Sept. 8, 1959 B. C. PHILLIPS 2,903,250

FUEL FEED AND CHARGE FORMING APPARATUS

Original Filed Nov. 30, 1955 3 Sheets-Sheet 1

FIG-1-

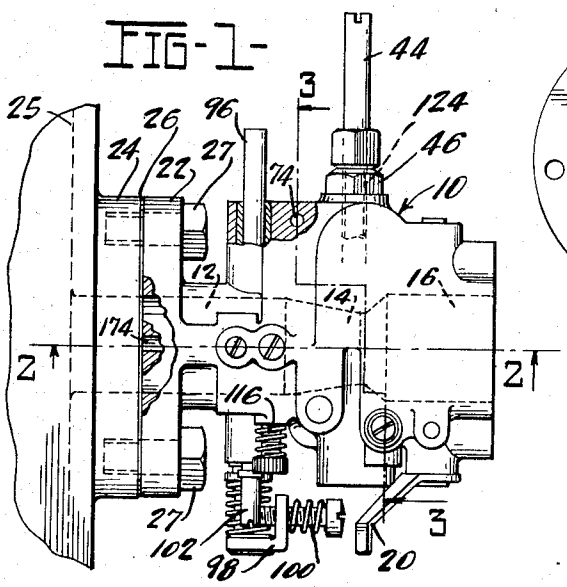


FIG-5-

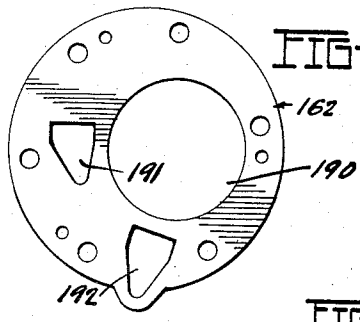
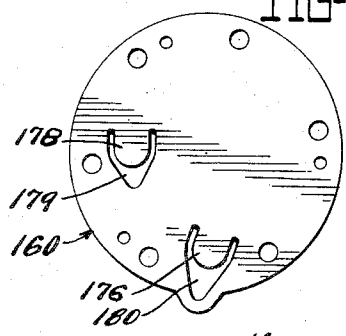


FIG-4-



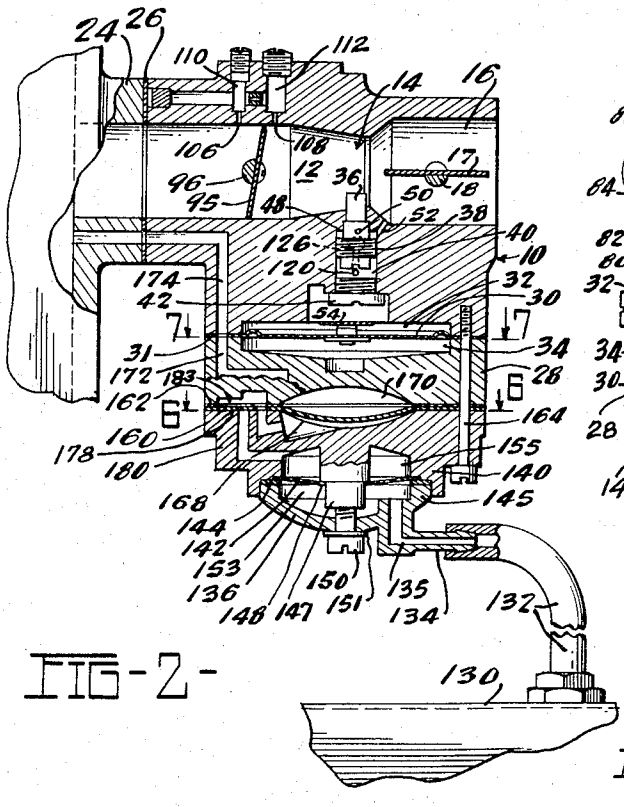


FIG-2-

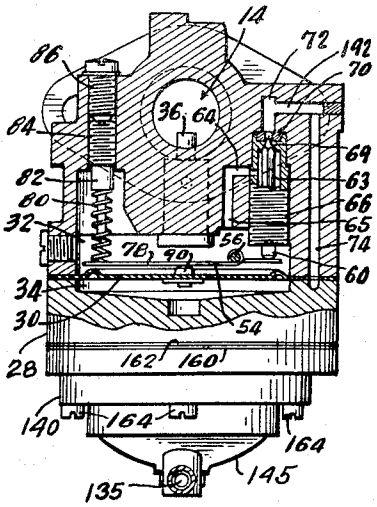


FIG-3-

INVENTOR:
BERNARD C. PHILLIPS.
BY
Harry O. Ernsberger
ATTY.

Sept. 8, 1959 B. C. PHILLIPS 2,903,250

FUEL FEED AND CHARGE FORMING APPARATUS

Original Filed Nov. 30, 1955 3 Sheets-Sheet 2

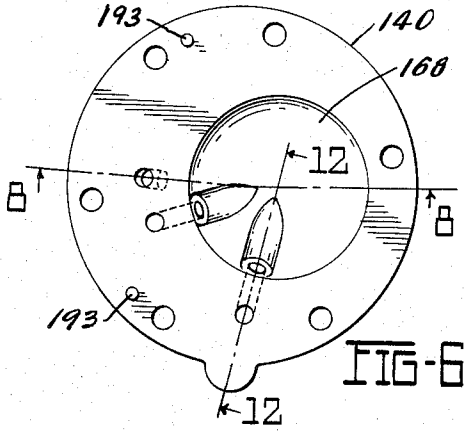


FIG-6-

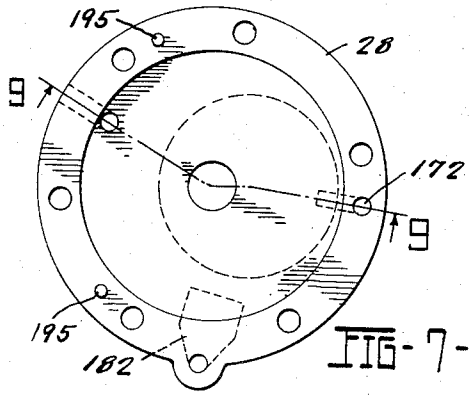


FIG-7-

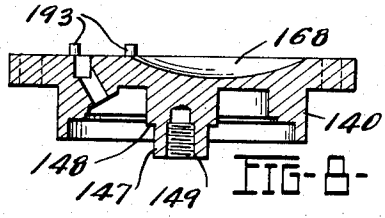


FIG-8-

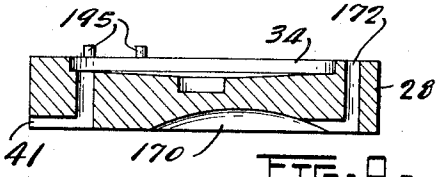


FIG-9-

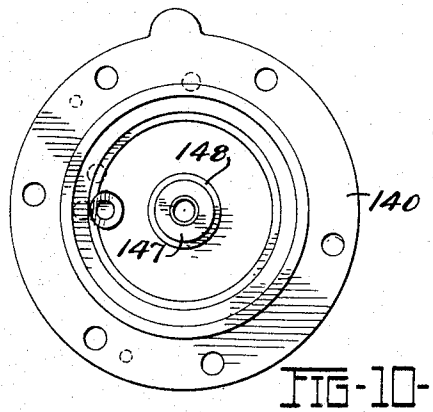


FIG-10-

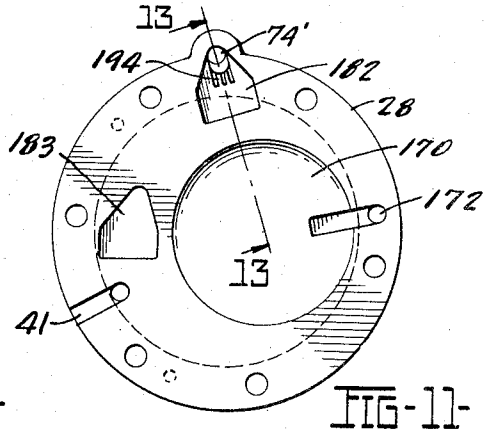


FIG-11-

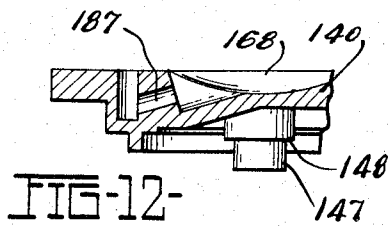


FIG-12-

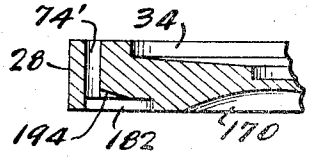


FIG-13-

INVENTOR:
BERNARD C. PHILLIPS.
BY
Harry O. Ernsberger
ATTY.

Sept. 8, 1959 B. C. PHILLIPS 2,903,250

FUEL FEED AND CHARGE FORMING APPARATUS

Original Filed Nov. 30, 1955 3 Sheets-Sheet 3

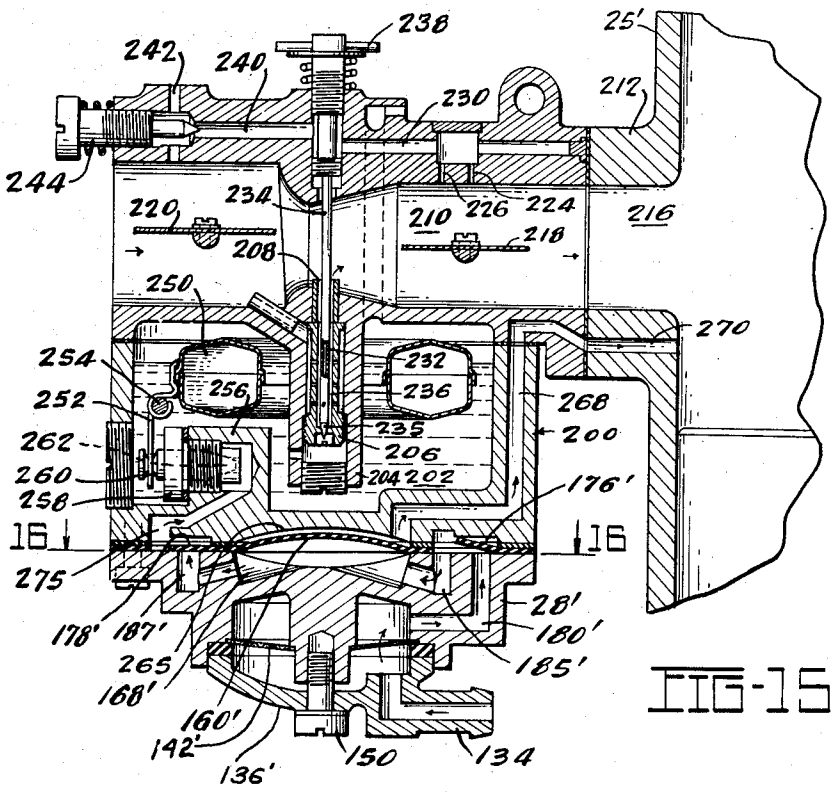


FIG-15-

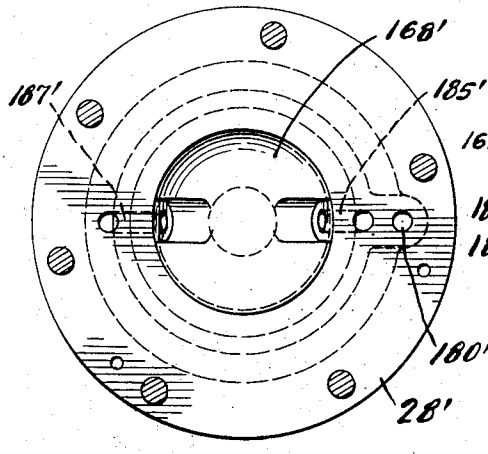


FIG-16-

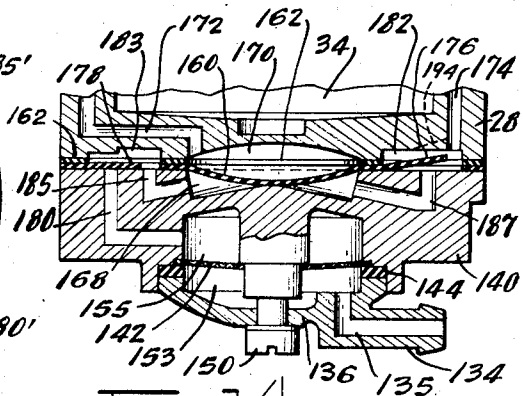


FIG-14-

INVENTOR:
BERNARD C. PHILLIPS.
BY
Harry O. Ernsberger
ATTY.

United States Patent Office 2,903,250 Patented Sept. 8, 1959

2,903,250

FUEL FEED AND CHARGE FORMING APPARATUS

Bernard C. Phillips, Toledo, Ohio, assignor to The Tillotson Manufacturing Company, Toledo, Ohio, a corporation of Ohio

Original application November 30, 1955, Serial No. 549,978, now Patent No. 2,796,838, dated June 25, 1957. Divided and this application April 15, 1957, Serial No. 652,891

3 Claims. (Cl. 261—37)

This invention relates to apparatus for delivering fuel to an internal combustion engine and more especially to an arrangement for feeding fuel to a charge forming device and delivering a fuel and air mixture from the charge forming device. This application is a division of my copending application Serial No. 549,978, now Patent No. 2,796,838 issued June 25, 1957.

In the operation of internal combustion engines, particularly of the two cycle type for use with chain-saws, lawn-mowers, and out-board type of marine engines and the like, it is imperative to provide an arrangement for delivering fuel and air mixture to the engine irrespective of the relative position of the engine. For example, engines for operating chain-saws must be capable of operation in extreme angular or even inverted positions and engines utilized for powering lawn-mowers must be capable of operation in extreme angular positions such as are encountered in mowing operations on uneven or hilly terrain. Serious difficulties have been encountered heretofore with fuel feed and charge forming apparatus for engines of this character as conventional type apparatus is wholly unsuited for satisfactory operation in extreme angular and inverted positions of the engines with which the apparatus may be used. For example, a carburetor or charge forming device embodying a float-controlled fuel supply will not function in an inverted position as the fuel inlet valve would remain in open position permitting flooding of the charge forming device.

A further factor impairing the use of conventional fuel feed and charge forming apparatus with engines operating in extreme angular or vertical positions is that delivery of fuel by gravity to the charge forming apparatus is rendered inoperative when the fuel supply reservoir is below the charge forming device. Efforts have been made to pressurize the fuel supply reservoir by means of a hand pump, but such arrangements have been unsatisfactory because of the varying pressures in the fuel supply tank.

The present invention relates to a fuel feed and charge forming apparatus for use with internal combustion engines which is adaptable for successful operation in any position.

An object of the invention is the provision of a combined charge forming device and fuel supply means which may be fixedly attached to an internal combustion engine and which will deliver the requisite fuel and and air mixture to the engine irrespective of the relative position of the engine and charge forming and fuel feeding means.

Another object of the invention is the provision of a diaphragm type of pumping means in combination with a charge forming device wherein the pulsations or differential pressures existent by reason of the engine operation are utilized to actuate the pump.

Another object of the invention is the provision of the diaphragm type fuel pump or liquid feeding device embodying valves formed as integral components of the diaphragm or membrane utilized as a pumping element.

Another object of the invention is the provision of a diaphragm type of fuel feed pump adapted for satisfactory use with carburetors or charge forming devices of diaphragm control or float control fuel flow means.

A further object of the invention resides in a small and compact diaphragm or membrance type of fuel pump in which spring biased valves are eliminated and which may be economically manufactured and utilized wherever differential or pulsating pressures are available for actuating the diaphragm.

Another object of the invention is a provision of fluid pump embodying a pumping member of the diaphragm or the membrance type wherein the valves are integrated components of the diaphragm and which are capable of operation under pulsations of very high frequency.

An object of the invention resides in a combined charge-forming and fuel-feeding apparatus wherein communication of a variable-volume pumping chamber with an engine crankcase is established through channel means formed in the body of a charge-forming device and wherein a fuel feed channel is incorporated in the charge-forming device for conveying fuel from a pumping chamber to a reservoir or chamber in the charge-forming device.

An object of the invention resides in a combination fuel delivery and mixture-forming apparatus for an internal-combustion engine wherein a pumping or pulsating chamber having a flexible wall is connected through a suitable duct with the crankcase of the engine with which the charge-forming apparatus is used whereby the varying pressures in the engine crankcase are utilized for moving the flexible wall, providing a motivating means for flowing liquid fuel from a supply to the charge-forming apparatus.

Another object of the invention resides in the provision of a fuel-feeding apparatus embodying a flexible member or diaphragm for exerting a pumping action, the flexible member or diaphragm being formed with portions functioning as valves or valve means to effect flow of liquid fuel from a supply to a zone at which the fuel is mixed with air or other oxidant to provide a combustible mixture for an internal-combustion engine.

Another object of the invention resides in the provision of a fuel-feeding device wherein components of the device or structure are fashioned in a manner to reduce machine work or machining operations to a minimum, providing an apparatus which may be inexpensively produced in substantial quantities.

Further objects and advantages are within the scope and function of the related elements of the structure, to various details of construction and to combinations of parts, elements per se, and to economies of manufacture and numerous other features as will be apparent from a consideration of the specification and drawing of a form of the invention, which may be preferred, in which:

Figure 1 is a top plan view illustrating one form of combined charge forming device and fuel feed means attached to the crank case of an internal combustion engine of the two cycle type;

Figure 2 is a vertical sectional view taken substantially on the line 2—2 of Figure 1;

Figure 3 is a vertical sectional view taken substantially on the line 3—3 of Figure 1;

Figure 4 is a plan view of a diaphragm forming a component of the fuel feeding means;

Figure 5 is a plan view of a gasket or sealing member for use with the diaphragm illustrated in Figure 4;

Figure 6 is a view taken substantially on the line 6—6 of Figure 2;

Figure 7 is a view taken substantially on the line 7—7 of Figure 2;

Figure 8 is a sectional view taken substantially on the line 8—8 of Figure 6;

Figure 9 is a sectional view taken substantially on the line 9—9 of Figure 7;

Figure 10 is a bottom plan view of the structure shown in Figure 8;

Figure 11 is a bottom plan view of the structure shown in Figure 9;

Figure 12 is a fragmentary sectional view taken on the line 12—12 of Figure 6;

Figure 13 is a fragmentary sectional view taken substantially on the line 13—13 of Figure 11;

Figure 14 is a diagrammatic sectional view through the fuel pump component illustrating the valve arrangement;

Figure 15 is a semi-diagrammatic vertical sectional view of a float controlled charge forming device and fuel feeding means showing the valves in diametrically opposed relation, and

Figure 16 is a transverse sectional view taken substantially on the line 16—16 of Figure 15.

While the fuel feed and charge forming apparatus has been illustrated as particularly constructed for use with an engine of the so-called two cycle type, it is to be understood that the arrangement of the invention may be utilized with other types of internal combustion engine or for other purposes where pulsating pressures are available.

Referring to the drawings in detail, and initially to Figures 1 through 3 and 14, the charge forming device or carburetor illustrated therein is of the diaphragm type especially constructed for delivering a fuel and air mixture into the crank case of a two cycle engine of the internal combustion type. The carburetor is inclusive of a body 10 formed with a mixing passage 12, the latter including a Venturi 14 into which fuel is delivered for admixing with air admitted through an air inlet 16. An air valve 17 mounted upon a shaft 18 is disposed in the inlet passage 16 for controlling the amount of air admitted to the mixing passage. An arm 20 is secured upon the shaft 18 for manipulating the valve 17.

The carburetor body 10 is formed with a flange portion 22 which is adapted to be secured to a boss portion 24 formed on a wall of the crank case 25 of an engine of a two cycle type. A gasket 26 is disposed between the flange 22 and the boss portion 24 and the flange 22 is secured to the boss by means of bolts 27.

Secured to the body 10 is a member 28 and disposed between member 28 and the body 10 is a flexible diaphragm 30. The body portion 10 has a chamber 32 formed therein, the diaphragm 30 forming one wall of the chamber 32.

A gasket 31 is disposed between the member 28 and the carburetor body 10 to effect a seal as well as to prevent or retard transfer of heat between these components. The chamber 32 is adapted to contain fuel to be delivered into the Venturi 14 of the mixing passage through a nozzle 36. The nozzle or fuel delivery tube 36 is formed as a part of a fitting 38 threaded into a bore or well 40 formed in the carburetor body 10. The fitting 38 is formed with a tubular channel (not shown) which conveys fuel from the well 40 to the nozzle 36.

The lower end of the well is closed by a threaded plug 42. Fuel from the chamber 32 is delivered into the well 40 through a duct (not shown) in which is disposed an adjustable metering pin 44 having a tapered extremity fitting into the duct. The metering pin 44 is threaded through a fitting 46 and is rotatably adjustable for metering or regulating the flow of fuel from the chamber 32 to the well 40. A collar portion 48 formed on the fitting 38 is provided with openings 50.

A duct 52 is arranged between the air inlet passage 16 and the space surrounding the collar 48 whereby air from the air inlet 16 may flow through the openings 50 in the collar portion 48 into the fuel in the nozzle 36. The air mixes with the fuel within the bore in the fitting 38 so that an emulsion or mixture of air and liquid fuel is discharged from the nozzle 36 into the Venturi 14 in order

to provide for a more homogeneous mixture delivered into the engine crank case.

A means is provided for controlling the flow of fuel into the chamber 32. A lever 54 is pivotally supported within the chamber 30 upon a pin or shaft 56. One arm of the lever engages a member 60 which extends within a bore formed in a valve member 63, a spring (not shown) being disposed between the member 60 and the valve 63 whereby upwardly directed pressure on the member 60 is resiliently transferred to the needle valve or fuel inlet control valve 63. The valve 63 is of polygonally-shaped cross section and is slidably disposed in a bore in a fitting 66.

The polygonal-shaped valve 63 facilitates flow of fuel along the facets of the valve through interconnecting ducts 64 and 65 into the chamber 32. The valve member 63 is formed with a cone shaped extremity 69 which cooperates with a seat 70, the bore in the seat being in communication with a duct 72. The duct 72 is in communication with a duct 74 which receives fuel from a fuel pump chamber in a manner hereinafter explained.

The arm 78 of the lever 54 is engaged by a coil spring 80 which rests against a shoulder of a member 82 the latter being formed with a threaded portion 84 which is threaded into a bore in the body 10 and is adjustable to regulate the pressure of the spring 80. The upper end of the threaded bore in the body 10 is closed by means of a plug 86.

The diaphragm 30 is provided with a centrally disposed button or member 90 which engages or contacts a lower surface of arm 78 of the lever 54.

The movement of diaphragm 30 is communicated by the lever 54 to the fuel inlet valve 63 for controlling the flow of fuel into the carburetor chamber or bowl 32. The air chamber or pressure equalizing chamber 34 formed in member 28 is vented to the atmosphere by means of a passage 41 shown in Figure 9, or the chamber may be vented into the air inlet passage 16 if desired. It is essential to vent the chamber 34 in order to facilitate flexure or movement of the diaphragm 30 in order to accurately control the delivery of fuel into the chamber 32.

The fuel is delivered from a pumping chamber through ducts 74 and 72, past the needle valve 63 and through passage 64 into the carburetor chamber or fuel channel 32 when the aspiration effective through the fuel nozzle sets up reduced pressure acting on the diaphragm to compress spring 80 and admit fuel into the channel or chamber 32. As fuel flows into the chamber 32, the pressure therein is raised and the diaphragm 30 is flexed downwardly as viewed in Figures 2 and 3, and the pressure of spring 80 swings the lever 54 about its pivot 56 exerting an upwardly acting pressure upon the needle valve 63 seating the cone-shaped valve portion 69 in the valve seat 70 and thus interrupting or restricting the flow of fuel into the chamber 32.

In this manner fuel is supplied to the chamber 32 and the well 40. The pressure of the spring 80 may be adjusted by manipulation of the threaded member 84. When air flow ceases in the mixing passage and Venturi fuel is no longer drawn through the nozzle 36 and the weight of the fuel on the diaphragm 30 causes it to be flexed downwardly or away from the mixing passage and, through tilting of the lever 54, the fuel inlet valve 63 is closed.

Disposed in the outlet zone of the mixing passage 13 is a throttle valve 95 which is supported upon a transversely shaft 96, the shaft being rotatable to vary the position of the throttle valve 95 for controlling the admission of fuel and air mixture into the engine crank case to regulate the speed of the engine. An arm 98 is mounted upon one end of the shaft 96 and has a threaded opening to accommodate a screw 100. A stop member or pin 102 is carried by the body 10 and is adapted to be engaged by the screw 100, this arrangement serving to

limit or determine the position of the throttle valve **95** for engine idling conditions.

Means are provided for delivering fuel into the mixing passage for engine idling purposes and low speed operation of the engine. As shown in Figure 2, there is provided an idling orifice **106** and a low speed orifice **108** formed in the wall of the mixing passage. The orifices **106** and **108** are in communication with passages **110** and **112** respectively and these passages are in communication with the fuel chamber **32** through a duct (not shown) leading into the fuel chamber **32**. The fuel flow to the idling and low speed orifices may be regulated by means of a needle valve **116**.

Means is provided for regulating the rate of flow of fuel into the well **40** for discharge through the main nozzle **36**. As shown in Figure 2, a duct **120** opens into the well **40** and is in communication with the fuel chamber **32**. A needle valve portion (not shown) formed at the end zone of a rod or valve member **44** projects into the duct **120** and is provided with a threaded portion **124** cooperating with a threaded bore in the fitting **46**.

By rotating member **44**, the needle portion of the valve may be adjusted in the duct **120** to regulate the fuel flow into the well **40**. A ball check valve **126** is disposed in the fitting **38** adapted to close the fuel passage to the main nozzle **36** upon inversion of the carburetor and prevent reverse flow of air from the mixing passage through the main nozzle such as would influence the sub-atmospheric pressure in the fuel chamber **32**.

A fuel pumping means is associated with the carburetor construction for delivering liquid fuel into the carburetor fuel chamber **32** from a fuel supply. As shown in Figure 2, a fuel reservoir or supply tank **130** is connected by means of a flexible tube **132** with a tubular projection **134** formed upon a closure member **136**. The fuel pumping arrangement includes a pump body construction formed by components or members **28** and **140**, the latter being formed with a circular recess arranged to receive the peripheral edge zone of a fuel filter or strainer **142**. A gasket **144** in the recess is engaged by a circular portion **145** of the closure member **136** for retaining the filter **142** in position. As shown in Figure 8, the pump body member **140** is formed with a boss portion **147** having a shoulder **148** engaged by the filter **142**. The boss **147** is formed with a threaded bore **149** to receive a threaded member or screw **150**, the latter projecting through an opening in the closure member **136** for securing the closure member **136** to the body member **140**. A sealing gasket **151** is interposed between the head of the screw and member **136**. The projection **134** is formed with a fuel inlet passage **135** which conveys fuel into a chamber **153** provided by the closure member **136**. The closure member forms a sump in which sediment or foreign matter may be collected as it is filtered from the fuel. The strained fuel passes through the filter **142** into an annular chamber **155**.

In the present invention, the valves for controlling flow of liquid fuel into and away from the fuel chamber **168** in the pumping means are integrally formed with the diaphragm **160** as component parts thereof. As particularly shown in Figures 2, 4 and 14, the valves **176** and **178** are formed by punching or removing material of the diaphragm providing spaces **179** and **180**, the valves **176** and **178** being shaped as tongues adapted to be flexed at the hinge or zone of juncture with the remainder of the diaphragm. The valve **178** controls the inlet passage of the fuel chamber **168** and valve **176** controls the outlet or discharge passage from the fuel chamber.

The chamber **155** adjacent the filter screen **142** is in communication with a fuel passage **180** for conveying fuel to the zone of the inlet valve **178**. The member **28**, adjacent the zones of the valves **176** and **178** is formed with spaces or recesses **182** and **183** to facilitate flexure or movement of the valves. A passage **185** is arranged to convey fuel from the zone of valve **178** into the pumping chamber **168**. A passage **187** is arranged to convey fuel from the chamber **168** to a zone adjacent the outlet valve **176**.

The chamber **182** is in communication with the fuel reservoir **32** in the carburetor body through the medium of passages **74**, **72** and **64**.

For purpose of illustration, Figure 14 is a section through the pump structure, the section being of an expanded character to better illustrate the valves and fuel passages in the fuel pumping apparatus. Disposed between the body member **140** of the pumping arrangement and the carburetor body **10** is a diaphragm or pumping element **160** and a gasket **162**.

The diaphragm or membrane **160** is formed of impervious flexible material such as synthetic rubber or cloth impregnated or coated with a material which is resistant to the deleterious effects of hydrocarbon fuels. A Celluloid-like material known as Mylar has been found to be satisfactory. The diaphragm is preferably of a thickness of from three thousandths of an inch to forty thousandths of an inch. The pump body member **140** and member **28** are secured to the carburetor body **10** by means of screws **164**, the screws passing through openings in the diaphragm **160** and the gasket **162**. The central zone of the pump body **140** adjacent the diaphragm is formed with a spherically-shaped recess or depression providing a fuel chamber **168** and the body portion **28** of the pump is formed with a spherically-shaped recess or depression forming a pumping chamber **170**, the diaphragm **160** forming an intermediate wall of each of the chambers **168** and **170**.

The pumping chamber **170** is arranged to be connected with a source of periodically or intermittently varying or differential pressure whereby the diaphragm **160** is flexed to exert a pumping action in the fuel chamber **168**. In the embodiment shown in Figures 1 through 3 and 14, the pumping chamber **170** is connected with the crank case of the engine through a passage in the carburetor body. As the engine is of the two-cycle type, the pressure in the engine crank case alternately increases and decreases during each revolution of the crankshaft. As shown in Figure 2, the pumping chamber **170** is in communication with a passage **172** formed in member **28** which is in registration with a passage **174** formed in the carburetor body **10**, the passage **174** being in communication with the interior of the crank case **25** of the engine.

Through the medium of these passages, the varying pressures existent in the crankcase during engine operation are effective in the chamber **170** to flex the pumping diaphragm **160**.

When the pressure within the chamber **32** is reduced through the discharge or delivery of fuel from the chamber **32** into the mixing passage through the main nozzle **36** or through the idling and low-speed orifices **106** and **108**, the lever **54** swings in a clock-wise direction as viewed in Figure 3 about the axis of pivot shaft **56**, which movement causes valve **63** to move away from its seat **70** to facilitate flow of fuel from the fuel chamber **168** of the pumping means into the reservoir **32**. The flow of liquid fuel into the carburetor chamber **32** and the fuel chamber **68** only takes place when the engine is in operation whereby the variable pressure in the crank case of the engine is effective to flex the pumping diaphragm **160**. So long as the fuel inlet control valve **63** is in open position, fuel flow into the carburetor reservoir chamber **32** continues until an amount of fuel is introduced into the chamber **32** sufficient to partially satisfy the sub-atmospheric pressure existing in the chamber **32**, causing the diaphragm to move downwardly whereby the pressure of spring **80** is effective against the arm **78** of the lever to cause the lever to swing in a counter-clockwise direction as viewed in Figure 3 to move the valve **63** into its seat **70** and interrupt the flow of fuel into the carburetor chamber.

Under this condition, further flexure and pumping action of the diaphragm **160** continues until sufficient fuel flows into the chamber **168** to equal or balance the pumping pressures effective in the pumping chamber **170**.

As fuel is discharged into the mixing passage **14** from the reservoir of fuel channel **32**, the diaphragm is drawn upwardly, moving the lever **54** to open the inlet valve **63** to admit more fuel until the proper supply of fuel is replenished in the reservoir **32**. Thus, during engine operation, the pumping means is effective to deliver fuel to the carburetor in accordance with the engine requirements. Through this arrangement fuel is supplied to the carburetor in any position of the latter including inverted position whereby the combination is particularly useable with engines for powering chain saws, lawn mowers and the like wherein carburetors are moved into various positions.

As shown in Figure 5 the gasket **162** is formed with a circular opening **190** substantially equal to the span or diameter of the chamber **168** in order to accommodate the movements of the diaphragm **160**. The gasket **162** is also formed with generally triangularly shaped openings **191** and **192** to accommodate movements of the valves **176** and **178**. Dowels or pins **193** in member **140** serve to position the diaphragm **160** and gasket **162** in proper position and pins **195** in member **28** position the member in proper relation on the carburetor body **10**.

The valves **176** and **178** are flexed at high speeds as two cycle engines with which the arrangement may be used operate at speeds up to 8,000 R.P.M. or more. Hence under high speed engine operation the outlet valve tends to be held open by reason of the inertia of the fluid moving through the valve port or passage. The pump body **28** at the outlet valve recess **182** is formed with a plurality of recesses **194** which are disposed above the outlet valve **178**.

Through this arrangement the column of fuel in the passage **74'** in member **28** and passage **74** in the carburetor body **10** is effective on the upper surface of the valve **178** to assist in urging the valve toward a closed position in the periods between successive pumping pulsations impressed upon the diaphragm by differential pressures in the crankcase of the engine.

Figures 15 and 16 illustrate the pumping arrangement embodied in a carburetor wherein the fuel in the carburetor is maintained in the bowl or chamber through the use of a float controlled inlet valve. In this form of construction, the inlet and outlet valves of the pump may be disposed in diametrically opposed relation as shown in Figure 16 or in any other desired relation.

With particular reference to Figure 15, there is illustrated a carburetor body **200** formed with a fuel reservoir, chamber or bowl **202**, the body being provided with a central boss portion **204** bored to accommodate a fitting **206** having passages through which fuel from the reservoir **202** is conveyed to a main nozzle **208** for discharge into a mixing passage **210**. The carburetor is secured to a boss portion **212** formed on the engine crankcase **25'**, the boss portion having a passage **216** in registration with the mixing passage **210** for conveying fuel and air mixture into the engine crankcase.

Disposed in the mixing passage **210** is a throttle control or valve **218** and an air inlet valve **220**, which constructions are similar to those shown in Figure 2. Low-speed and idling orifices **226** and **224** are in communication with fuel in the reservoir through a passage **230** and a tubular duct **232** formed within a needle valve member **234**, the latter having a valve portion **235** cooperating with the fitting **206** for regulating the admission of fuel into a well **236** formed in the fitting **206**.

The needle valve **234** is provided with a manipulating means or grip member **238** for rotating the valve **234** to regulate the flow of fuel from the reservoir or chamber **202** into the fuel well for discharge through the main orifice or nozzle **208**. The idling and low-speed orifices **224** and **226** receive fuel through the duct **232** in the valve member **234**. Air may be mixed with or bled into the fuel prior to its discharge from the orifices **224** and **226** through passages **240** and **242**, a rotatable valve member **244** being provided for controlling the amount of air mixed with the fuel.

Disposed within the fuel reservoir or bowl **202** is an annularly shaped float member **250** which is of a type to be buoyantly supported by the fuel contained within the chamber **202**. Secured to the float member **250** is an arm or lever **252** pivotally supported on a shaft **254** secured to the body of the carburetor. The body of the carburetor is formed with a boss **256** bored to accommodate a fitting **258** in which is moveably mounted a fuel inlet control valve member **260**. The valve member **260** has a conically-shaped valve portion **262** which cooperates with an opening in the fitting **258** to control the flow of fuel into the reservoir **202**.

The fuel pumping or feeding mechanism illustrated in Figures 15 and 16 is similar to the fuel pump mechanism hereinbefore described and shown in Figure 2. The carburetor body shown in Figure 15 is formed with a chamber **265** of a spherical sector shape, a diaphragm **160'** forming a wall of the chamber **265** being configurated to provide inlet and outlet valves **176'** and **178'**. The chamber **265** provides a pumping chamber and is connected with the crankcase of the engine through a passage **268** formed in the carburetor body **200** and passage **270** formed in the boss portion **212** of the engine crankcase wall structure.

The pump construction includes a pump body **28'** formed with a fuel chamber **168'**, fuel inlet passages **180'** and **185'**, and a fuel outlet passage **187'**.

The carburetor body **200** is formed with a fuel passage **275** which conveys fuel from the chamber **168'** into a region adjacent the fuel inlet control valve **262**. The fuel strainer **142'** and the closure **136'** are of the same construction as the corresponding elements shown in Figure 2.

In the operation of the arrangement shown in Figures 15 and 16, when the engine is operating, fuel is discharged into the mixing passage **210** from the nozzle **208** at normal engine speeds and from the orifices **224** and **226** at low or idling speeds. As the fuel level in the chamber **202** is thereby lowered, the float **250** swings downwardly about the shaft **254** opening the fuel control valve **260**. Under the influence of differential pressure pulsations in the engine crankcase, which are communicated to the pumping chamber **265** through passage **270**, the diaphragm is vibrated causing fuel from the chamber **168'** to flow past the outlet valve **178'** of the diaphragm through the passage **275** into the chamber **202**. In this manner the fuel level in the carburetor chamber **202** is maintained substantially constant. As fuel is delivered from the chamber **168'** to the carburetor, the upward movements of the diaphragm establish suction or reduced pressure in the chamber **168'** causing fuel from a supply tank (not shown) to flow through the passage **180'** past the inlet valve **176'** into the chamber **168'**. Through this arrangement, the engine during operation is continuously supplied with fuel.

It will be apparent that the invention provides a simple, yet compact and efficient fuel feeding means or pump which, combined with the carburetor construction, forms a unitary device occupying comparatively small space adapted to operate at high efficiency. The pump arrangement may be operated from any source of pulsating pressures to feed liquids or gases for other purposes.

It is to be understood that the diaphragm of the fuel feeding means or pump may be formed of any suitable material providing a flexible impervious membrane. When the material of the pumping diaphragm is sufficiently resilient to form an effective seal between the components shaped to provide the pumping and fuel

chambers, the gasket **162** may be eliminated from the assembly.

It should be noted that the fuel pump is disposed whereby several heat barriers retard or prevent heat from the engine being transferred to the fuel in the fuel chamber in the pump. With particular reference to Figure 2, it will be apparent that the gasket **26**, body **10**, diaphragm **30**, member **28**, gasket **162** and pumping diaphragm **160** serve to retard transfer of heat to the fuel in the chamber **168**.

It is apparent that, within the scope of the invention, modifications and different arrangements may be made other than is herein disclosed, and the present disclosure is illustrative merely, the invention comprehending all variations thereof.

I claim:

1. In combination, a body formed with a passage adapted to accommodate air flow, said body having a recess formed therein, a disc-like member formed with a recess, a first diaphragm formed of flexible material disposed between said body and said member and extending across said recesses and forming therewith a first liquid receiving chamber and a clearance space to accommodate movements of said first diaphragm, said recess forming a clearance space being vented to the atmosphere, an element disposed adjacent the disc-like member, said member and element each being formed with a cavity, a second diaphragm disposed between said member and element and extending across said cavities forming therewith a second liquid receiving chamber and a pumping chamber, a duct establishing communication between said first liquid receiving chamber and the passage for conveying liquid into the passage under the influence of reduced pressure set up by air flow through the passage, liquid conveying channel means between said first and second liquid receiving chambers, valve means in said channel means, means responsive to movements of said first diaphragm controlling the valve means to regulate the admission of liquid from the second liquid receiving chamber into said first liquid receiving chamber, said element being formed with inlet and outlet ports for said second liquid receiving chamber, said pumping chamber being adapted to be connected with a source of varying fluid pressure for actuating said second diaphragm for pumping liquid from a supply into the second liquid receiving chamber, and valve means integrally formed on said second diaphragm for controlling the flow of liquid through said inlet and outlet ports.

2. In combination, a body formed with a passage adapted to accommodate air flow, said body having a recess formed therein, a disc-like member formed with a recess, a first diaphragm formed of flexible material disposed between said body and said member and extending across said recesses and forming therewith a first liquid receiving chamber and a clearance space to accommodate movements of said first diaphragm, said recess forming a clearance space being vented to the atmosphere, an element disposed adjacent the disc-like member, said member and element each being formed with a cavity, a second diaphragm disposed between said member and element and extending across said cavities forming therewith a second liquid receiving chamber and a pumping chamber, a duct establishing communication between said first liquid receiving chamber and the passage for conveying liquid into the passage, liquid conveying channel means between said first and second liquid receiving chambers, valve means in said channel means, means responsive to movements of said first diaphragm controlling the valve means to regulate the admission of liquid from the second liquid receiving chamber into said first liquid receiving chamber, said element being formed with inlet and outlet ports for said second liquid receiving chamber, said pumping chamber being adapted to be connected with a source of varying fluid pressure for actuating said second diaphragm for pumping liquid from a supply into the second liquid receiving chamber, and valve means associated with said second diaphragm for controlling the flow of liquid through said inlet and outlet ports.

3. In combination, a body formed with a passage adapted to accommodate air flow, said passage being formed with a Venturi, said body having a recess formed therein, a disc-like member formed with a circular recess, a first diaphragm formed of flexible material disposed between said body and said member and extending across said recesses and forming therewith a first liquid receiving chamber and a clearance space to accommodate movements of said first diaphragm, said recess forming a clearance space being vented to the atmosphere, an element disposed adjacent the disc-like member, said member and element each being formed with a cavity, a second diaphragm disposed between said member and element and extending across said cavities forming therewith a second liquid receiving chamber and a pumping chamber, a duct establishing communication between said first liquid receiving chamber and the passage for conveying liquid into the passage, liquid conveying channel means between said first and second liquid receiving chambers, valve means in said channel means, means responsive to movements of said first diaphragm controlling the valve means to regulate the admission of liquid into said first liquid receiving chamber, said element being formed with inlet and outlet ports for said second liquid receiving chamber, said pumping chamber being adapted to be connected with a source of varying fluid pressure for actuating said second diaphragm for pumping liquid from a supply into the second liquid receiving chamber, valve means associated with said second diaphragm for controlling the flow of liquid through said inlet and outlet ports, said element being formed with a recess, a strainer extending across the recess in the element, a circular closure for the recess in the element being formed with a tubular elbow-shaped portion to admit liquid from a supply into the recess in the element, and means securing the closure to the element whereby the closure is rotatably adjustable for changing the relative position of the elbow-shaped portion.

References Cited in the file of this patent

UNITED STATES PATENTS

109,678	Shearer	Nov. 29, 1870
2,496,688	Armstrong	Feb. 7, 1950
2,634,684	Alvarez et al.	Apr. 14, 1953
2,713,854	Conover	July 26, 1955
2,796,838	Phillips	June 25, 1957
2,801,621	Anderson et al.	Aug. 6, 1957