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[54] **DUAL FUEL SYSTEM FOR INTERNAL COMBUSTION ENGINE**

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[73] Assignee: **Outboard Marine Corporation**, Waukegan, Ill.

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[22] Filed: **Sep. 1, 1987**

Related U.S. Patent Documents

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Appl. No.: **406,446**
Filed: **Aug. 9, 1982**

U.S. Applications:

[63] Continuation of Ser. No. 816,404, Jan. 2, 1986, abandoned.

[51] **Int. Cl.**[4] **F02M 1/16**

[52] **U.S. Cl.** ..... **123/73 B**; 123/187.5 R

[58] **Field of Search** ..... 123/187.5 R, 179 G, 123/179 L, 73 R, 73 A, 73 B, 73 C, 180 R, 73 PP

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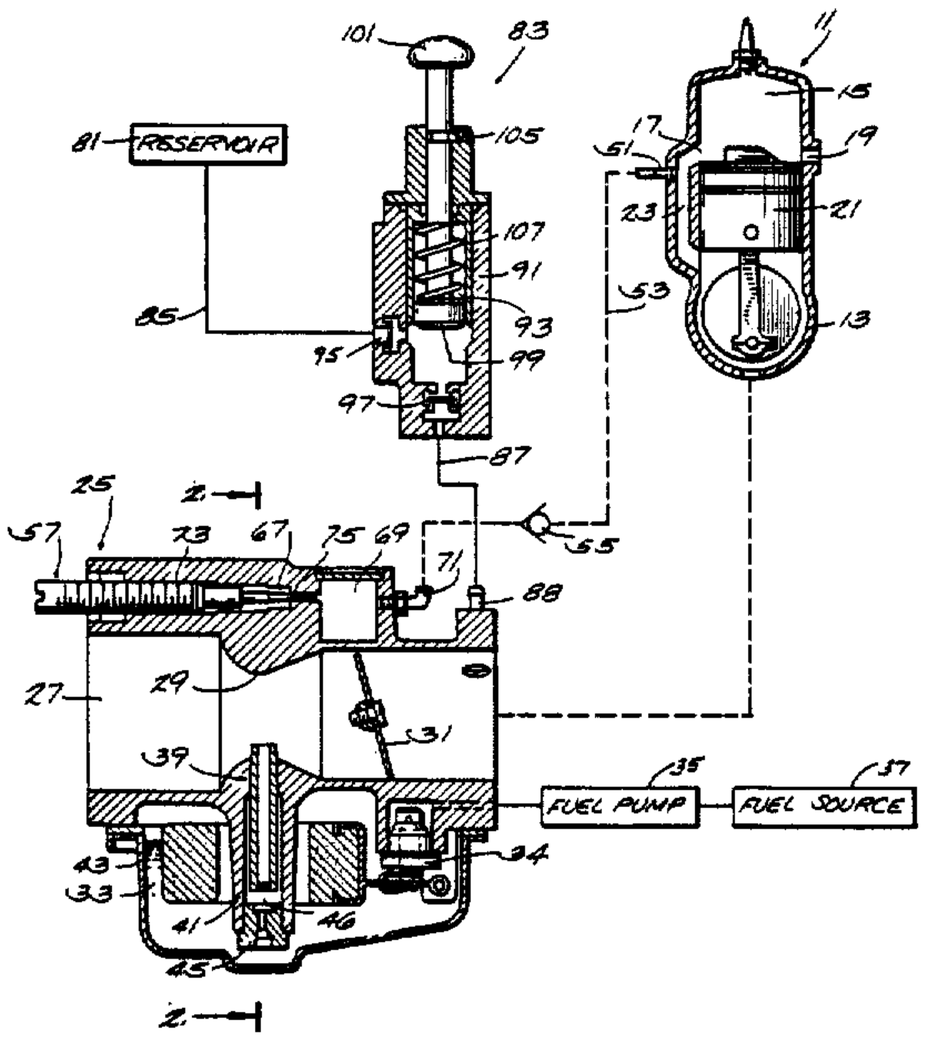
[57] **ABSTRACT**

Disclosed herein is an internal combustion engine comprising a crankcase, a cylinder extending from the crankcase and having an inlet port, a piston located in the cylinder, a transfer passage located between the crankcase and the cylinder inlet port, a fuel pump adapted to communicate with a source of fuel for normal operation, a carburetor having an air induction passage communicating with the crankcase and including a venturi, which carburetor also includes a float bowl communicating with the fuel pump and a high speed nozzle communicating between the float bowl and the venturi, a low speed fuel nozzle communicating with the transfer passage adjacent the inlet port, and a fuel line communicating between the float bowl and the low speed nozzle and including therein check valve means preventing flow from the transfer passage to the float bowl and permitting flow from the float bowl to the transfer passage, which fuel line also includes fuel flow metering means.

6 Claims, 1 Drawing Sheet



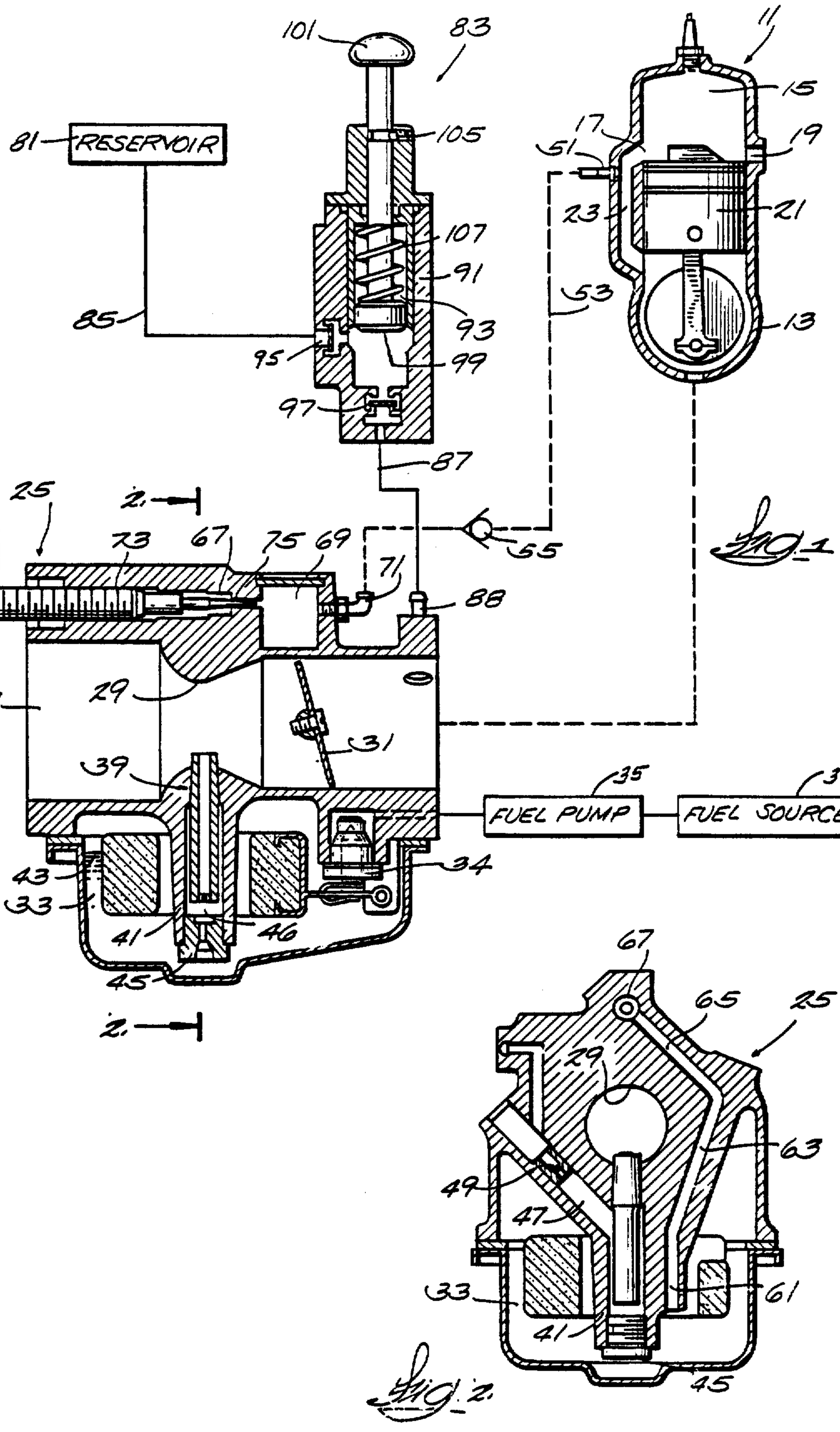

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Fig. 1

Fig. 2

DUAL FUEL SYSTEM FOR INTERNAL COMBUSTION ENGINE

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

RELATED APPLICATION

This application is a continuation of application Ser. No. 816,404, filed Jan. 2, 1986, and now abandoned.

BACKGROUND OF THE INVENTION

The invention relates to fuel supply systems for two-stroke internal combustion engines and, particularly, to arrangements for supplying fuel for low speed operations.

The invention also relates to dual fuel engines, i.e. to engines which, in one form or another, operate with a more expensive fuel, such as gasoline, for starting and warm-up and with an inexpensive fuel, such as kerosene, for normal and low speed operation.

Attention is directed to the following U.S. Pat. Nos.: Eastman 1,181,122 Ronan 752,181 Allec 1,572,701 Mikulaske 2,016,337 Ko Verlinde 3,515,106 Kusche 4,333,425

SUMMARY OF THE INVENTION

The invention provides an internal combustion engine comprising a crankcase, a cylinder extending from the crankcase and having an inlet port, a transfer passage communicating between the crankcase and the cylinder inlet port, a source of fuel, a low speed fuel nozzle communicating with the transfer passage adjacent the inlet port, and a fuel line communicating between the source of fuel and the low speed nozzle and including therein check valve means preventing flow from the transfer passage to the fuel source and permitting flow from the fuel source to the transfer passage, which fuel line also include fuel flow metering means.

The invention also provides an internal combustion engine comprising a crankcase, a cylinder extending from the crankcase and having an inlet port, a transfer passage communicating between the crankcase and the inlet port, a carburetor having an air induction passage communicating with the crankcase and including a venturi, and a high speed nozzle communicating between the venturi and a source of fuel for normal operation, a low speed fuel nozzle communicating the transfer passage adjacent the inlet port, and a fuel line communicating between the low speed nozzle and a source of fuel for normal operation and including therein check valve means preventing flow from the combustion chamber and permitting flow to the combustion chamber, which fuel line also includes therein fuel flow metering means.

The invention also provides an internal combustion engine comprising a combustion chamber, a carburetor having an air induction passage communicating with the combustion chamber, a venturi, a float bowl communicating with a source of fuel for normal operation, and a high speed nozzle communicating between the float bowl and the venturi, a low speed fuel nozzle communicating with the combustion chamber, and a fuel line communicating between the float bowl and the low speed nozzle and including therein check valve means preventing flow from the combustion chamber to the float bowl and permitting flow from the float bowl to the combustion chamber, which fuel line also includes therein fuel flow metering means.

In one embodiment in accordance with the invention the internal combustion engine further includes a reservoir for a primer fuel, and a primer fuel pump communicating with the primer fuel reservoir and with the air inducation passage downstream of the throttle valve, which primer fuel pump is manually operable to deliver primer fuel to the air induction passage.

Other features and advantages of the embodiments of the invention will become known by reference to the following general description, claims and appended drawings.

IN THE DRAWINGS

FIG. **1** is a schematic view, partially in cross-section, of an engine fuel feeding system in accordance with the invention.

FIG. **2** is a sectional view taken along line **2—2** of FIG. **1**.

Before explaining one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for the purpose of description and should not be regarded as limiting.

GENERAL DESCRIPTION

Shown in the drawings is an internal combustion engine **11** which is preferably of the two stroke type and which includes a crankcase **13**, together with a cylinder or combustion chamber **15** which extends from the crankcase **13**, which includes an inlet port **17** and an outlet or exhaust port **19**, and which contains therein a piston **21** movable reciprocally so as to open and close the inlet and outlet ports **17** and **19**. The engine **11** also includes a transfer passage **23** extending between the crankcase **13** and the cylinder inlet port **17**. Any suitable construction of the foregoing components can be employed.

The engine **11** also includes a carburetor **25** which is mounted on the crankcase **13** and which comprises an air induction passage **27** communicating with the crankcase **13** and including a venturi **29** and, downstream of the venturi **29**, i.e., between the venturi **29** and the crankcase **13**, a throttle valve **31**.

The carburetor **25** also includes a float bowl or reservoir **33** which communicates, subject to the usual float valve **34**, with a fuel pump **35** which is preferably driven by the engine **11** and which is adapted to communicate with a suitable source **37** of fuel for normal running operation. Either gasoline or an inexpensive fuel, such as kerosene, can be used. If desired, means other than the fuel pump **35** could be employed to supply fuel to the float bowl or reservoir **33**.

Extending between the float bowl or reservoir **33** and the venturi **29** is a high speed nozzle **39**. In this regard, the carburetor **25** includes a depending hollow boss **41** which extends into the float bowl or reservoir **33** below the normal liquid level **43**. The lower open end of the boss **41** is closed by a high speed orifice plug or part **45**. The high speed nozzle **39** extends into the hollow inte-

rior of the boss **41** above the plug **43** and includes, at the lower end thereof, a restriction **46**. The hollow interior of the boss **41** also communicates with the atmosphere through a bore or duct **47** having therein a restriction **49**.

If desired, the high speed nozzle **39** can communicate with a source of fuel other than the carburetor float bowl **33**.

Means are also provided for supplying the engine **11** with fuel for low speed operation independently of the air induction passage **27**. While various arrangements can be employed, in the illustrated construction, the engine **11** also includes a low speed nozzle **51** which, in the preferred and illustrated construction, extends into the transfer passage **23** adjacent the inlet port **17**. As a consequence, the vacuum condition periodically present in the crankcase draws fuel into the transfer passage in the area adjacent the inlet port **17**. This fuel is, accordingly, located for immediate conveyance into the cylinder **15** upon opening of the inlet port **17** by the piston.

The low speed nozzle **51** communicates with a source of fuel through a fuel line **53** which includes therein check valve means **55** permitting fuel flow to the cylinder **15** and preventing fuel flow from the cylinder **15**. Any suitable check valve construction can be employed. The fuel line **53** also preferably includes fuel flow metering means **57** which can be a restriction but which is preferably adjustable.

While other constructions can be employed, in the illustrated consruction, the fuel source with which the fuel line **53** communicates is the float bowl or reservoir **33**. In this connection, the fuel line **53** includes, in the carburetor **25**, a series of serially connected ducts or bores **61, 63, 65**, and **67** which extend from or communicate with the float bowl or reservoir **33** and which lead to a well **69** which does not communicate with the air induction passage **27**. Instead, the well **69** communicates through a fitting **71** with the remainder of the fuel line **53**.

While other constructions can be employed, the fuel metering means **57** includes an adjustable needle valve **73** having a tip **75** which is movable relative to the duct **67** to meter flow to the low speed nozzle **51**.

Particularly if the source of fuel is an inexpensive fuel, such as kerosene, it is desirable to provide the engine **11** with means for providing primer fuel, such as gasoline, to the cylinder **15** for starting and warm-up purposes. While other various arrangements can be employed, in the illustrated construction, such means comprises a reservoir **81** for the primer fuel, together with a manually operated primer pump **83** which communicates through a conduit **85** with the primer fuel reservoir **81** and through a conduit **87** with a nipple **88** communicating with the air induction passage **27** downstream of the throttle valve **31**, i.e. adjacent to the crankcase **13**. If desired, the primer pump **83** could communicate through the line or duct **87** directly with the cylinder **15**, or with the transfer passage **23**, or with the crankcase **13**.

If the desired construction, the primer pump **83** includes a housing **91** defining a pumping chamber **93** communicating through inlet and outlet check valves **95** and **97** with the lines or conduits **85** and **87**. Movable relative to the pumping chamber **93**, is a pumping piston **99** which is connected to an operating knob **101** for actuation by the operator. The pumping piston **99** is movable between an inner position, an outer position,

and an intermediate detent position which is determined by a suitable detent mechanism **105**, and which is shown in FIG. **1**. Any suitable detent mechanism **105** can be employed.

Means in the form of a spring **107** are also provided for biasing the piston **99** from the outer position to the intermediate detent position.

In operation, when starting, withdrawal of the pumping piston **99** to the outer position by the operator, followed by insertion of the pumping piston **99** to the inner position, will supply primer fuel to the air induction passage **27** adjacent to the crankcase **13**. As many strokes as is desirable can be applied. Retention of the pumping piston **99** in the inner position serves to prevent flow of primer fuel from the primer fuel reservoir **81** to the cylinder **17**. If the pumping piston **99** is retained in the indeterminate position by the detent mechanism **105**, engine vacuum in the air induction passage **27** will be effective to draw or suck primer fuel through the primer pump **83** from the primer fuel reservoir **81** so as to enable warming-up operation of the engine. Thereafter, communication between the cylinder **17** with the primer fuel reservoir **81** is discontinued by insertion of the pumping piston **99** to the inner position.

If the throttle valve **31** is set at low speed, after the engine has been warmed-up as just indicated, engine vacuum will draw or suck fuel through the low speed nozzle **51**. The extent of the engine vacuum occurring at such low speed will be ineffective to suck or draw fuel from the main or high speed nozzle **39** and thus, at low engine speed with the primer pump **83** closed, only air will be fed through the air induction tube or passage **27**.

However, when the throttle valve **31** is moved to an advanced setting, increased engine vacuum will cause fuel to be drawn or sucked from the high speed nozzle **39**. Thus, at high speeds, the high speed nozzle **39**, as well as the low speed nozzle **51**, supply fuel to the engine **11**.

There is thus provided an engine in which, under low speed conditions, fuel (in the absence of air) is delivered directly to the transfer passage adjacent the inlet port so as thereby to provide for effective conveyance into the combustion chamber in a manner reducing the possibility of fuel accumulation during low speed operation in the crankcase. In addition, there is provided a dual fuel engine which can be started on gasoline, or other relatively expensive fuel, and, after warm-up, if necessary, can be run at low or high speeds on a less expensive fuel, such as kerosene.

While the invention has been described with respect to a single cylinder **15**, the invention is also applicable to multi-cylinder engines, and the fuel line **53** can be provided with one or more additional branch lines to serve one or more additional cylinders.

Various of the features of the invention are set forth in the following claims:

We claim:

1. An internal combustion engine comprising a crankcase, a cylinder extending from said crankcase and defining a combustion chamber having an inlet port, a transfer passage communicating between said crankcase and said inlet port, a carburetor having an air induction passage communicating with said crankcase and including a venturi *and a float bowl adapted to contain fuel for normal operation,* a throttle valve intermediate said venturi and said crankcase. and a high speed nozzle communicating between said venturi and [a source of operating fuel for normal operation] *said float bowl, a low speed*

fuel nozzle communicating with said transfer passage adjacent said inlet port, a fuel line communicating between said low speed nozzle and said [source of operating fuel] *float bowl for delivering fuel unmixed with air from said float bowl through said low speed nozzle to said transfer passage, said fuel line including check valve means for preventing flow from said combustion chamber and permitting flow to said combustion chamber and also including fuel flow metering means separate from said check valve means, a reservoir for a primer fuel different from said operating fuel, and a primer fuel pump communicating with said primer fuel reservoir and with one of said induction passage, said crankcase, said transfer passage and said combustion chamber, said primer fuel pump being manually operable to deliver primer fuel to said one of said induction passage, said crankcase, said transfer passage, and said combustion chamber.*

2. An internal combustion engine according to claim 1 wherein said low speed nozzle extends into said transfer passage adjacent said inlet port.

[3. An internal combustion engine according to claim 1 wherein said source of operating fuel comprises a float bowl and wherein said fuel line communicates with said float bowl.]

4. An internal combustion engine according to claim 1 wherein said operating fuel is less [volatile] than said primer fuel.

5. An internal combustion engine according to claim 4 wherein said operating fuel is kerosene and said primer fuel is gasoline.

6. An internal combustion engine in accordance with claim 1 wherein said primer fuel pump communicates with said induction passage intermediate said throttle e valve and said crankcase.

7. An internal combustion engine comprising a crankcase, a cylinder extending from said crankcase and defining a combustion chamber having an inlet port, a transfer passage communicating between said crankcase and said inlet port, a carburetor having an air induction passage communicating with said crankcase and including a venturi and a float bowl adapted to contain fuel for normal operation, a high speed fuel nozzle communicating between said venturi and said float bowl, a low speed fuel nozzle communicating with said transfer passage adjacent said inlet port, a fuel line communicating between said low speed nozzle and said float bowl for delivering fuel unmixed with air from said float bowl through said low speed nozzle to said transfer passage, said fuel line including check valve means for preventing flow from said combustion chamber and permitting flow to said combustion chamber and also including fuel flow metering means separate from said check valve means, a reservoir for a primer fuel different from the operating fuel, and a primer fuel pump communicating with said primer fuel reservoir and delivering primer fuel to one of said air induction passage, said crankcase, said transfer passage, and said combustion chamber, said primer fuel pump being manually operable.

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