a fuel passage extending from the float bowl where it is dispersed into the throat of the carburetor from fuel nozzle 24 (EX1031, 3:66-4:24):

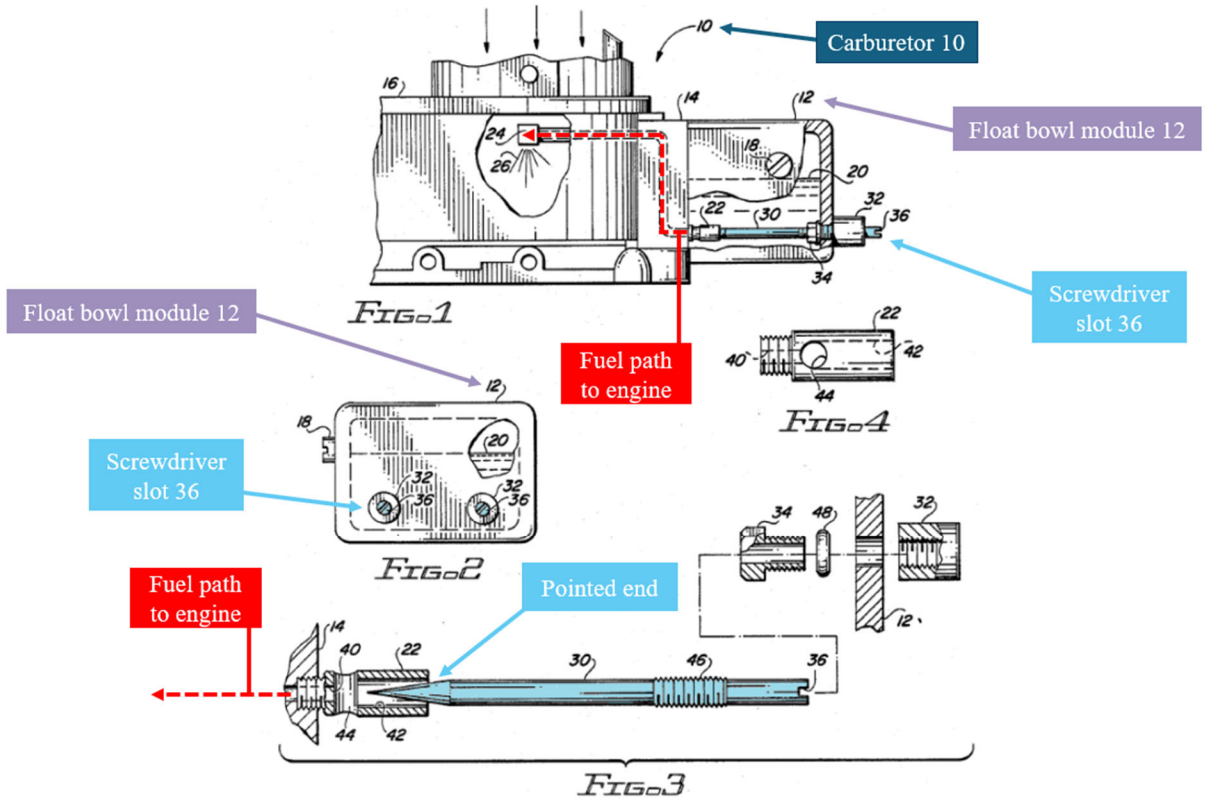


EX1031, Figures 1-4 (annotated).

c. Element [43.2]

436. Element [43.2] recites "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."

437. Neal's metering rod 30 (i.e., a fuel shutoff) is coupled to the carburetor 10 (EX1031, 4:1-56):



EX1031, Figures 1-4 (annotated).

438. The pointed end of the metering rod (first end) is in the float bowl module 12 of the carburetor and rotates (actuates) to close the fuel passage. *Id.*, 6:16-24 (disclosing that 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 (a "screwdriver slot is provided at the end of the metering rod which protrudes outside the carburetor"), 4:25-52, 6:15-42

("adjustment of metering rod 30…is accomplished by the means of a screwdriver"), Figures 1 & 3.

d. Element [43.3]

439. Element [43.3] recites "wherein the fuel shutoff actuates free from linear motion."

440. Neal's metering rod 30 actuates by rotation. *Id.*, 3:12-24, 6:15-42; Figures 1-3.

2. Claim 44

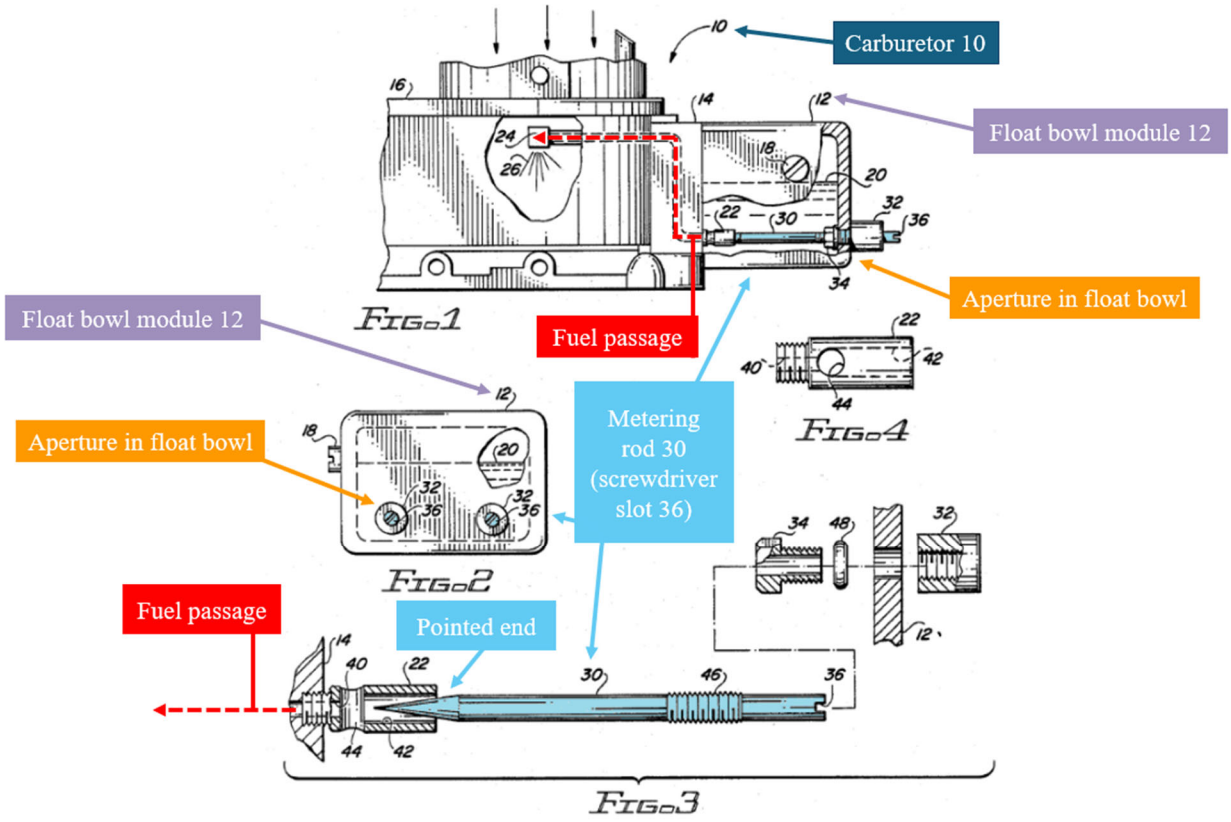
441. Claim 44 depends from Claim 43, and further recites "wherein the fuel shutoff is a manually actuated fuel shutoff."

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

3. Claim 45

443. Claim 45 depends from Claim 43 and further recites "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."

444. 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, 2:67-3:1, 4:25-38):



EX1031, Figures 1-4 (annotated).

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

4. Claim 46

446. Claim 46 depends from Claim 45, and further recites "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."

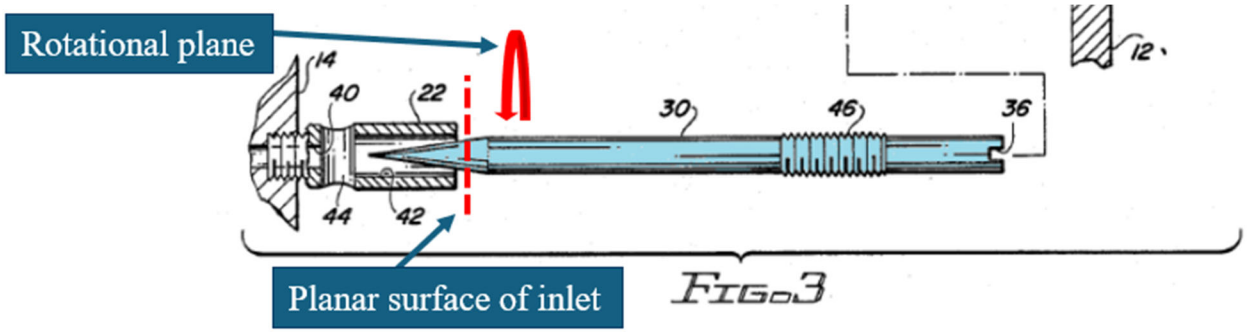
447. The scope of Claim 46 is unclear in two respects. First, the claim recites "the valve tip rotates parallel." Typically, in mathematics and mechanical devices, the word "parallel" refers to lines or planes that are parallel to each other. It is unclear

what line or plane Claim 46 refers to by reciting "the valve tip rotates parallel." Without any clarification, the claim could be referring to the axis of rotation or the rotational plane of the valve tip.

448. Second, the claim recites "parallel to an inlet of the fuel passage." It is unclear whether the claim is referring to the passageway of the inlet or the planar surface through which the inlet penetrates.

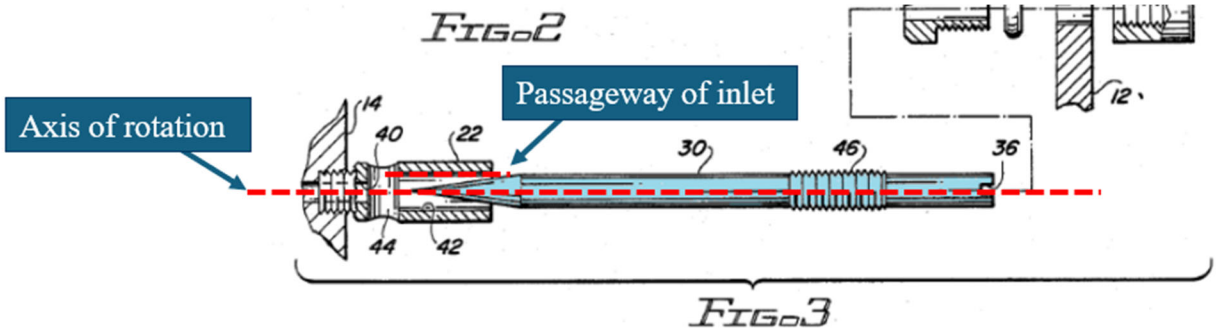
449. From these possibilities, Neal teaches the elements of this claim in two ways.

450. First, 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:



Id., Fig. 3 (annotated).

451. Second, pointed end (valve tip) of Neal's metering rod 30 has an axis of rotation that is parallel to the passageway of the inlet:



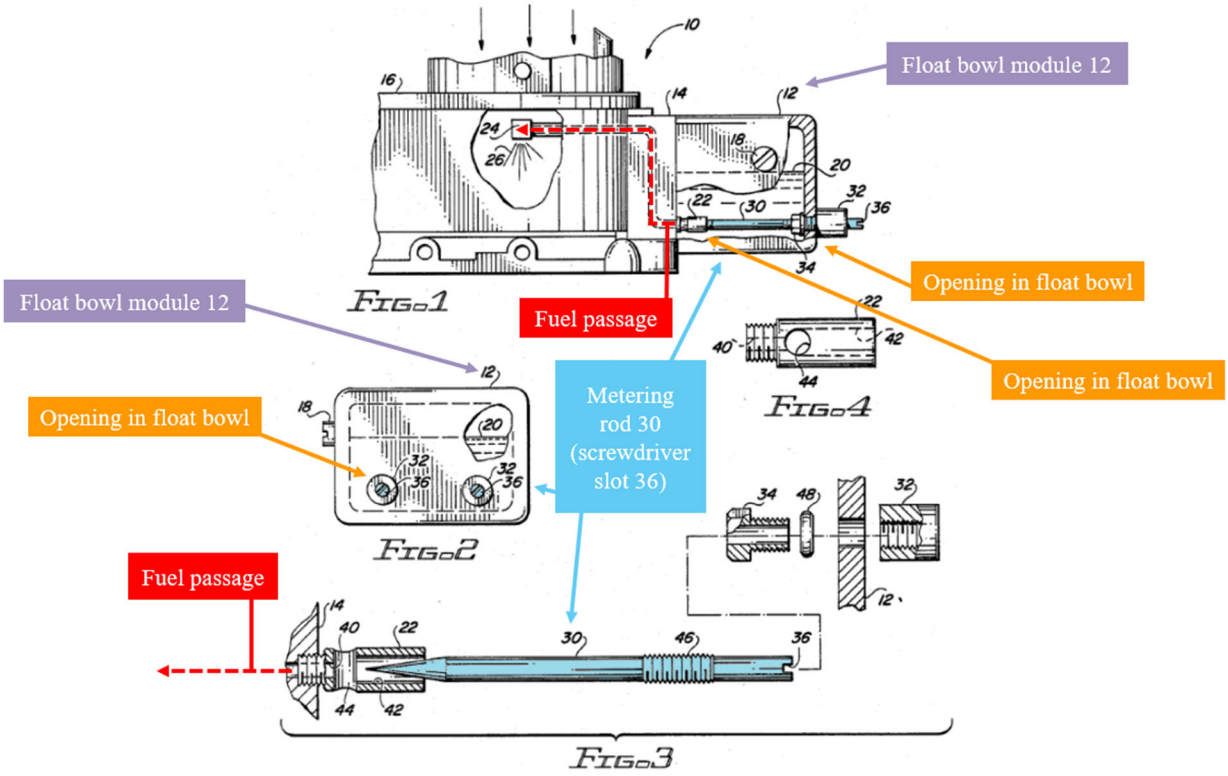
Id., Fig. 3 (annotated).

452. Neal's metering rod 30 rotates between a 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. *Id.*, 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.

5. Claim 56

453. Claim 56 depends from Claim 43, and further recites "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."

454. Neal discloses a metering rod 30 that extends through an opening into the float bowl and the first end actuates in the float bowl to close the fuel passage (EX1031, 6:15-42; *see also* §XII.F.3):



EX1031, Figs 1-3 (annotated).

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

455. In my opinion, Claims 43-46, 53-54, and 56 of the '398 Patent are anticipated and/or obvious for at least the reasons described below.

456. It is my understanding that in the Patent Owner's infringement contentions, it is contended that a cable that actuates a pivot arm to move a gasoline needle valve between blocking and non-blocking positions is rotational and "free

from linear motion" because the motion of the cable and pivot arm causes the gasoline need valve to be "slightly angled." EX1033, 9.

457. In particular, the Patent Owner contends:

> The actuation by the cable causes rotational motion on the pivot arm and the two-pronged fork of the gasoline valve. Since that motion is rotational, the motion of the needle must also be rotational. When looking at the motion of the needle, it does not travel in a straight linear motion of in and out. Rather, the rotational motion of the pivot arm causes the needle to be slightly angled such that it runs into the wall of the needle bore into the float bowl.
>
> In other words, the fuel shutoff actuates free from linear motion and instead relies solely on rotational motion. The cable actuates the valve by causing the pivot arm to rotate. Since the two-pronged fork is fixed to one end of the pivot arm, the rotational motion of the pivot arm translates to the needle. That is, the pivot arm causes the needle to rotate between its extended and retracted positions.

Id.

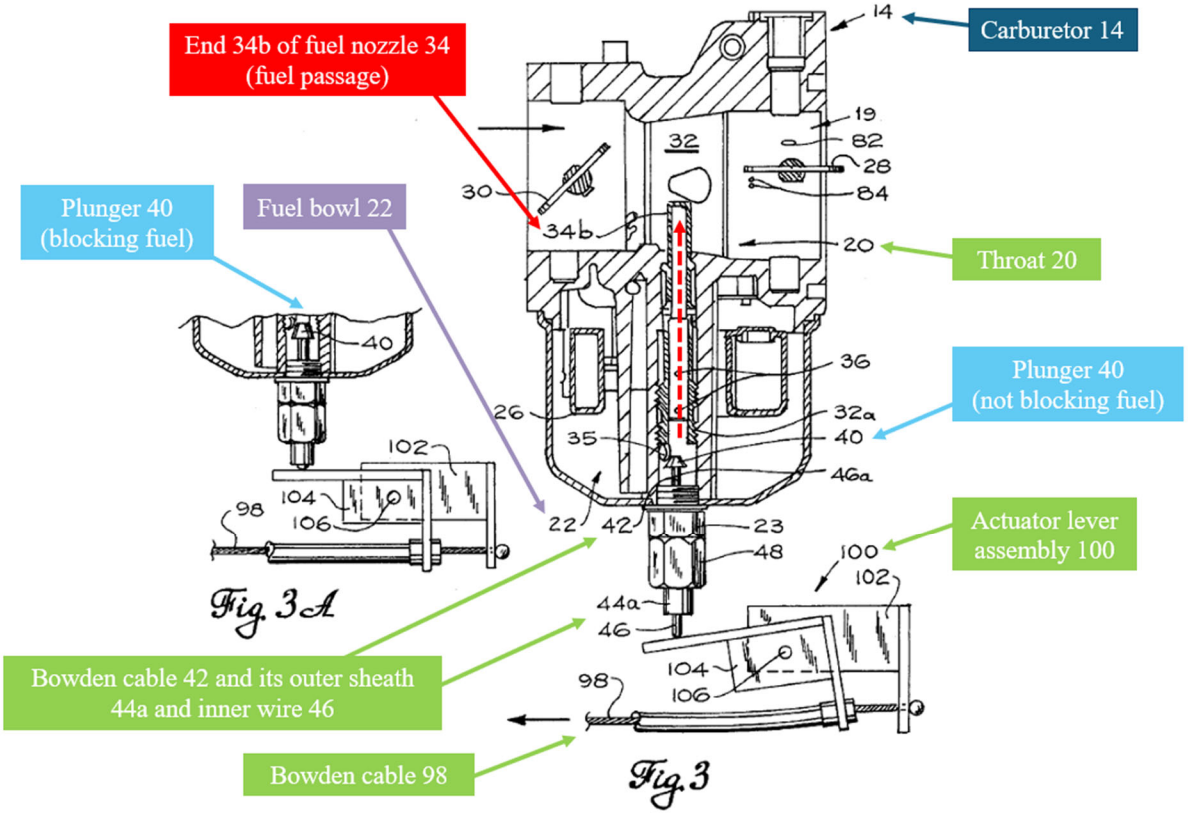
458. Based on the Patent Owner's infringement contentions, Claims 43-46, 53-54, and 56 are anticipated and/or obvious based on Winberg's embodiment in Figures 3 and 3A for the reasons described below.

1. Claim 43

a. Element [43.0]

459. Element [43.0] recites "a carburetor having a fuel shutoff."

460. Winberg discloses a carburetor 14 having a fuel shutoff, which has a mechanically operated blocking member or plunger 40 that blocks the flow of fuel from the float bowl 22 to the intake of the engine, including embodiments shown in Figures 3-3A and Figure 8 (EX1032, Abstract, Figures 1-8, 2:6-36, 3:61-4:33, 5:34-6:43, 7:31-8:52):



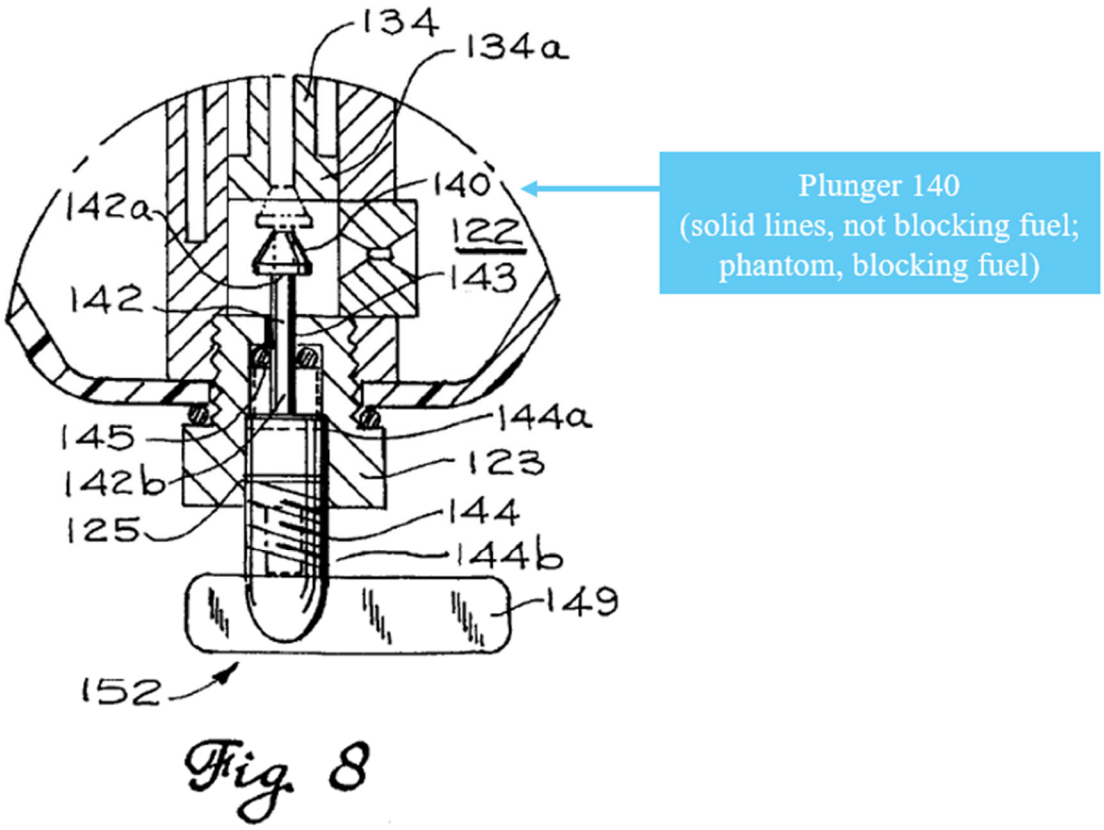


Fig. 8

EX1032, Figures 3-3A & 8 (annotated).

b. Element [43.1]

461. Element [43.1] recites "a carburetor comprising: a float bowl, a throat, and a fuel passage extending from the float bowl to the throat."

462. Winberg discloses a carburetor 14, which has a float bowl 22/122 and throat 20. EX1032, Abstract, 2:25-29, 3:67-4:33, 7:65-8:53; Figures 3A-5 & 8. The carburetor has a fuel nozzle 34/134, which has a fuel passage extending from the float bowl (labeled as 34a) to the throat (labeled as 34b). *Id.*, 4:12-33, 7:65-8:53, Figures 3A-5 & 8.

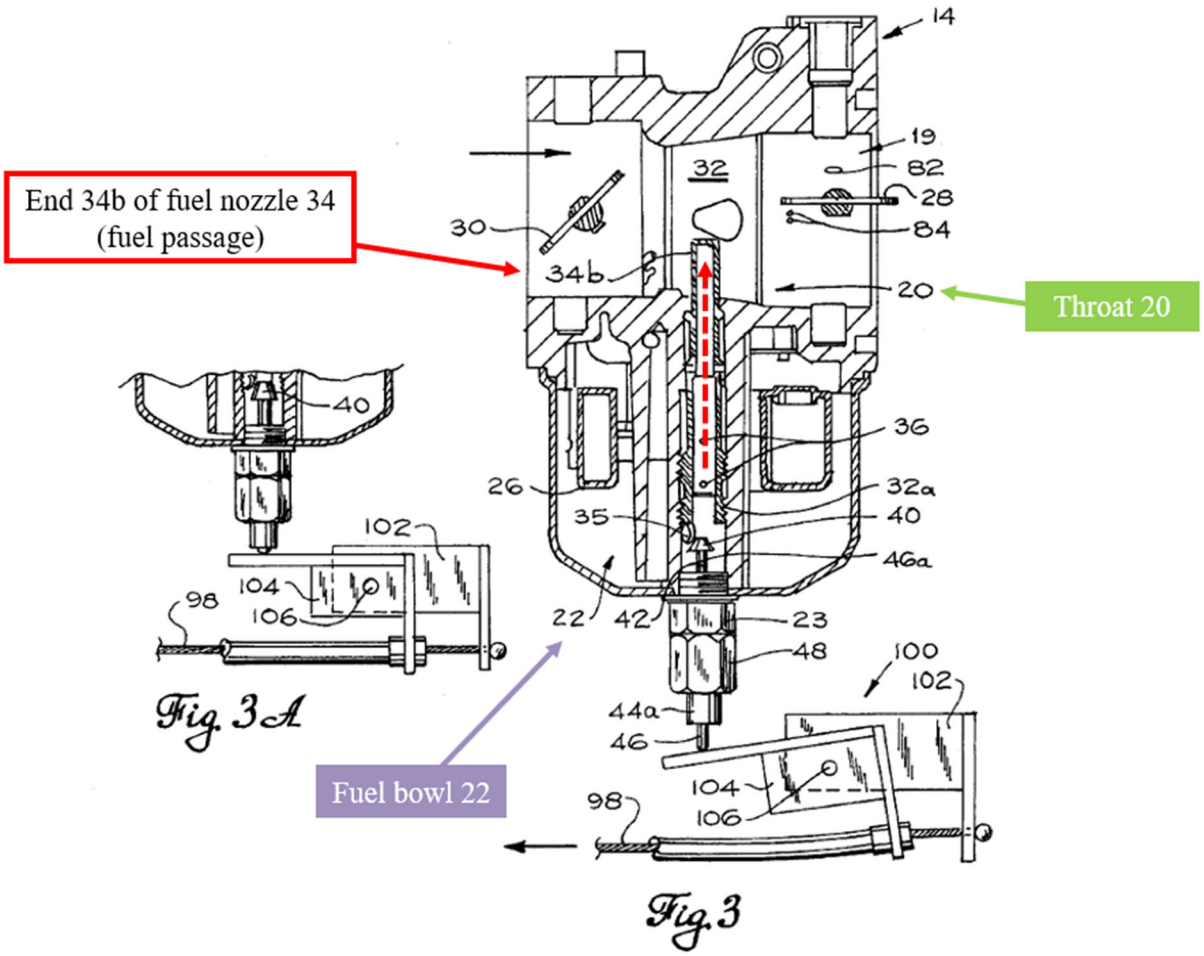

End 34b of fuel nozzle 34 (fuel passage)
Throat 20
Fuel bowl 22
14
19
82
28
84
32
30
34b
20
36
26
32a
35
40
46a
22
42
23
48
100
102
44a
46
104
106
98
40
102
104
106
98

Fig. 3A

Fig. 3

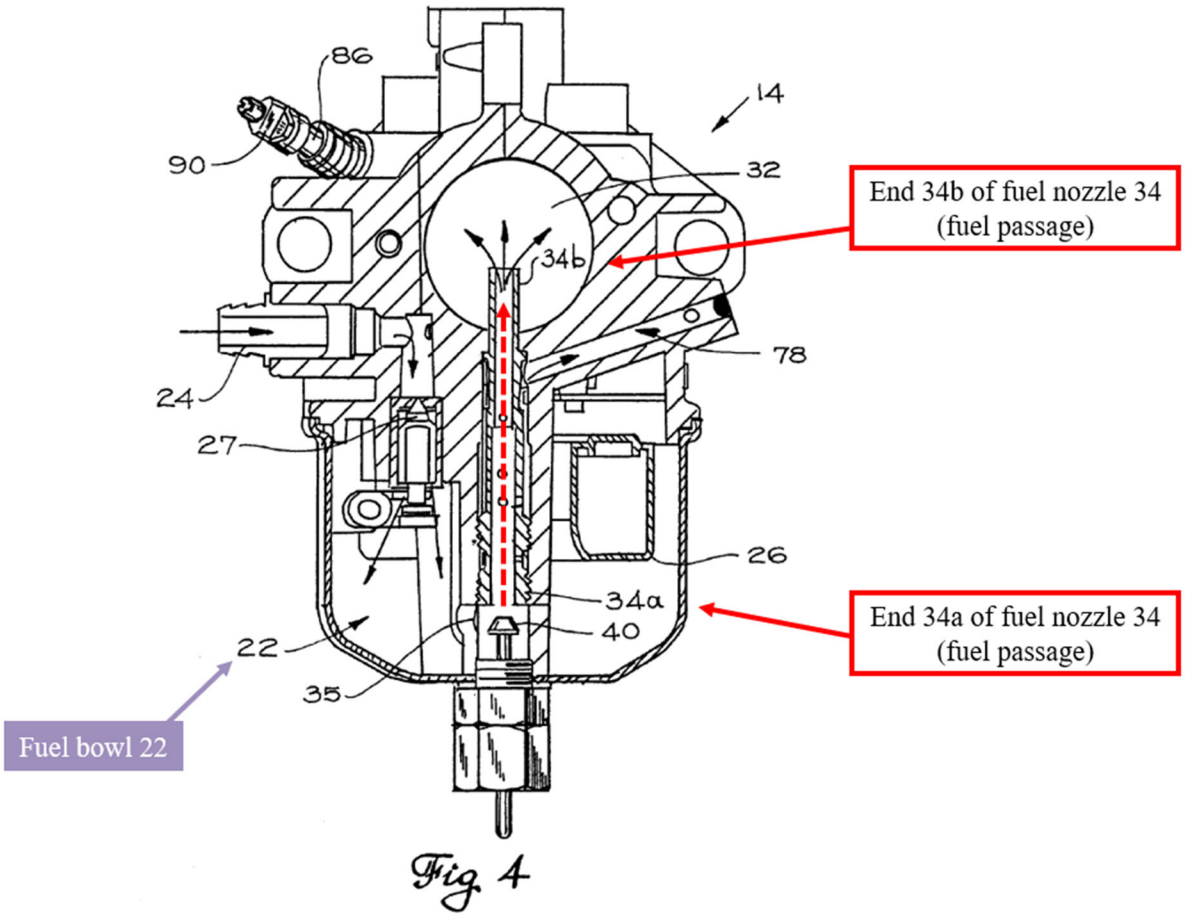

86
14
90
32
End 34b of fuel nozzle 34 (fuel passage)
34b
78
24
27
26
34a
End 34a of fuel nozzle 34 (fuel passage)
40
22
35
Fuel bowl 22

Fig. 4

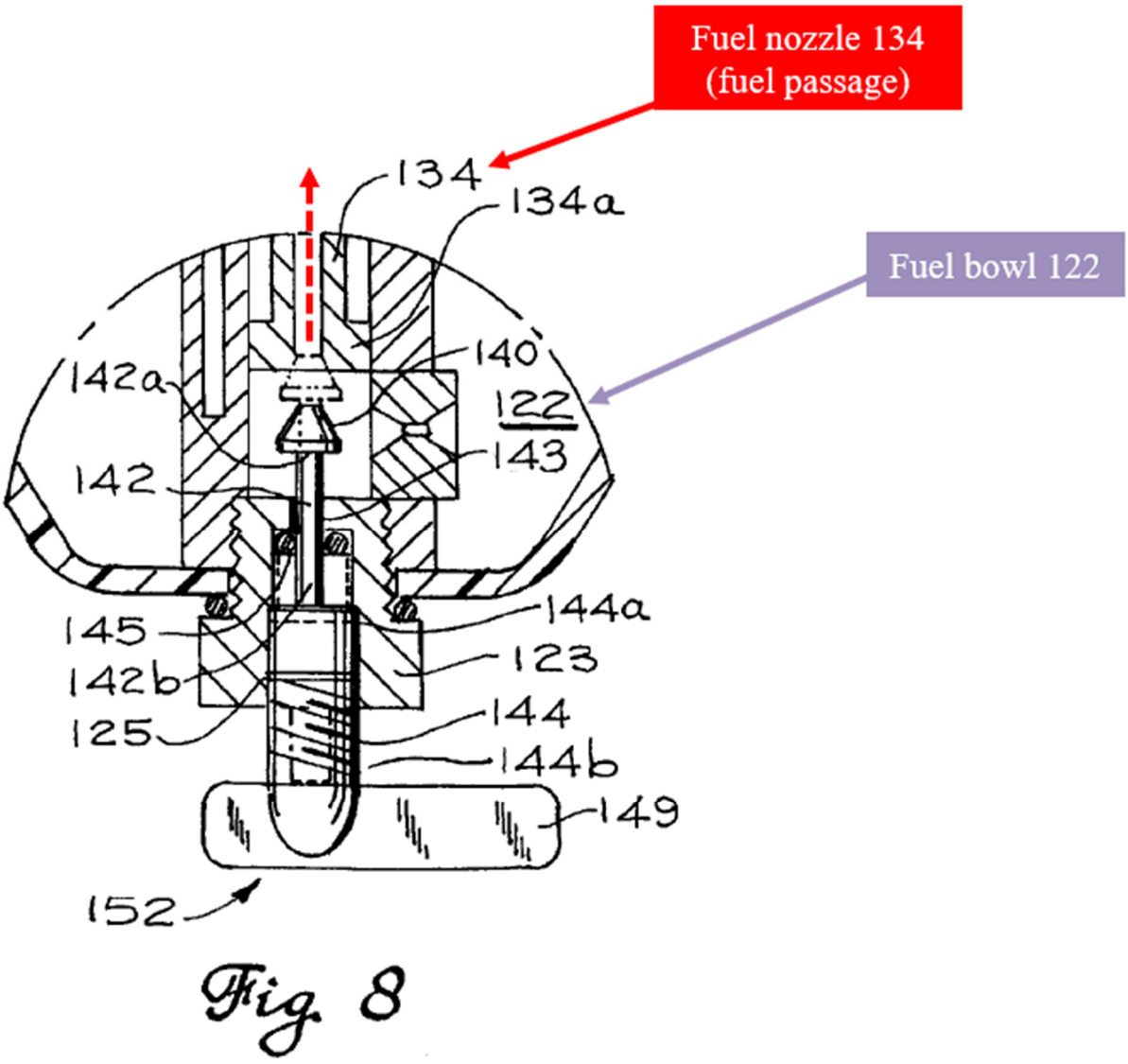


Fig. 8

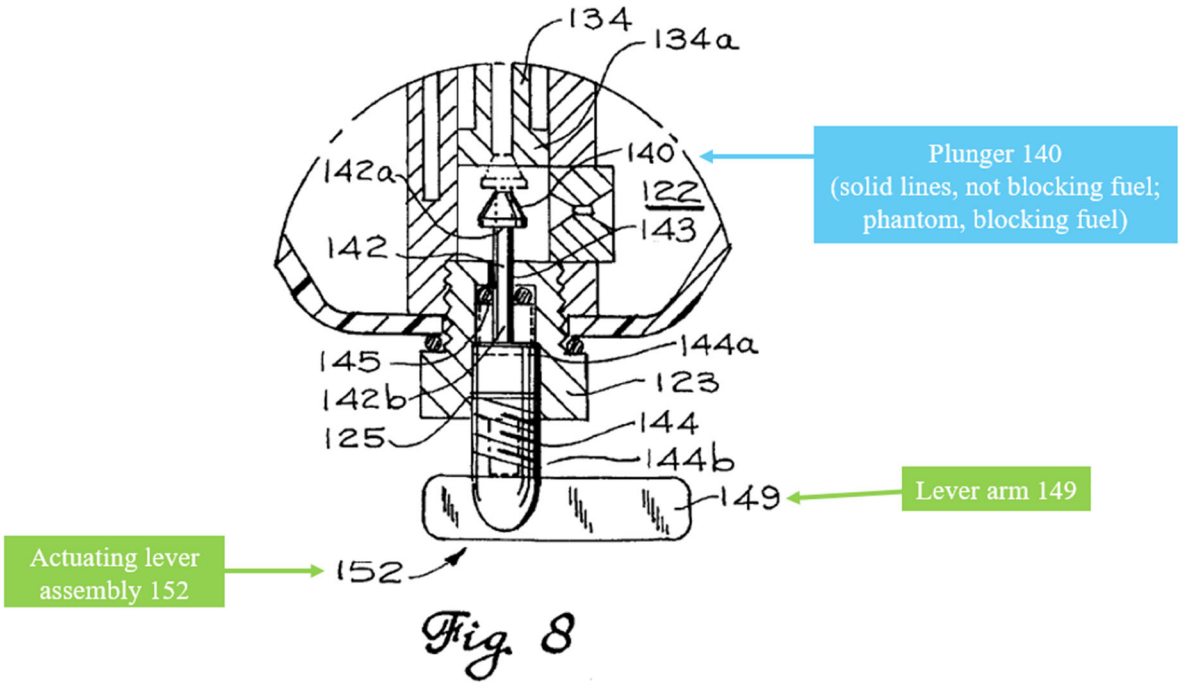
Id., Figures 3-3A, 4 & 8 (annotated).

c. Element [43.2]

463. Element [43.2] recites "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."

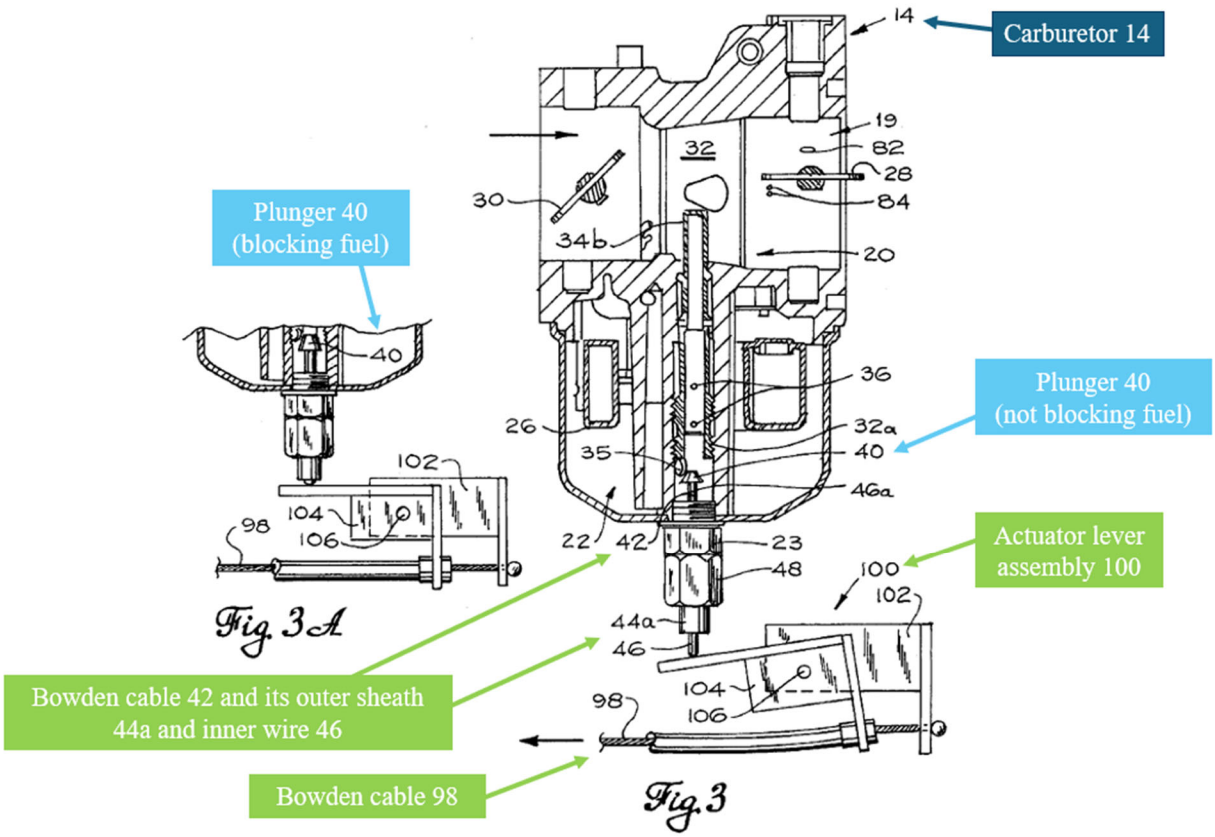
464. Winberg's fuel shutoff has a plunger 40/140, which is a first end in the carburetor that actuates to close the fuel passage within fuel nozzle 34/134. EX1032, 5:34-46, 7:65-8:53, Figures 3-3A & 8.

465. In the Figure 8 embodiment, Winberg's fuel shutoff has a rotating actuating lever assembly 152, which is a second end external to the carburetor to actuate the plunger (the first end). EX1032, 7:65-8:53, 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, 7:65-8:53):



EX1032, Figure 8 (annotated).

466. In the embodiment in Figure 3 and 3A, Winberg's fuel shutoff has an actuator lever assembly 100, which is a second end external to the carburetor to actuate the plunger (the first end). *Id.,* 7:31-55. The plunger moves between a blocking position (Figure 3A) and a non-blocking position (Figure 3) through the use of a Bowden cables 42 and 98 interconnected with actuator lever assembly. *Id.*, 5:34-46, 7:31-55.



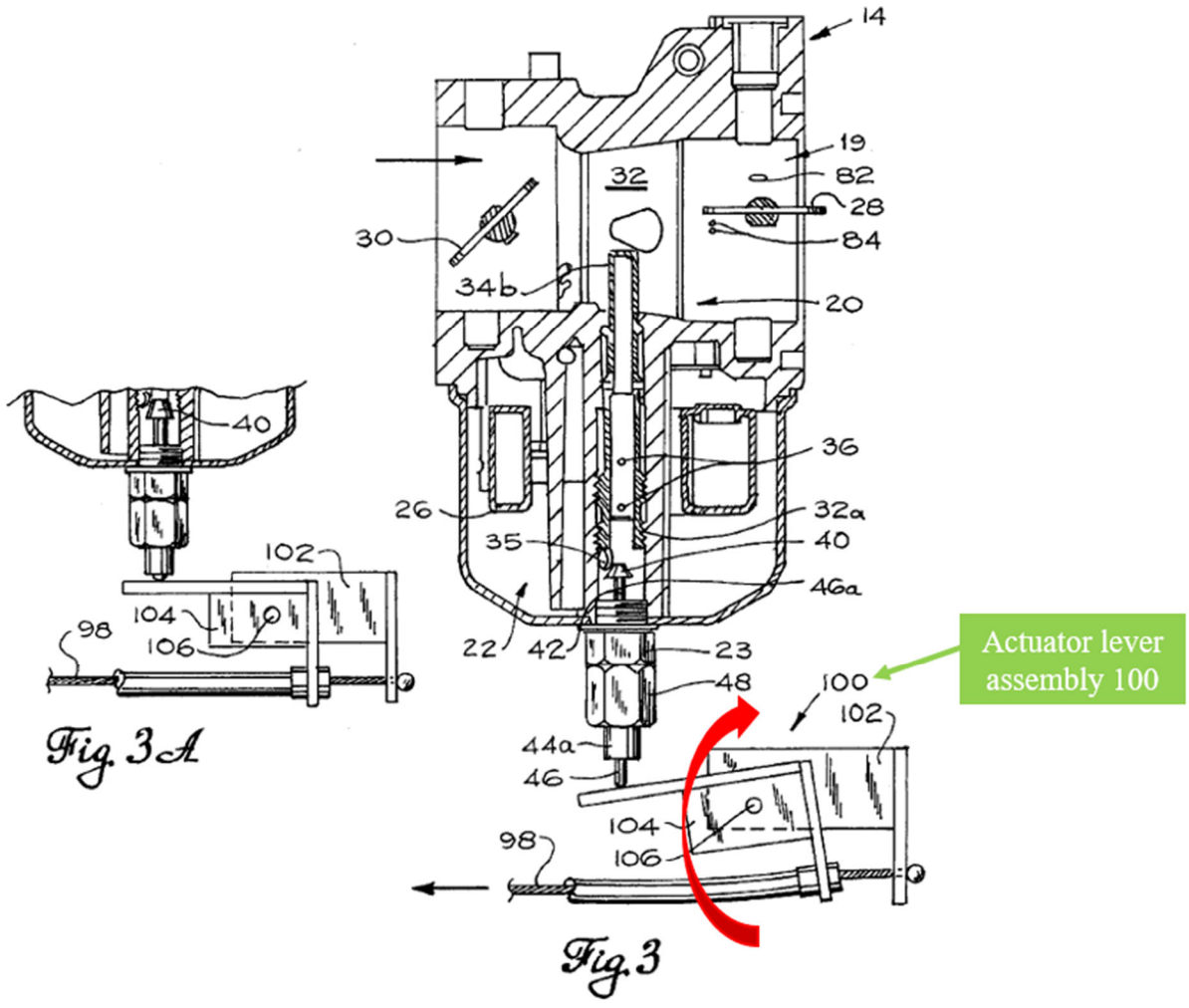
Id., Figures 3-3A (annotated).

d. Element [43.3]

467. Element [43.3] recites "wherein the fuel shutoff actuates free from linear motion."

468. Winberg's fuel shutoff in the Figure 8 embodiment actuates free from linear motion by rotating actuating lever assembly 152. EX1032, 7:65-8:53, Fig. 8.

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



Id., Figures 3-3A (annotated).

2. Claim 44

470. Claim 44 depends from Claim 43, and further recites "wherein the fuel shutoff is a manually actuated fuel shutoff."

471. Winberg's fuel shutoff is manually actuated in the Figure 8 embodiment and the embodiment of Figures 3 and 3A (e.g., Winberg specifies a "manually operable control for actuating the blocking member"). EX1032, Abstract, 2:17-21.

3. Claim 45

472. Claim 45 depends from Claim 43, and further recites "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."

473. 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, 7:65-8:53, Fig. 8. Winberg's valve tip (plunger 140) rotates to open and close the fuel passage. *Id.*, 8:15-52. Winberg discloses that plunger 140 is attached to connecting member 142 and connecting member is attached to actuating lever assembly 152. *Id.* Lever 149 is attached to actuating lever assembly 152 and is rotated, causing connecting member 142 and plunger 140 to also rotate. *Id.* Specifically, Winberg discloses:

> **Plunger 140 in FIG. 8 is selectively movable between the stop or blocking position, and the run or non-**

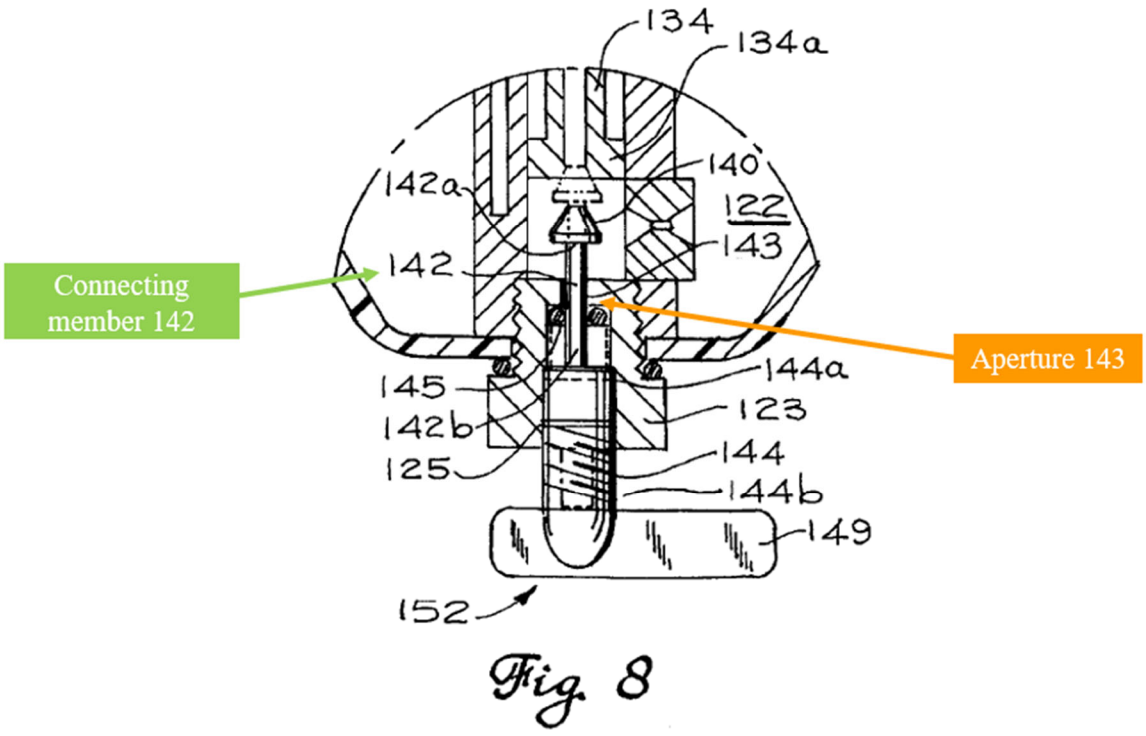
blocking position through the use of a connecting member 142 interconnected with a rotating actuating lever assembly 152. Connecting member 142 has one end 142a attached to plunger 140, and extends from plunger 140 through an aperture 143 drilled through the center of the carburetor bowl mounting screw 123. **Connecting member 142 then extends to and has a second end 142b interconnected with a rotating actuating lever assembly 152.**

***

Carburetor bowl mounting screw 123 has an internally threaded bore 125 therein, and **the actuating lever assembly 152 includes a threaded member 144 which is threaded into threaded bore 125. One end 144 a of threaded member 144 is connected to connecting member 142, and the other end 144 b of threaded member 144 is connected to a lever arm 149.** When lever arm 149 is rotated such that the pitch of the thread in threaded bore 125 advances threaded member 144 further into threaded bore 125, plunger 140 is advanced towards the intake end 134 a of fuel nozzle 134 via connecting member 142. When plunger 140 contacts or substantially contacts the intake end 134 a of fuel nozzle 134, plunger 140 blocks or substantially blocks the flow of fuel into fuel nozzle 134, and is therefore in the stop or blocking position.

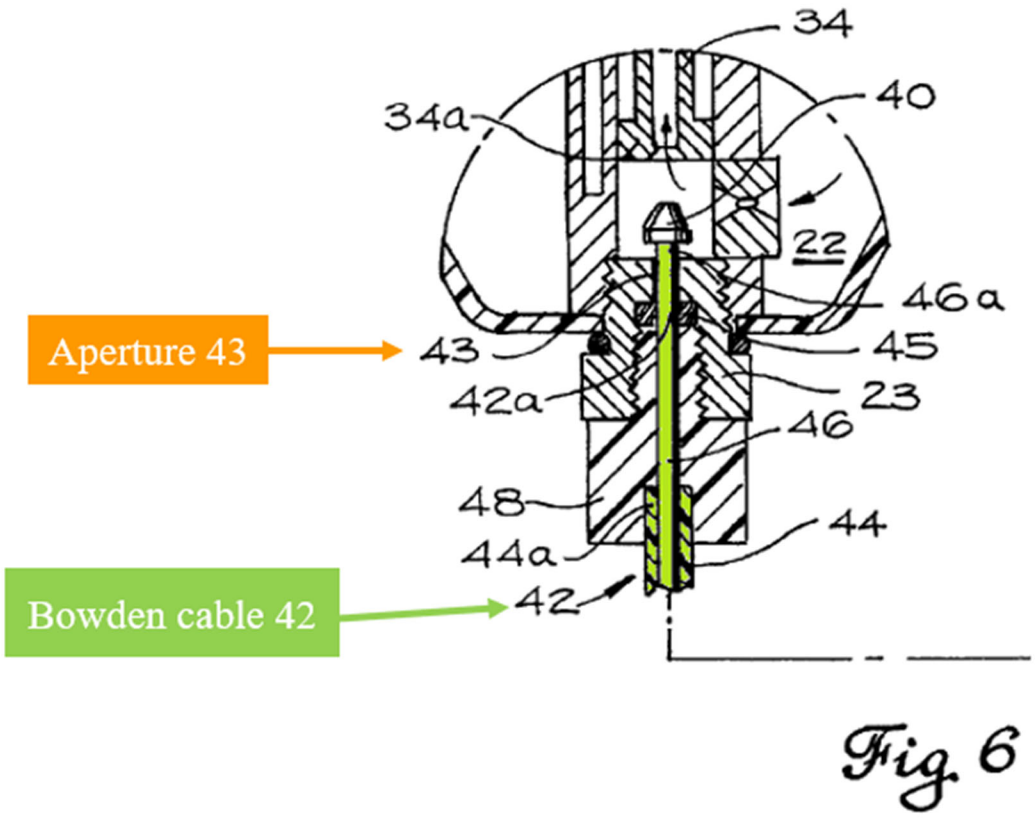
> As lever 149 arm is rotated such that the pitch of the thread in threaded bore 125 moves threaded member 144 further out of threaded bore 125, plunger 140 is moved away from intake end 134 a of fuel nozzle 134 via connecting member 142. When plunger 140 is not in contact or substantial contact with intake end 134 a of fuel nozzle 134, plunger 140 does not block or substantially block fuel from flowing into fuel nozzle 34, and is therefore in the run or non-blocking position.

Id. (emphasis added).



Id., Fig. 8 (annotated).

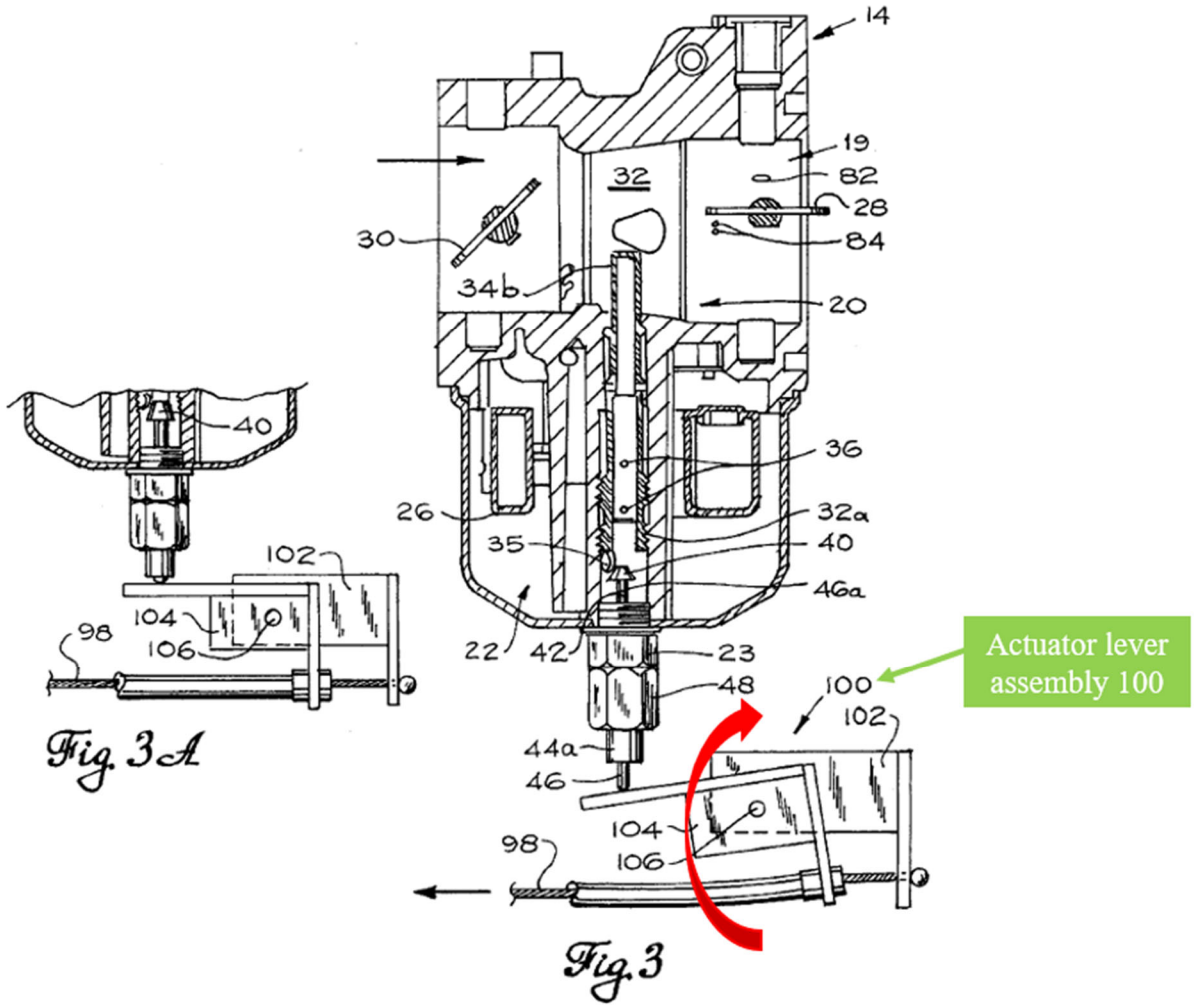
474. In the embodiment of Figures 3 and 3A, Winberg's fuel shutoff comprises a shaft (Bowden cable 42) attached to plunger 40 that extends through an aperture 43 in the carburetor. EX1032, 5:54-6:17, 7:31-55, Figures 3-3A & 6.



Id., Fig. 6 (annotated).

475. Based on Patent Owner's infringement contentions in litigation and photos and videos of an accused generator in those contentions (EX1033, 9; EX1034-1037), 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, 7:42-56, Figures 3-3A).



Id., Figures 3-3A (annotated).

476. Based on photos and videos of an accused Generac generator in EX1033, it appears Winberg's rotational motion is similar to the accused Generac generators. EX1034-1037.

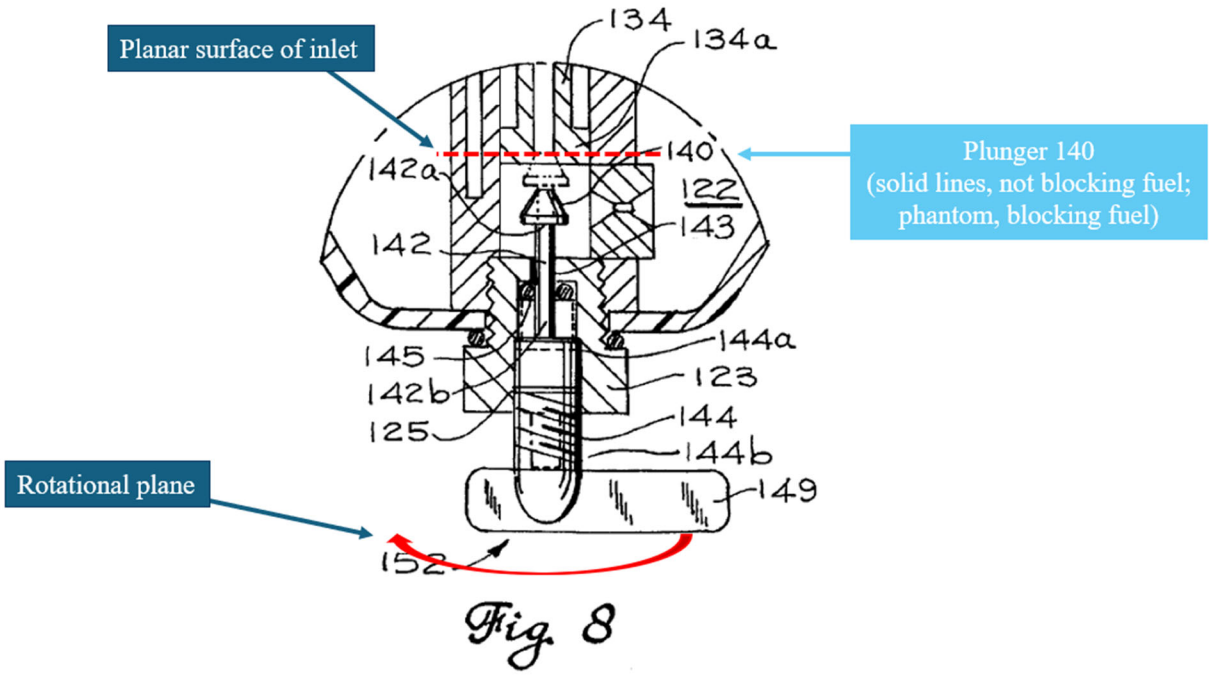
4. Claim 46

477. Claim 46 depends from Claim 45, and further recites "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."

478. As discussed above, the meanings of "valve tip rotates parallel" and "parallel to an inlet of the fuel passage" are unclear. *See* §XII.F.4.

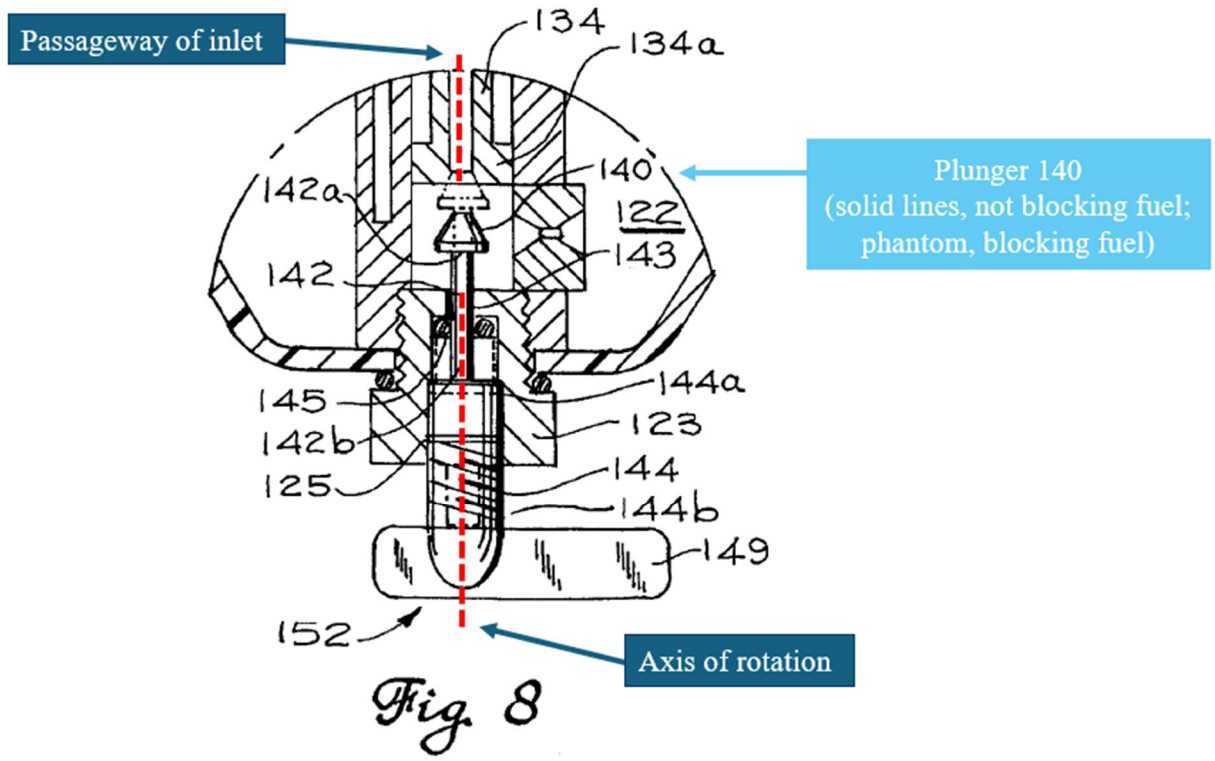
479. Of the possibilities discussed above (*see* §XII.F.4), Wingberg teaches the elements of this claim in two ways.

480. First, 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, 7:65-8:53):



Id., Figure 8 (annotated).

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



Id., Figure 8 (annotated).

482. 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. *Id.*, 7:65-8:53, Figure 8.

5. Claim 53

483. Claim 53 depends from Claim 45, and further recites "wherein the valve tip comprises thermoplastic."

484. 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.

485. It would have been obvious to a POSA to use a thermoplastic valve tip. A POSA would have been motivated to use a thermoplastic material because such material was well known to not degrade when used with corrosive fluids, such as fuel. 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.

6. Claim 54

486. Claim 54 depends from Claim 45, and further recites "wherein the valve tip comprises one of an oval and stadium shape."

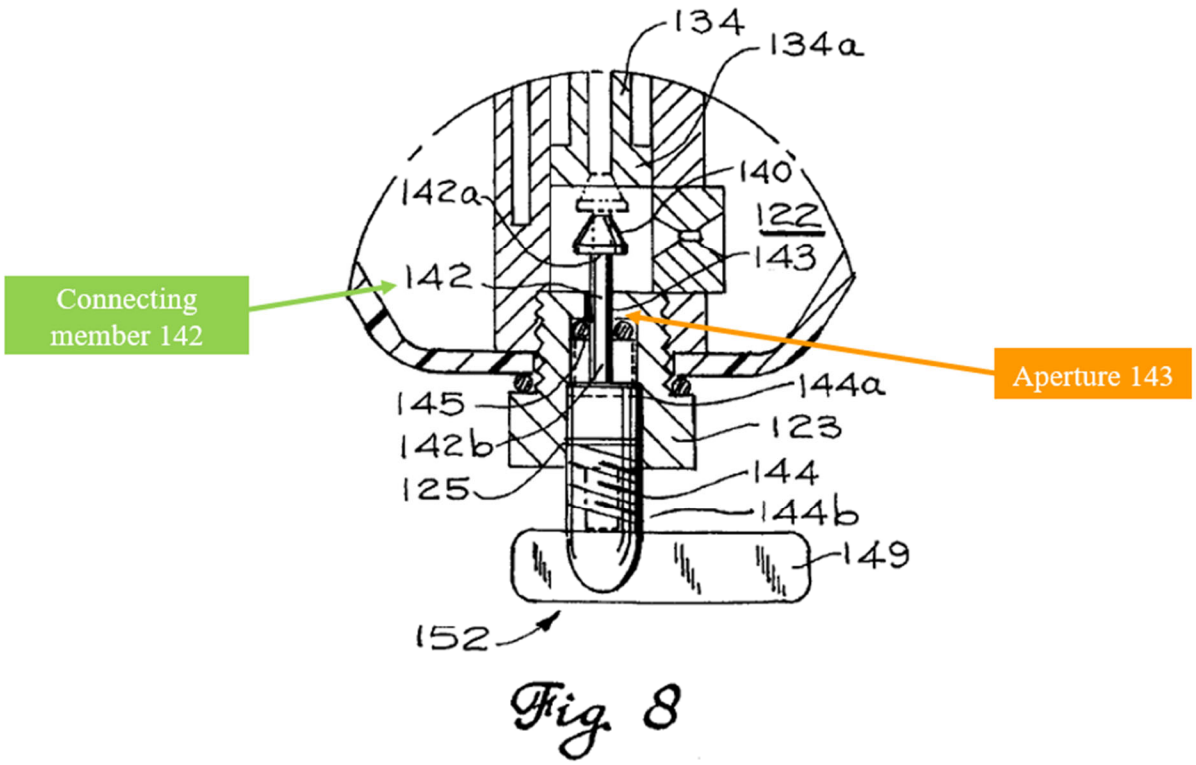
487. Winberg discloses plunger 40 with a cone shape but also discloses the plunger "may have a different shape (e.g., a plate or sphere)." EX1032, 5:42-52.

488. It would have been obvious to a POSA to use an oval or stadium shape, which are substantially similar to a sphere. 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. 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.

7. Claim 56

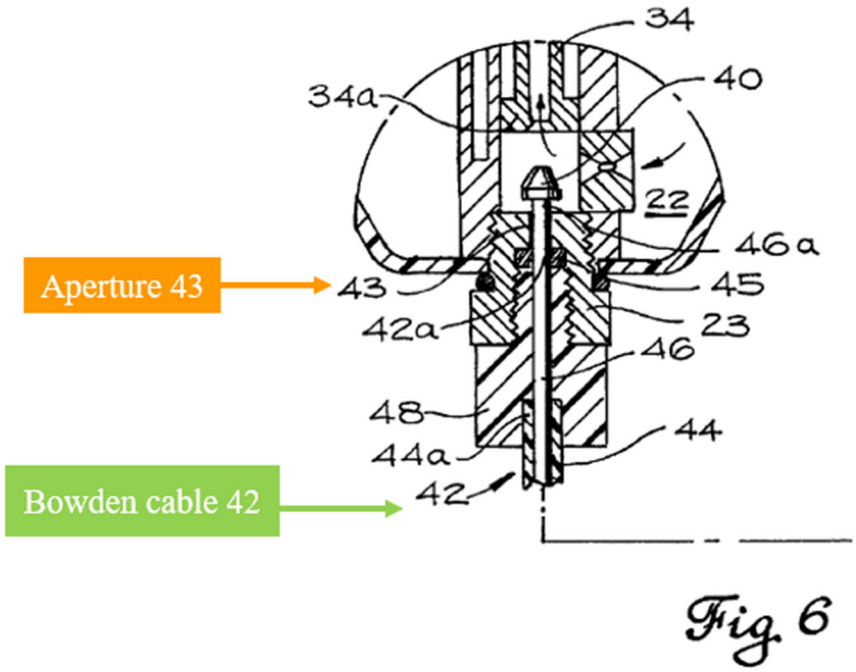
489. Claim 56 depends from Claim 43, and further recites "wherein the fuel shutoff extends through an opening into the float bowl such that the first end actuates in the float bowl to close the fuel passage."

490. 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 actuates in the float bowl to close the fuel passage through fuel nozzle 134. EX1032, 7:65-8:53, Fig. 8.



Id., Figure 8 (annotated).

491. In the embodiment of Figures 3 and 3A, 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, Figures 3-3A & 6.



Id., Fig. 6 (annotated).

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

492. In my opinion, Claims 17 and 23-26 of the '398 Patent are obvious for the reasons described below.

1. Claim 17

493. Claim 17 depends from Claim 1. As discussed, Holzapfel discloses the elements of Claim 1. *See* §XII.E.1.

a. Element [17.1]

494. Element [17.1] recites "a rotating shaft extending through an aperture in the carburetor."

495. As discussed, *see* §XII.E.4.a, the fuel shutoff of Holzapfel comprises rotary valve 14, lever 45, and rod or wire 47. 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.

496. Alternatively, rather than utilize Holzapfel's float bowl and rotary valve 14 as the fuel shutoff, it would have been obvious to use Winberg's float bowl and liquid fuel cutoff. EX1032, Abstract, 2:6-36, 3:61-4:32, 7:65-8:53, Fig. 8.

497. In the Figure 8 embodiment, Winberg discloses a rotating shaft (connecting member 142) that extends through an aperture 143 in the carburetor (EX1032, 7:65-8:53):

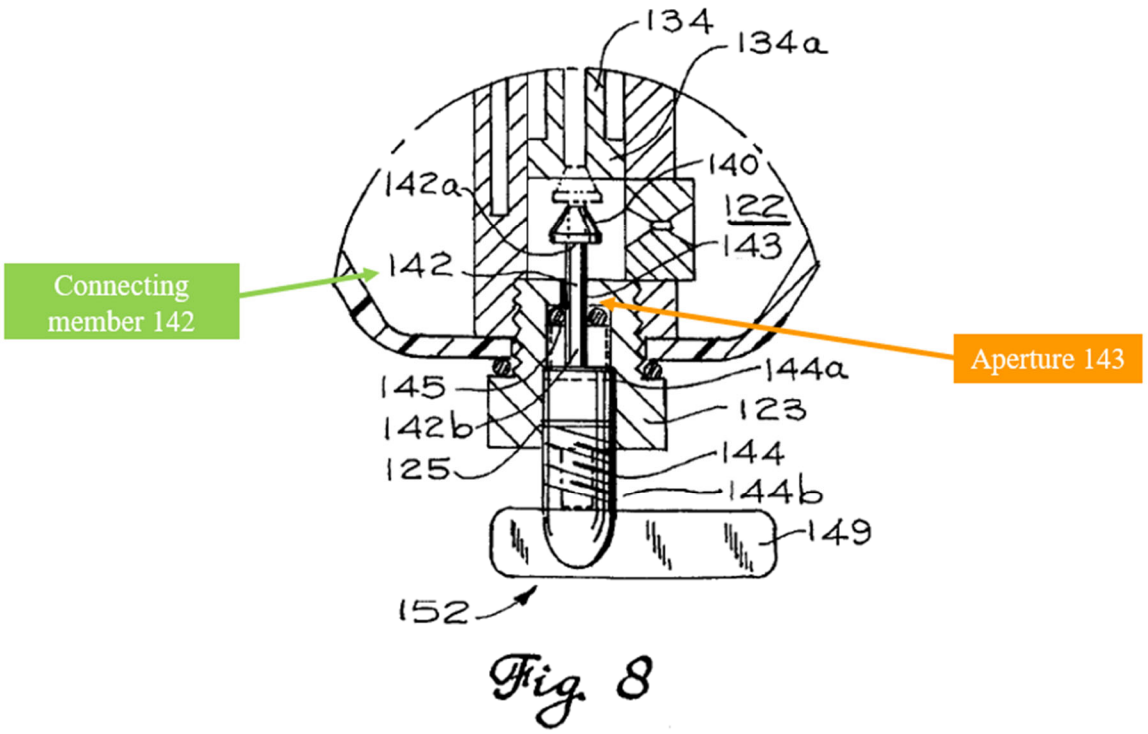


Fig. 8

Id., Figure 8 (annotated).

i. Motivation/Expectation of Success

498. 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.

499. 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. This motivation would have been particularly important for a generator (an

obvious application discussed below, §XII.H.2.a), to allow an unsophisticated user to replace the valve at minimal expense.

500. 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. 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.

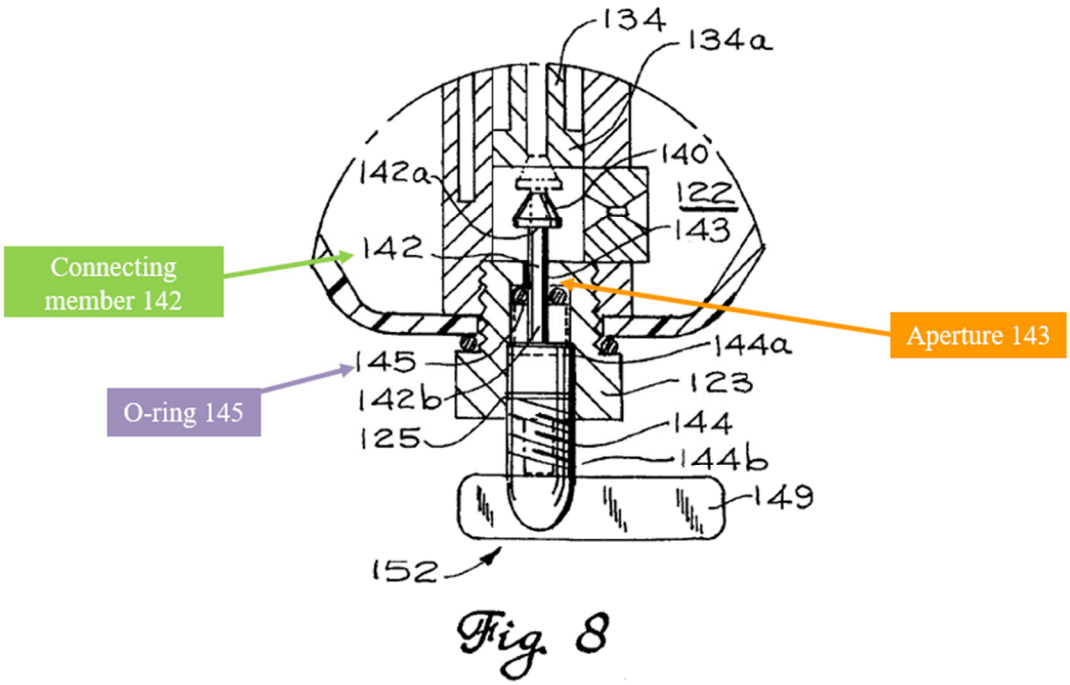
501. A POSA would have had a reasonable expectation of success because Winberg's float bowl configuration was common for use with small engines (e.g., Olmr and Neal) and given Winberg's disclosure of using its float bowl and fuel shutoff in generators.

b. Element [17.2]

502. Element [17.2] recites "a fuel seal around the shaft to seal the aperture."

503. 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. Alternatively, this would have been obvious given that Holzapfel's lever 45 must have a shaft that extends into the carburetor.

504. Alternatively, Winberg discloses a fuel seal (such as O-ring 145) around the shaft (connecting member 142) to seal the aperture (EX1032, 8:25-29):



Id., Figure 8 (annotated).

c. Element [17.3]

505. Element [17.3] recites "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."

506. Holzapfel'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.

507. Alternatively, Winberg discloses a blocking member (plunger 140) coupled to the shaft to selectively block a liquid fuel path to the engine (EX1032, 7:65-8:53):

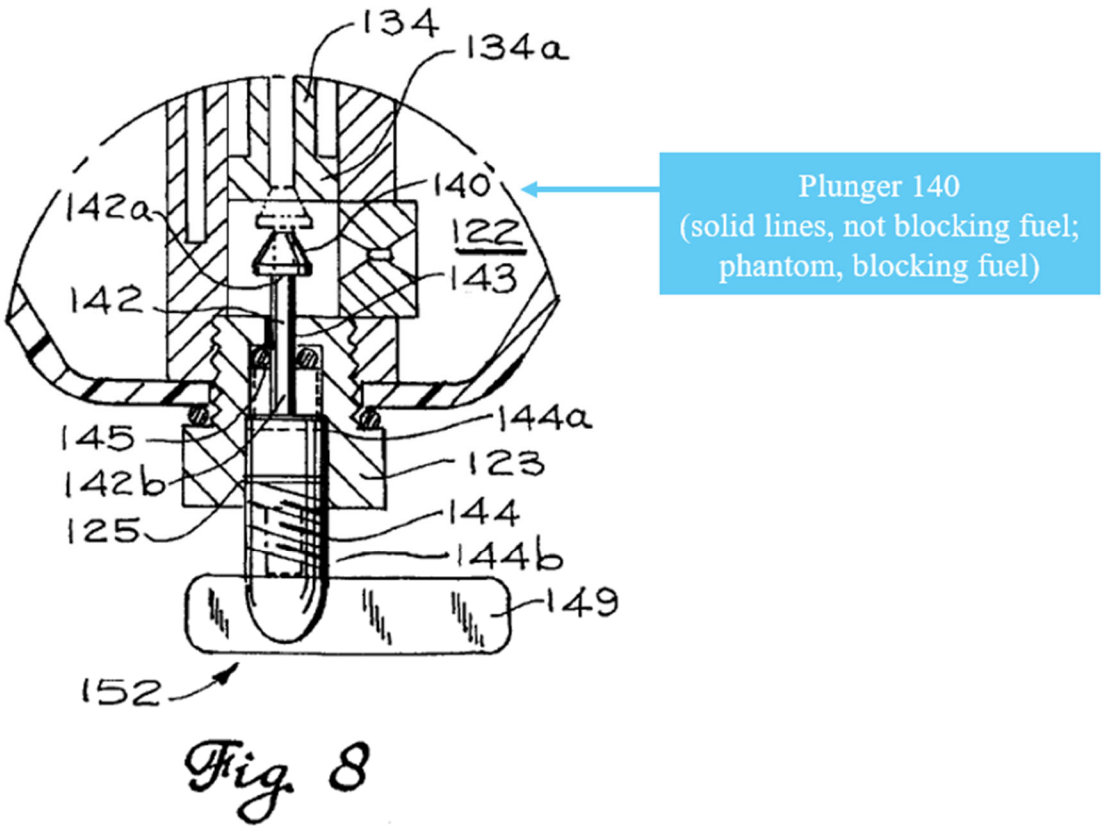


Fig. 8

Id., Figure 8 (annotated).

508. Plunger 140 rotates with connecting member 142 between a blocking and a non-blocking position. *Id.*, 7:65-8:53.

2. Claim 23

a. Element [23.0]

509. Element [23.0] recites "a batteryless dual fuel generator."

510. Holzapfel discloses a dual fuel engine. EX1009, 1:1-5. Yamamoto discloses a batteryless generator. *See* §XI.F.

511. A POSA would have found it obvious to incorporate Holzapfel's carburetor and fuel supply system into Yamamoto's generator to make a dual-fuel generator.

i. Motivation/Expectation of Success

512. 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.

513. 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. 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. Enabling the option of using gasoline or LPG makes the generator more versatile. 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.

b. Element [23.1]

514. Element [23.1] recites "a housing containing a pull start engine coupled to drive an alternator, the engine operable on a gaseous fuel and a liquid fuel."

515. Yamamoto discloses a generator with a housing and a pull-start engine (*see* §XI.F):

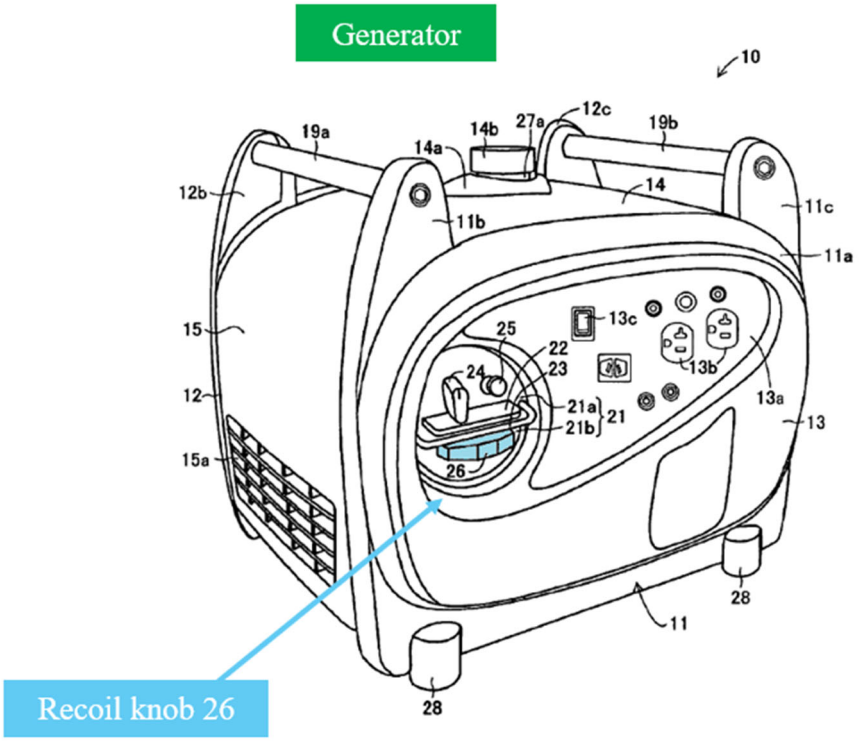


Figure 1

EX1030, Figure 1 (annotated).

516. Yamamoto discloses that generator 32 generates power as rotor shaft 46 rotates. EX1030, 5:54-58. 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. 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.

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

c. Element [23.2]

518. Element [23.2] recites "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."

519. Holzapfel's carburetor would be attached to Yamamoto's intake in the same way shown in Figure 1 of Holzapfel. Holzapfel's carburetor comprises a float bowl, a throat, and a fuel passage extending from the float bowl to the throat. *See* §XII.E.4.b. The fuel passage of Holzapfel's engine provides liquid fuel, and the throat mixes fuel with air. *See* §XII.E.1.d.

d. Element [23.3]

520. Element [23.3] recites "a fuel shutoff attached to the carburetor to close the fuel passage upon selection of engine operation to gaseous fuel."

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

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

3. Claim 24

523. Claim 24 depends from Claim 23, and further recites "wherein the fuel shutoff actuates to close the fuel passage free from linear motion."

524. Holzapfel's fuel shutoff (rotary valve 14) actuates to close the fuel passage 13 free from linear motion because it is a rotary valve. *See* §XII.E.4.d.

525. Alternatively, Winberg's fuel shutoff actuates to close the fuel passage free from linear motion. *See* §XII.G.1.d.

4. Claim 25

526. Claim 25 depends from Claim 23, and recites two additional elements.

a. Element [25.1]

527. Element [25.1] recites "wherein the fuel shutoff comprises: a rotating shaft extending through an opening in the carburetor."

528. As discussed, *see* §XII.H.1.a, Holzapfel discloses that its fuel shutoff comprises a rotating shaft extending through an opening in the carburetor.

529. Alternatively, Winberg discloses this element. *See* §XII.H.1.a.

b. Element [25.2]

530. Element [25.2] recites "a valve member coupled to the shaft in the carburetor that rotates to control fuel flow into the fuel passage."

531. As discussed, the fuel shutoff of Holzapfel comprises rotary valve 14, lever 45, and rod or wire 47, where lever 45 is coupled to rotary valve 14 via a shaft. *See* §§XII.E.4.a, XII.H.1.a. Because rotary valve 14 interrupts liquid fuel upon actuation of rod or wire 47, which controls lever 45 (*see* §XII.E.2), lever 45 rotates rotary valve 14 to control fuel flow into the fuel passage.

532. Alternatively, Winberg discloses this element. *See* §XII.H.1.c.

5. Claim 26

533. Claim 26 depends from Claim 25 and further recites "wherein the valve member is positioned in the float bowl and the shaft extends substantially horizontal through the opening."

534. 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, 7:65-8:53):

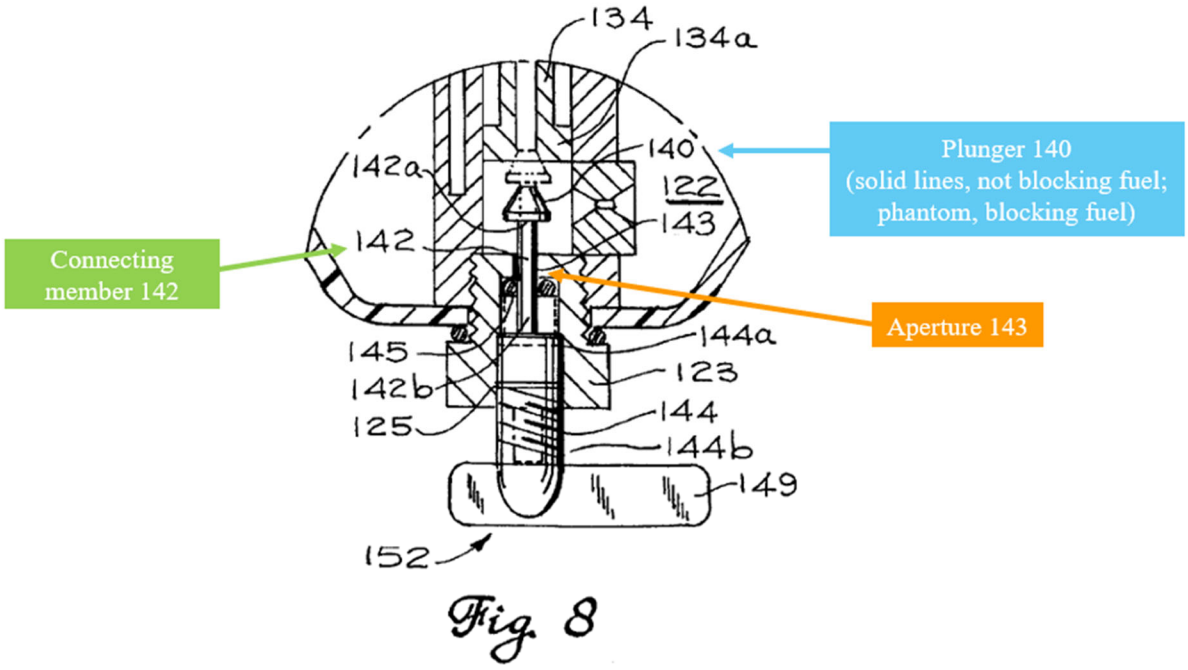


Fig. 8

Id., Figure 8 (annotated).

535. The shaft in Winberg is oriented vertically, but it would have been obvious to use a shaft that extends substantially horizontally. A horizontal shaft is used in Neal, for example.

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

536. In my opinion, Claims 17 and 23-26 of the '398 Patent are obvious for the reasons described below.

1. Claim 17

537. Claim 17 depends from Claim 1.

538. As discussed, Holzapfel discloses the elements of Claim 1. *See* §XII.E.1.

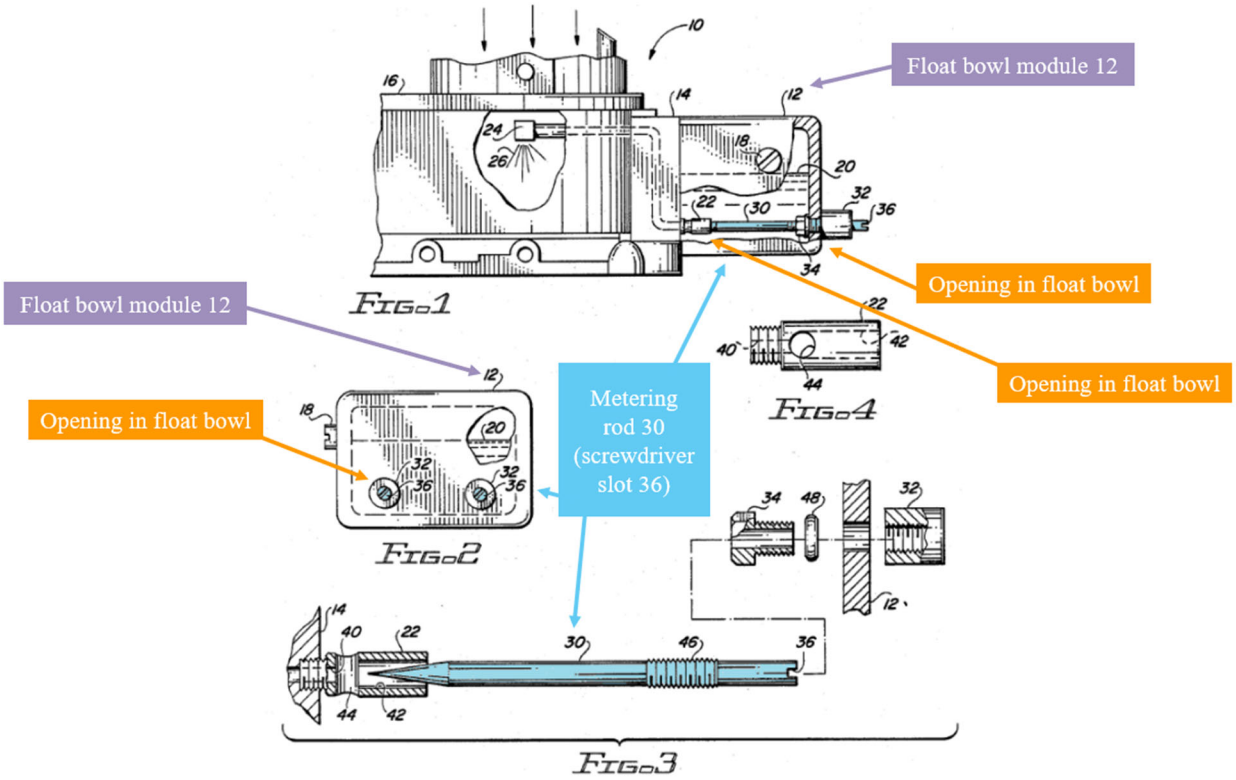
a. Element [17.1]

539. Element [17.1] recites "a rotating shaft extending through an aperture in the carburetor."

540. Holzapfel discloses this element or renders it obvious. *See* §XII.H.1.a.

541. 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. EX1031, 4:25-51, Figures 1-3. Neal's metering rod is a liquid fuel cut-off because it interrupts gasoline flow from the float bowl to the engine. EX1031, 6:15-42. Although Neal's metering rod 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.

542. Neal discloses a rotating shaft (metering rod 30) that extends through an aperture in the carburetor (*see* §XII.F.3):



EX1031, Figures 1-4 (annotated).

i. Motivation/Expectation of Success

543. 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. 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. For example, in the context of generators (an obvious application discussed below, §XII.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.

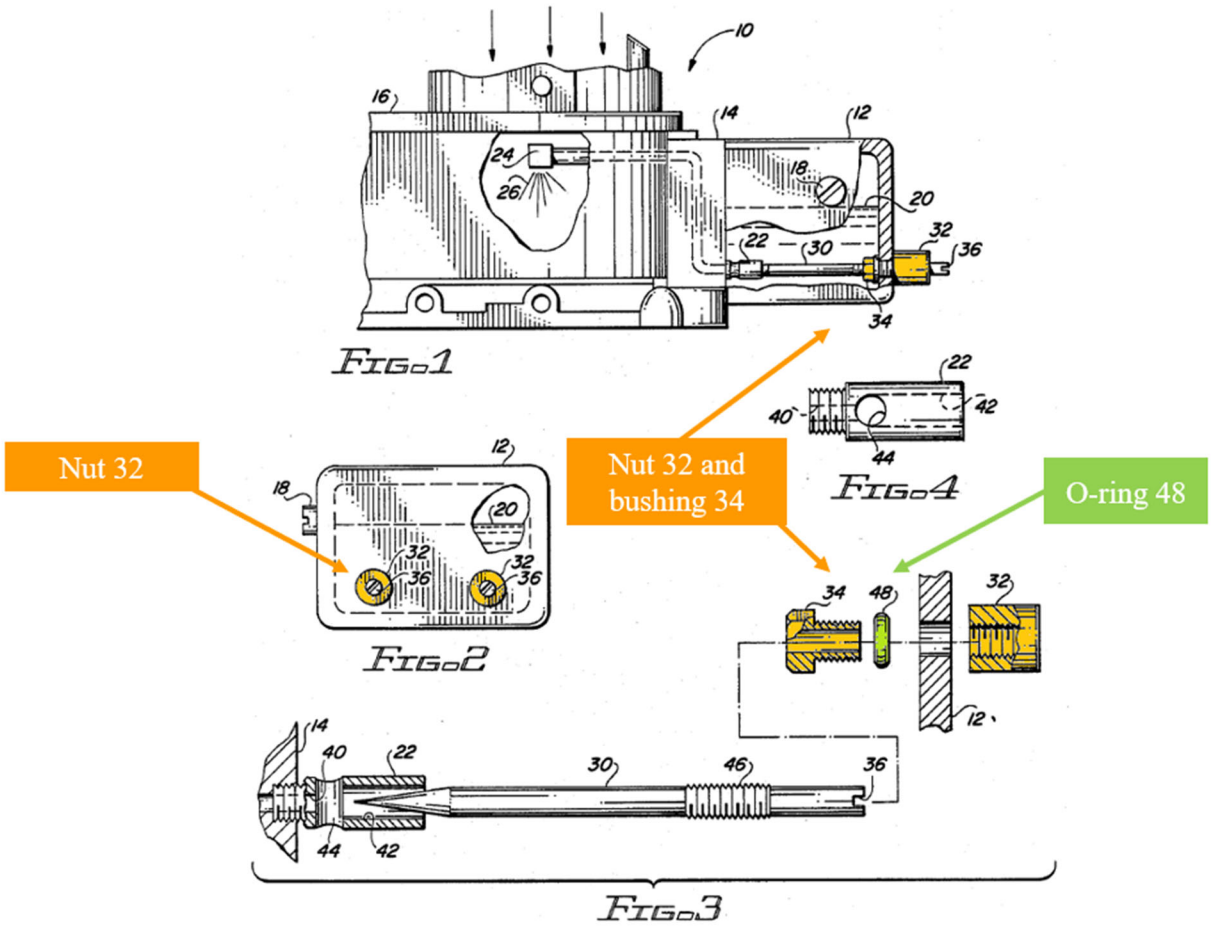
544. A POSA would have had a reasonable expectation of success in using Neal's metering rod as a fuel shutoff because use of similar valves was well known and shown to have success at the time of the invention, as taught by Neal and others (e.g., Winberg).

b. Element [17.2]

545. Element [17.2] recites "a fuel seal around the shaft to seal the aperture."

546. Holzapfel discloses this element or renders it obvious. *See* §XII.H.1.b.

547. 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, Abstract, 4:25-51, 5:47-6:2.



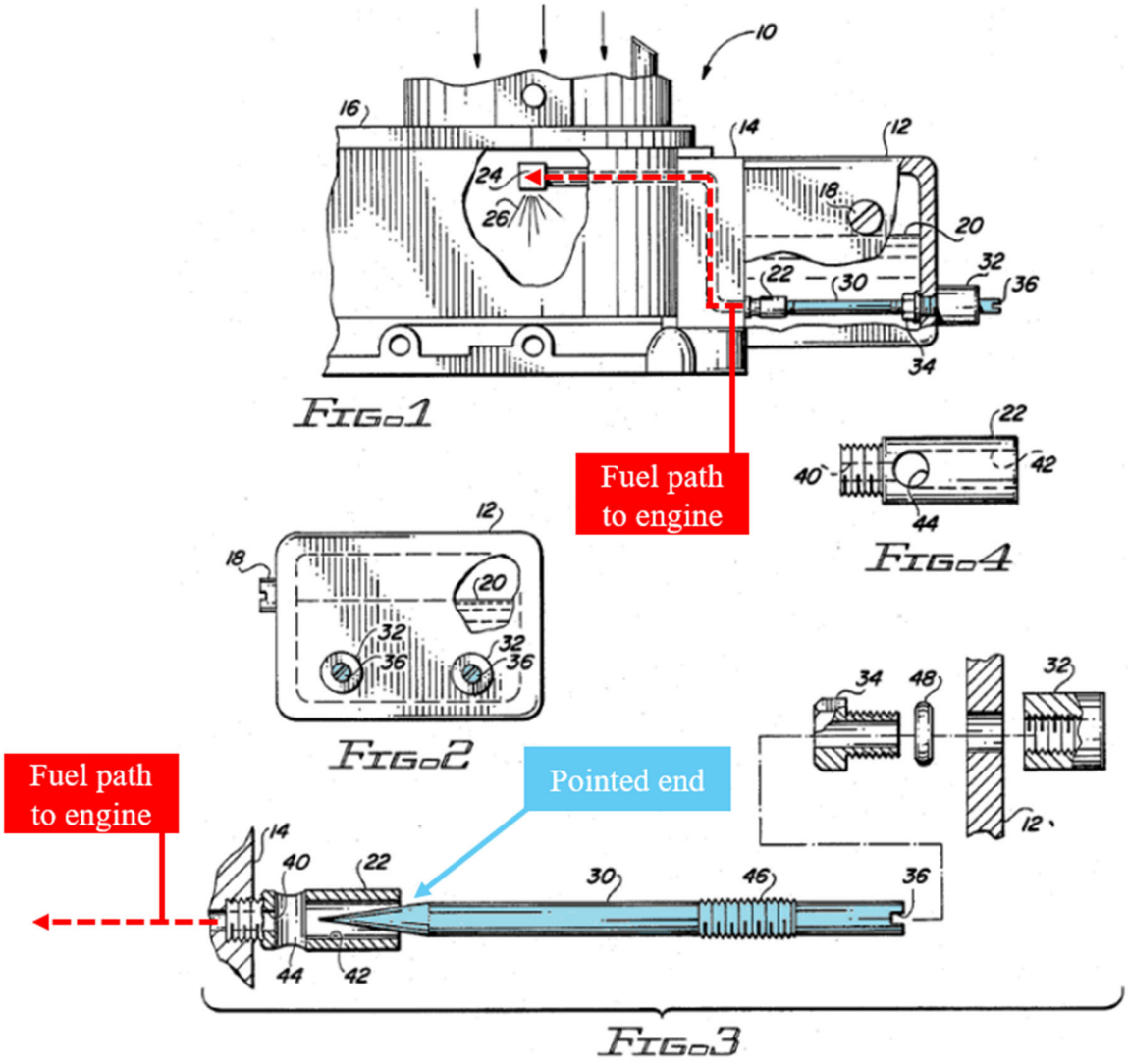
EX1031, Fig. 1-3 (annotated).

c. Element [17.3]

548. Element [17.3] recites "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."

549. Holzapfel discloses this element. *See* §XII.H.1.c.

550. 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, 5:11-34, 6:15-42):



EX1031, Figures 1, 3 (annotated).

551. The pointed end rotates with the metering rod 30 between a blocking and a non-blocking position. EX1031, 6:15-42.

2. Claim 23

a. Element [23.0]

552. Element [23.0] recites "a batteryless dual fuel generator."

553. Holzapfel discloses a dual fuel engine. *See* §XII.E.1.a. Yamamoto discloses a batteryless generator. *See* §XI.F.

554. As discussed, a POSA would have found it obvious to incorporate Holzapfel's carburetor and fuel supply system into Yamamoto's generator to make a dual-fuel generator. *See* §XII.H.2.a.

b. Element [23.1]

555. Element [23.1] recites "a housing containing a pull start engine coupled to drive an alternator, the engine operable on a gaseous fuel and a liquid fuel."

556. Holzapfel in combination with Yamamoto discloses this element. *See* §XII.H.2.b.

c. Element [23.2]

557. Element [23.2] recites "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."

558. Holzapfel in combination with Yamamoto discloses this element. *See* §XII.H.2.c.

d. Element [23.3]

559. Element [23.3] recites "a fuel shutoff attached to the carburetor to close the fuel passage upon selection of engine operation to gaseous fuel."

560. Holzapfel in combination with Yamamoto discloses this element. *See* §§XII.H.1.c, XII.H.2.d.

561. Alternatively, Neal discloses this element. *See* §XII.I.1.c.

3. Claim 24

562. Claim 24 depends from Claim 23, and further recites "wherein the fuel shutoff actuates to close the fuel passage free from linear motion."

563. Holzapfel in combination with Yamamoto discloses the elements of this claim. *See* §XII.H.3.

564. Alternatively, Neal's fuel shutoff actuates to close the fuel passage free from linear motion. *See* §XII.F.1.d.

4. Claim 25

565. Claim 25 depends from Claim 23, and recites two additional elements.

a. Element [25.1]

566. Element [25.1] recites "wherein the fuel shutoff comprises: a rotating shaft extending through an opening in the carburetor."

567. Holzapfel in combination with Yamamoto discloses this element. *See* §XII.H.1.a, XII.H.4.a.

568. Alternatively, as discussed, it would have been obvious to utilize Neal's valve (metering rod 30) instead of Holzapfel's rotary valve 14, and Neal discloses this element. *See* §XII.I.1.a.

b. Element [25.2]

569. Element [25.2] recites "a valve member coupled to the shaft in the carburetor that rotates to control fuel flow into the fuel passage."

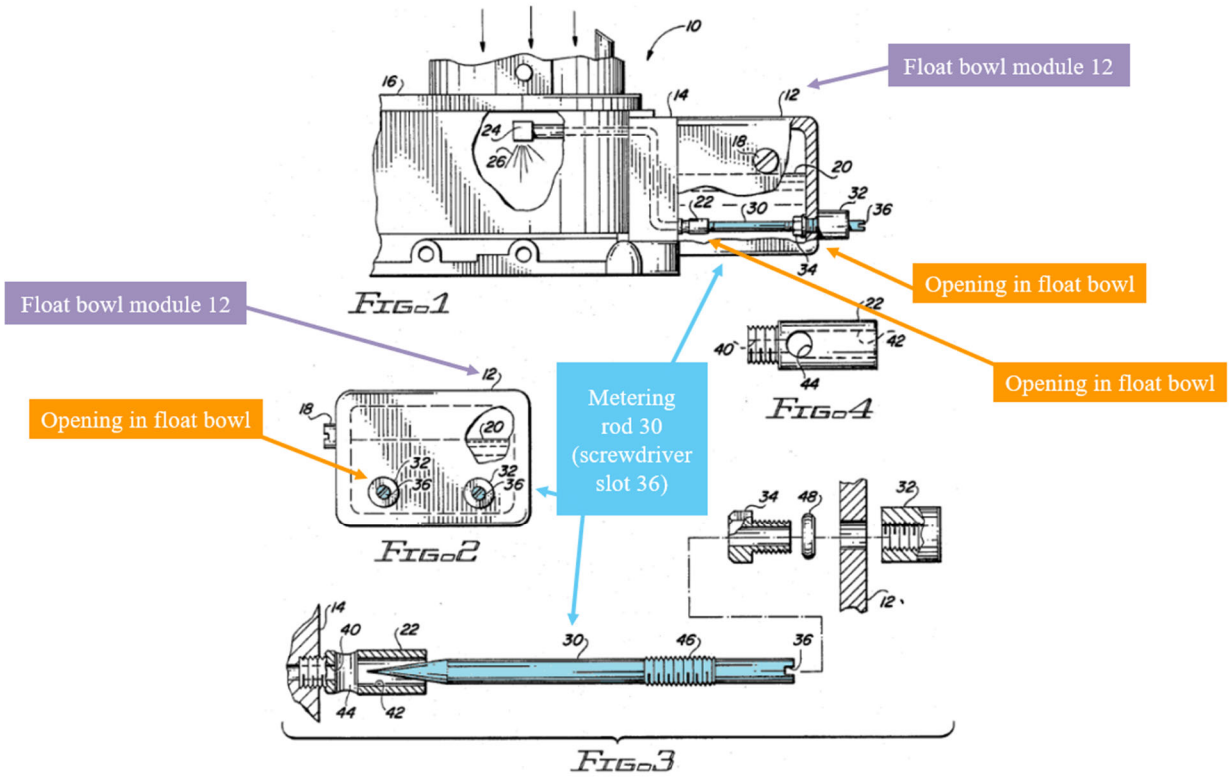
570. Holzapfel in combination with Yamamoto discloses this element. *See* §XII.H.4.b.

571. Alternatively, Neal discloses this element. *See* §XII.I.1.c.

5. Claim 26

572. Claim 26 depends from Claim 25 and further recites "wherein the valve member is positioned in the float bowl and the shaft extends substantially horizontal through the opening."

573. Neal's metering rod 30 is positioned in the float bowl 12 and the shaft (the rod) extends substantially horizontal through the opening of the float bowl:



EX1031, Figures 1-4 (annotated).

XIII. CONCLUSION

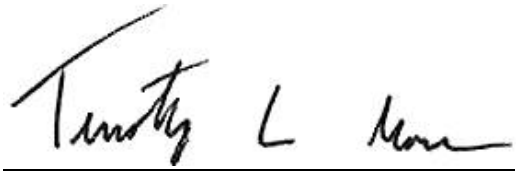
574. For at least the foregoing reasons, in my opinion, Claims 1-17, 19-26, 32-45, and 56-58 of the ’398 Patent are invalid.

* * * * *

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

Date: September 3, 2025

Respectfully submitted,

By: 

Timothy Morse, Ph.D., P.E.



Exponent®
Engineering & Scientific Consulting

Timothy Morse, Ph.D., P.E., CFEI

Principal Engineer | Thermal Sciences
Natick
+1-508-652-8525 | tmorse@exponent.com

Professional Profile

Dr. Morse is a licensed professional mechanical engineer who specializes in failure analysis, failure prevention, and design risk assessment for thermal and flow processes, products, and equipment. His project experience includes turbines, compressors, engines, generators, valves, heat exchangers, boilers, furnaces, refrigeration systems, piping systems, heat transfer systems, flammable liquids, cryogenic liquids, consumer products, and medical devices.

Dr. Morse's expertise is used in a variety of litigation matters, and he has experience testifying at both trial and international arbitration. Dr. Morse also has experience with intellectual property matters involving mechanical engineering principles, including medical devices, consumer products, and industrial equipment.

Dr. Morse applies his expertise to the investigation and prevention of fires, explosions, floods, and equipment failures. He has conducted fire origin and cause investigations involving electrical appliances, electrical systems, consumer products, heating appliances, and other combustion equipment. Dr. Morse performs testing and analysis of HVAC systems and components, including the analysis of the production and spread of carbon monoxide. Dr. Morse also investigates the origin and cause of motor vehicle fires, including post-collision fires.

Dr. Morse has performed engineering analysis for the oil and gas industry, ranging from offshore oil and gas extraction facilities to retail motor fuel stations. Dr. Morse has investigated flow-induced vibration issues over a wide range of applications, including heat exchanger tube bundles, pipelines, and offshore structures.

Dr. Morse has extensive experience with power generation equipment and facilities, including nuclear power plants, fossil fuel power plants, and renewable energy. He has investigated failures in heat exchangers, generators, compressors, turbines, and boilers. In the renewable energy area, Dr. Morse has investigated wind turbine failures and wind turbine fires.

Prior to joining Exponent, Dr. Morse was a researcher in the Fluid Dynamics Research Laboratories at Cornell University where he conducted research on the wakes of stationary and oscillating structures in a flow and particularly on how flow-induced vibration due to vortex shedding causes fatigue and failure of structures.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, Cornell University, 2009

M.S., Mechanical Engineering, Cornell University, 2007

© 2025 Exponent, Inc. All Rights Reserved

B.E., Mechanical Engineering, Cooper Union, 2003

National Science Foundation Fellowship, 2004-2008

National Defense Science and Engineering Graduate Fellowship, 2004-2007

Tau Beta Pi Engineering Honor Society, 2002

Pi Tau Sigma Mechanical Engineering Honor Society, 2002

Licenses and Certifications

Professional Engineer Mechanical, California, #35464

Professional Engineer Mechanical, Florida, #83952

Professional Engineer, Kansas, #PE24740

Professional Engineer Mechanical, Massachusetts, #52419

Professional Engineer Chemical and Mechanical, New Hampshire, #13976

Professional Engineer, New York, #110148

Professional Engineer, Pennsylvania, #PE084735

Professional Engineer, Rhode Island, #PE.0011724

Professional Engineer Mechanical, Vermont, #018.0126189

40-Hour Hazardous Waste Operation and Emergency Response Certification (HAZWOPER)

Certified Fire and Explosion Investigator (CFEI)

Professional Affiliations

American Society of Mechanical Engineers

American Clean Power Association

• Wind Technical Standards Committee Member

National Association of Fire Investigators

National Fire Protection Association

• Alternate Member: NFPA Technical Committee on Vehicular Alternative Fuel Systems (VAF-AAA), responsible for NFPA 52: Vehicular Natural Gas Fuel Systems Code.

• Alternate Member: NFPA Technical Committee on Liquified Petroleum Gases (LPG-AAA), responsible for NFPA 58: Liquified Petroleum Gas Code.

Society of Automotive Engineers

Publications

Davies WA, Wolf MI, Barry M, O'Hern SC, Morse TL. The Effect of Valve Closure Time on Water Hammer. ASME 2021 International Mechanical Engineering Congress and Exposition. November 2021. Paper No. 71153.

Morse TL, Cundy M, Kytömaa, HK. Vehicle fires resulting from hot surface ignition of grass and leaves. SAE Technical Paper 2017-01-1354. 2017.

Stern MC, O'Hern SC, Morse TL, Bishop J, Kytömaa HK. Fire risks due to unintentionally energized metal structures. Journal of Fire Sciences. 2017; 35(5):415-426.

Ponchaut NF, Morse TL, Bigham GN, Castro J. Degassing dissolved carbon dioxide. Drilling & Exploration World. January 2017; 26(3):77-84.

Ponchaut NF, Morse TL, Bigham GN, Castro J. Degassing Africa's Lake Kivu for population safety and power generation. Scandinavian Oil-Gas Magazine No. 11/12 2016; 44:26-29.

Morse TL, Ponchaut NF, Bigham GN. Plume modeling in Lake Kivu, Rwanda for a gas extraction facility. Offshore Technology Conference. Houston, TX. June 2016.

Morse TL, Kytömaa HK. The effect of turbulence on the rate of evaporation of LNG on water. Journal of Loss Prevention in the Process Industries 2011; 24:791-797.

Morse TL, Williamson CHK. Steady, unsteady, and transient vortex-induced vibration predicted using controlled motion data. Journal of Fluid Mechanics 2010; 649:429-451.

Morse TL, Williamson CHK. Prediction of vortex-induced vibration response by employing controlled motion. Journal of Fluid Mechanics 2009; 634:5-39.

Morse TL, Williamson CHK. Fluid forcing, wake modes, and transitions for a cylinder undergoing controlled oscillations. Journal of Fluids and Structures 2009; 25(4):697-712.

Morse TL, Williamson CHK. The effect of Reynolds number on the critical mass phenomenon in vortex-induced vibration. Physics of Fluids 2009; 21(4):045105.

Morse TL. Investigating phenomena in vortex-induced vibration of a cylinder using controlled vibration. Ph.D. Thesis, Cornell University, 2008.

Morse TL, Govardhan RN, Williamson CHK. The effect of end conditions on the vortex-induced vibration of cylinders. Journal of Fluids and Structures 2008; 24:1227-1239.

Morse TL, Williamson CHK. Understanding mode transitions in vortex-induced vibration using controlled motion. Proceedings, 9th International Conference on Flow-Induced Vibrations (FIV-2008), Prague, Czech Republic, 2008.

Kysar JW, Gan YX, Morse TL, Chen X, Jones ME. High strain gradient plasticity associated with wedge indentation into face-centered cubic single crystals: Geometrically-necessary dislocation densities. Journal of the Mechanics and Physics of Solids 2007; 55(7):1554-1573.

Morse TL, Williamson CHK. Understanding mode transitions in vortex-induced vibration using controlled vibration. Proceedings, 5th Conference on Bluff Body Wakes and Vortex-Induced Vibration (BBVIV-5), Costa do Sauipe, Brazil, 2007.

Morse TL, Williamson CHK. Employing controlled vibrations to predict fluid forces on a cylinder undergoing vortex-induced vibration. Journal of Fluids and Structures 2006; 22:877-884.

© 2025 Exponent, Inc. All Rights Reserved

Gan YX, Kysar JW, Morse TL. Cylindrical void in a rigid-ideally plastic single crystal II: Experiments and simulations. International Journal of Plasticity 2006; 22(1):39-72.

Morse TL, Williamson CHK. Employing controlled vibrations to predict fluid forces on a freely vibrating cylinder. Proceedings, 4th Conference on Bluff Body Wakes and Vortex-Induced Vibration (BBVIV-4), Santorini, Greece, 2005.

Presentations and Conference Papers

Morse TL, Wolf MI, Kytömaa HK. Ignition of fuel gas jets from leaks in residential gas piping. International Symposium on Fire Investigation. Orlando, FL, September 2024

Morse TL, Watson H, Buehler C, Kytömaa HK. Ignition due to electrostatic discharge in multi-phase hydrocarbon flows. Mary Kay O'Connor Process Safety Center 2022 International Symposium. College Station, TX, October 2022.

Morse TL, Stern M, Watson H, Buehler C, Kytömaa HK. Experimental evaluation of electrostatic discharge in multi-phase hydrocarbon flows. AIChE Spring Meeting, 18th Global Congress on Process Safety, Houston, TX, April, 2022.

Morse TL, Wolf MI, Davies WA. Residential Fuel Gas Explosions. Oakland County Association of Arson and Fire Investigators, Inc. OCAAFII Quarterly Training. November 2020.

Morse TL, Barry MT. Combining Wind Power with Compressed Air Energy Storage. CleanPower 2020: Stronger Together Virtual Poster Reception. June 2020.

Kytomaa HK, Barry MT, Colella F, Natarajan, S, Lee, K, Morse, TL, Investigating Burn Injuries. AEGIS 2018 Claims Seminar. October 2018.

Morse TL. Wind Turbine Fires and Fire Investigation. Onyx Insight Wind Turbine Technical Symposium. Golden, CO. September 2018.

Morse TL, Colella F, Wolf MI, Barry MT. Space Heater Fires and Fire Investigation. International Symposium on Fire Investigation. Itasca, IL, September 2018.

Morse TL, Sipe JE, Wright SA. Rooftop Solar Fire Investigation. International Symposium on Fire Investigation. Itasca, IL, September 2018.

Morse TL. Plume Modeling in Lake Kivu, Rwanda for a Gas Extraction Facility. Society of Petroleum Engineers (SPE) New York and New England Petroleum Section Invited Lecture Series. Cambridge, MA. November 2017.

Whittlesey R, Morse TL, Morrison A. Analysis of the Relevance of WAF Preparations to Field Mixing Conditions. International Oil Spill Conference. Long Beach, CA. May 2017.

Kane Driscoll SB, Whittlesey R, Hauri J, Kulacki K, Schierz P, Morse T, Morrison A, Yozzo K, McArdle M, Edgington A, Edwards M, Aldea M. The Influence of mixing energy on the concentration and composition of oil in laboratory toxicity tests. Society of Environmental Toxicology and Chemistry. 7th SETAC World Congress. North America 37th Annual Meeting. Orlando, FL, November 2016

Stern MC, O'Hern SC, Morse TL, Bishop J, Kytömaa HK. Fire risks due to unintentionally energized metal structures. Internal Symposium on Fire Investigation, Scottsdale, AZ, October 2016.

Morse TL, Ellison AD, Kytömaa HK. Electrical fault damage to corrugated stainless steel tubing in a house fire. International Symposium on Fire Investigation, University of Maryland, September 2014.

Morse TL, Whittlesey RW. Wind turbine fire origin investigation. International Symposium on Fire Investigation, University of Maryland, September 2014.

Marr KC, Verghese PM, Braff WA, Morse TL. Analysis of arc erosion on thermal switch contacts. International Symposium on Fire Investigation, University of Maryland, September 2014.

Morse TL, Ponchaut NF, Bigham GN. Gas extraction from Lake Kivu: The dynamics of the degassed water plume. World Environmental and Water Resources Congress. Portland, OR. June 2014.

Ellison AD, Morse TL, Kytömaa HK. Lightning related structure fires. International Symposium on Fire Investigation Science and Technology, University of Maryland, October 2012.

Morse TL, Ibarreta AF, Kytömaa HK. Explosions in transformer tanks due to arcing events. AIChE Spring Meeting, 8th Global Congress on Process Safety, Houston, TX, April 2012.

Morse TL, Kytömaa HK. Variations in the evaporation rate of a cryogenic liquid on a water surface. Mary Kay O'Connor Process Safety Center 2010 International Symposium. College Station, TX, October 2010.

Morse TL, Kytömaa HK. The effect of turbulence on the evaporation of cryogenic liquid spills on water. AIChE Spring Meeting, 10th Topical Conference on Natural Gas Utilization, San Antonio, TX, March 2010.

Morse TL, Williamson CHK. Understanding mode transitions in vortex-induced vibration using controlled motion. 9th International Conference on Flow-Induced Vibrations (FIV-2008), Prague, Czech Republic, 2008.

Morse TL, Williamson CHK. Understanding mode transitions in vortex-induced vibration using controlled vibration. 5th Conference on Bluff Body Wakes and Vortex-Induced Vibration (BBVIV-5), Costa do Sauipe, Brazil, 2007.

Morse TL, Williamson CHK. Employing controlled vibrations to predict fluid forces on a freely vibrating cylinder. 4th Conference on Bluff Body Wakes and Vortex-Induced Vibration (BBVIV-4), Santorini, Greece, 2005.

Morse TL, Williamson CHK. An investigation of wake mode transitions and amplitude jumps in vortex-induced vibration using controlled vibration. 60th Annual Meeting of the American Physical Society (APS) Division of Fluid Dynamics, Salt Lake City, UT, 2007.

Morse TL, Williamson CHK. Understanding mode transitions in vortex-induced vibrations of a circular cylinders using controlled vibration. 59th Annual Meeting of the American Physical Society (APS) Division of Fluid Dynamics, Tampa, FL, 2006.

Morse TL, Williamson CHK. Predicting the response of a cylinder undergoing vortex-induced vibration using controlled vibrations. 58th Annual Meeting of the American Physical Society (APS) Division of Fluid Dynamics, Chicago, IL, 2005.

Morse TL, Williamson CHK. Forces on a cylinder with periodic transverse motion in a free stream. 57th Annual Meeting of the American Physical Society (APS) Division of Fluid Dynamics, Seattle, WA, 2004.

Morse TL, Watson H, Buehler C, Kytömaa HK. Ignition due to electrostatic discharge in multi-phase hydrocarbon flows. Mary Kay O'Connor Process Safety Center 2022 International Symposium. College Station, TX, October 2022.

Morse TL, Stern M, Watson H, Buehler C, Kytömaa HK. Experimental evaluation of electrostatic discharge in multi-phase hydrocarbon flows. AIChE Spring Meeting, 18th Global Congress on Process

Safety, Houston, TX, April, 2022.

Book Chapters

Somandepalli V, Morse TL. PIV in combustion systems. Laser Diagnostics in Combustion. Lackner M(ed), Verlag ProcessEng Engineering GmbH, 2009.

Peer Reviews

Journal of Fluid Mechanics

Physics of Fluids

Journal of Fluids and Structures

Journal of Wind Engineering

International Journal of Heat and Fluid Flow

Journal of Loss Prevention in the Process Industries

Energy and Fuels

Nuclear Technology