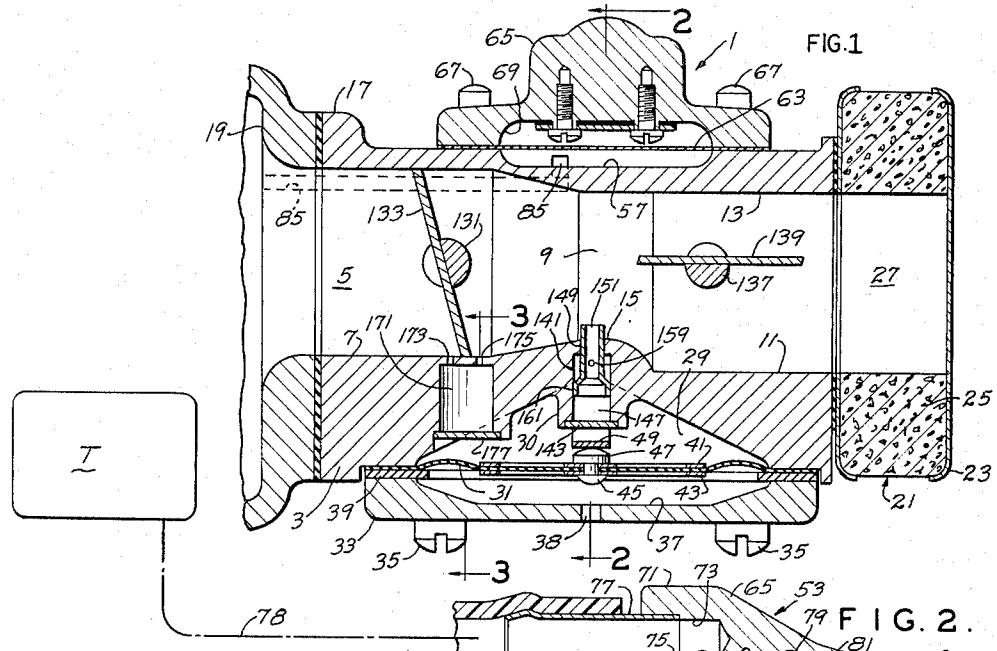
Feb. 15, 1966 C. L. MARTIN ETAL 3,235,238

CARBURETOR

Filed May 13, 1963

FIG. 1



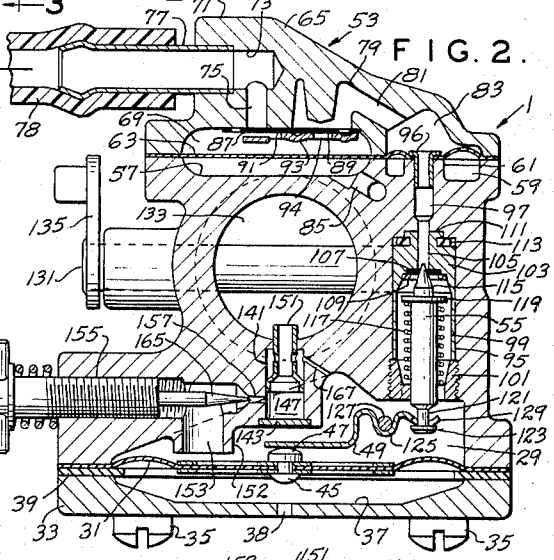


FIG. 2.

FIG. 3.

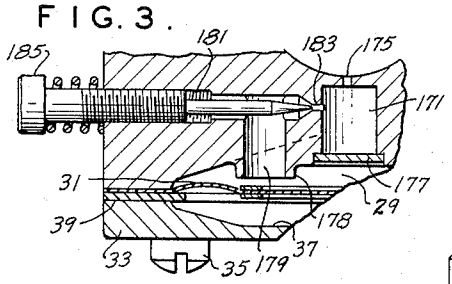


FIG. 4.

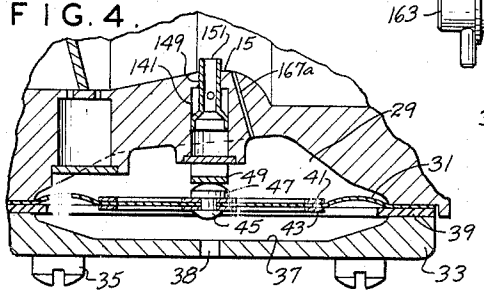


FIG. 5.

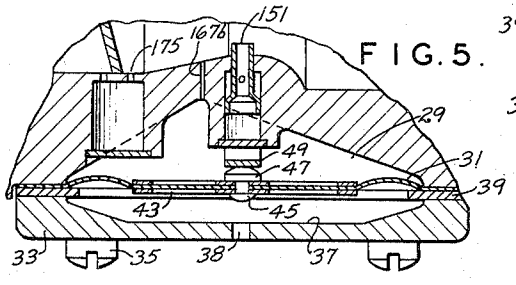
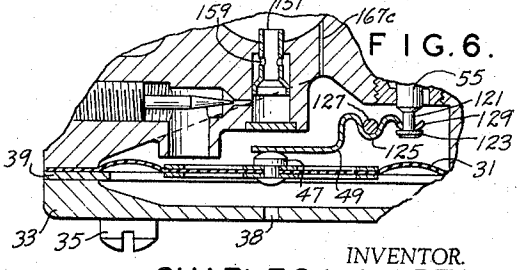


FIG. 6.



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3,235,238

CARBURETOR

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6 Claims. (Cl. 261—69)

This invention relates to carburetors, and more particularly to carburetors of the class having a diaphragm for control of fuel admission thereto.

The invention is especially concerned with carburetors of the class described for small internal combustion engines, such as are used on power saws, for example, where ability to operate in any position, even upside down, is important. For such application, flat-type carburetors are generally unsuitable, and a diaphragm-type carburetor is preferred. A typical diaphragm-type carburetor has a fuel chamber closed by a diaphragm which is subject on the outside to atmospheric pressure. The diaphragm actuates a valve controlling admission of fuel to the fuel chamber from a fuel supply tank. Fuel is adapted to be supplied from the fuel chamber to the mixture conduit of the carburetor via a so-called high-speed fuel system by pressure of the diaphragm on the fuel in the fuel chamber, resulting from vacuum drawn in the mixture conduit on operation of the engine.

In such a carburetor, the fuel chamber acts in effect as a sensing chamber, sensing the demand for fuel as reflected by the position of the throttle valve of the carburetor. The sensing function of the fuel chamber is generally based on what may be termed a solid fuel condition in the chamber, meaning a condition in which the chamber is substantially free of bubbles of air or fuel vapor. Accuracy of sensing is adversely affected by the presence of such bubbles in the chamber, noting that such bubbles are compressible whereas liquid fuel without bubbles therein (which may be referred to as solid fuel) is not compressible. For example, if there should be a substantial accumulation of bubbles in the fuel in the fuel chamber, pressure of the diaphragm on the fuel and bubbles in the chamber may initially result merely in compression of the bubbles without delivery of fuel to the mixture conduit in the amount of demand. This results undesirably in lag of delivery of fuel. Air may enter the fuel chamber due to what may be referred to as back bleeding, resulting from fuel being pulled out of the high speed system on account of suction from the idle system of the carburetor, with resultant diminution of fuel in the high-speed system and entry of air to replace the lost fuel. This results in fuel being taken away from the nozzle of the high-speed system with the result that when the throttle is opened for acceleration from idle, there may be a lag in delivery of fuel to the nozzle.

Accordingly, among the several objects of the invention may be noted the provision of a carburetor of the class described which is so constructed that bubbles of air and fuel vapor are purged from the fuel chamber to maintain a better solid fuel condition in the fuel chamber for more accurate sensing of fuel demand, and also so that back bleeding is minimized, thereby providing for more accurate sensing of fuel demand and tending to avoid lag in delivery of fuel to the mixture conduit of the carburetor on acceleration; and the provision of a carburetor such as described which is economical to manufacture and reliable in operation even in extreme positions, including upside down position. In general, the stated objects are accomplished by a special formation of the fuel chamber of the carburetor and by special passage means extending from the fuel chamber to the mixture conduit for purging the chamber. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which several of various possible embodiments of the invention are illustrated,

FIG. 1 is a longitudinal section of a diaphragm-type carburetor constructed in accordance with this invention;

FIG. 2 is a traverse section taken generally on line 2—2 of FIG. 1, showing the high-speed fuel system of the carburetor, a fuel tank and a line from the tank to the carburetor being illustrated diagrammatically;

FIG. 3 is a fragmentary section of the carburetor shown in FIG. 1, taken generally on line 3—3 of FIG. 1;

FIG. 4 is a fragmentary section of a modified version of the carburetor taken generally on the same line as FIG. 1;

FIG. 5 is a view similar to FIG. 4 illustrating another version of the carburetor; and

FIG. 6 is a fragmentary section of a third modified version of the carburetor taken on the same line as FIG. 2.

Corresponding reference characters indicate corresponding parts throughout at the several views of the drawings.

Referring to the drawings, a carburetor constructed in accordance with this invention, and generally designated 1, is shown to comprise a main body 3 formed to provide a mixture conduit 5 extending therethrough from one end to the other. As appears in FIG. 1, the mixture conduit 5 is formed to form a cylindric throttle bore 7 toward one end, an intermediate venturi section 9, and an inlet section 11 toward its other end. The latter is generally cylindric, but with a flat as indicated at 13. The throat (the region of smallest cross section) of the venturi is indicated at 15. Body 3 has a flange 17 at the said one end of the mixture conduit (which constitutes its downstream end) for attaching the carburetor to the intake manifold 19 of an internal combustion engine as appears in FIG. 1, the flange being provided with suitable bolt holes (not shown) for receiving bolts extending from the intake manifold for this purpose.

An air filter 21 is attached in suitable manner to the body 3 at the upstream end of the mixture conduit. As appears in FIG. 1, this air filter is of a type comprising a casing 23 containing an annular filter element 25. The hole in the center of the filter element is indicated at 27. This hole is aligned with the mixture conduit 5. Air enters the filter peripherally, flows through the filter element to the hole 27, and thence through the mixture conduit during the operation of the engine.

Body 3 is formed with a recess 29 of circular outline in one side thereof (its bottom side as appears in the drawings). This recess, which constitutes a fuel chamber, is generally dome-shaped. Body 3 has a portion 30 extending down and from one side of the recess into the center of the recess. The center of the recess is generally in the plane of the venturi throat 15. The fuel chamber is closed by a flexible diaphragm 31 (made of fuel-resistant synthetic rubber, for example). The margin of the diaphragm 31 is clamped against the body by a cover 33, fastened to the body by screws as indicated at 35. Cover 33 is recessed as indicated at 37 and has a vent hole 38. A gasket 39 is interposed between the margin of the diaphragm and the cover. The central portion of the diaphragm is maintained substantially flat and rigid by a pair of flat spoked wheel-like backing member 41 and 43 lying on opposite faces of the diaphragm, and held in as-

sembly with the diaphragm by a rivet **45** having its shank extending through a center hole in the diaphragm and center holes in members **41** and **43**. The inner end head of the rivet is in the form of a button **47** for engagement by one end of a valve-actuating lever **49**.

Fuel is adapted to be supplied to fuel chamber **29** from a fuel tank T, the carburetor including fuel pump means as generally indicated at **53** for pumping fuel to chamber **29**, and a needle valve **55** controlled by the aforementioned lever **49** for controlling delivery of fuel to the fuel chamber **29**. For purposes of providing the fuel pump means, body **3** is formed with a shallow circular recess **57** constituting a pulsation chamber in the side thereof (its top side as shown) opposite the chamber **29** and, laterally offset from this recess **57**, with an annular cavity **59** surrounding a boss **61**. Recess **57** and cavity **59** are closed by a flexible pump diaphragm **63** (made of fuel-resistant synthetic rubber, for example) clamped against the body all around the recess **57** and the cavity **59** by a pump cap **65**. The latter is fastened to the body by screws as indicated at **67**. It has a recess **69** constituting a pumping chamber on the opposite side of the diaphragm from recess or pulsation chamber **57**.

The pump cap is formed with an upwardly extending boss **71** having a horizontal hole **73** extending inward from one side of the carburetor and a vetrical hole **75** extending down from the inner end of hole **73** to the pumping chamber **69**. Holes **73** and **75** together constitute a fuel inlet passage. A nipple **77** pressed in the end of hole **73** is adapted for connection of a fuel line **78** leading from the fuel tank T. The pump cap is also formed with an outlet dome **79** which opens upward from pumping chamber **57** alongside hole **73**, from which there is an inclined outlet passage **81** to a cavity **83** in the pump cap on the opposite side of pump diaphragm **63** from the annular cavity **59**. From the pulsation chamber **57** there is a passage **85** through the body **3** of the carburetor for communication between the intake manifold **19** and pulsation chamber **57**. Pressure pulsations such as occur in the intake manifold (as in the case of a two-cycle engine, for example) are transmitted through passage **85** to chamber **57** and cause flexing of pump diaphragm **63**. Fuel is thereby drawn into pumping chamber **69** from tank **51** through inlet passage **73**, **75** on downstrokes of diaphragm **63** and forced out of pumping chamber **69** on upstrokes of the diaphragm **63** through outlet chamber **79** and outlet passage **81** under control of flapper-type inlet and outlet check valves **87** and **89**. These are formed by C-shaped cuts in a valve member consisting of a disk **91** of fuel-resistant synthetic rubber, for example, held in place by a retainer **93**. The inlet flapper valve **87** flexes down to open when diaphragm **63** flexes down (outlet check **89** then being closed), and flexes up to close off the lower end of hole **75** when diaphragm **63** flexes up. The outlet flapper valve **89** flexes up to open when diaphragm **63** flexes up (inlet check **87** then being closed) and flexes down to close off an outlet hole **94** in retainer **93** when diaphragm **63** flexes down.

Body **3** has a cylindric pocket **95** extending up from fuel chamber **29** alongside the mixture conduit **5**, this pocket being aligned with the aforementioned boss **61**. A passage **97** extends down through the boss **61** and the body **3** to the upper end of the recess **95**. A flanged tubular fitting **96** pressed in the upper end of passage **97** holds down the pump diaphragm **63**. A tubular cylindric needle valve body **99** is received in recess **95**, being held in recess **95** by a screw-threaded fitting **101** threaded in the lower end of this recess. The needle valve body **99** has an upper end head **103** provided with an axial bore **105** forming a continuation of passage **97**. A resilient valve seat **107**, consisting of a disk of fuel-resistant synthetic rubber, for example, having a center hole, is retained at the bottom of the head **103** as by a ring **109** pressed into the needle valve body. The latter has a reduced extension **111** from the upper end of head **93** having

an annular groove receiving an O-ring **113** for sealing against body **3** at the upper end of recess **95**.

Fitting **101** has a central opening slidably receiving the stem of needle valve **55**, the latter having a tapered nose **115** at its upper end for engagement with valve seat **107**. The opening in the fitting is formed for flow of fuel therethrough around the stem of the needle valve. A coil compression spring **117** surrounding the needle valve reacts from the lower end of retainer **101** against a collar **119** on the needle valve to bias the needle valve to a closed position engaging the valve seat **107**. The needle valve has an annular groove **121** at its lower end providing a lower end head **123** on the needle valve. The valve-actuating lever **49** comprises a metal strip bent as indicated at **125** to form an upwardly opening loop. Lever **49** is pivoted intermediate its ends on a pivot pin **127** received in loop **125**. This pin extends parallel to the axis of the mixture conduit **5** across the upper portion of the fuel chamber **29**. Lever **49** thus extends laterally in respect to the carburetor and has its inner end overlying button **47** on the control diaphragm **31**. The outer end of the lever is forked as indicated at **129** and straddles the needle valve **55** within the groove **121** above the lower end head **123** of the needle valve.

A throttle shaft **131** is journalled in body **3** extending laterally across throttle bore **7** of the mixture conduit **5**. Shaft **131** carries a throttle **133** constituted by an elliptical sheet metal plate, and has an operating arm **135** on one end. A choke shaft **137** is journalled in body **3** extending laterally across the inlet section **11** of mixture conduit **5**. Shaft **137** carries a choke **139** constituted by a sheet metal plate, and, as will be understood, has an operating arm (not shown) on one end.

Body **3** is formed with a hole **141** extending up from the center of fuel chamber **29** through the projection **30** to mixture conduit **5**, this hole being closed at its lower end by plug **143**. Hole **141** is stepped, having an enlarged portion **147** forming a fuel well and a smaller upper portion **149**. A nozzle **151** is received in the hole **141**. This nozzle comprises a tubular element with an upper portion having an outside diameter corresponding to the diameter of the upper portion **149** of hole **141**, and a lower portion having a diameter corresponding to the lower portion **147** of hole **141**. The tubular element is pressed into the hole. The lower end of the nozzle extends into the fuel well **147** and the top of the nozzle extends up into the venturi throat **15**.

Body **3** is provided with a tubular extension **152** extending down from the body alongside hole **141** (on the side thereof opposite the needle valve pocket **95**) to a point between lever **49** and diaphragm **31**. The tubular extension **152** and body **3** have a common cavity **153** extending up from the fuel chamber **29**. It will be seen that cavity **153** opens into the fuel chamber in close proximity to diaphragm **31**. Cavity **153** is intersected by a lateral horizontal hole **155** which at its inner end is in communication with the fuel well **147** via an orifice **157**. The upper portion of the nozzle has ports **159**, the purpose of which will become apparent hereinafter, and the lower portion of the nozzle is open a its lower end **161** for communication from the fuel well **147** to the interior of the nozzle. Cavity **153**, hole **155**, orifice **157**, fuel well **147**, and the passage in nozzle **151** constitute the high-speed fuel circuit or system of the carburetor, fuel being adapted to flow therethrough from chamber **29** to the mixture conduit upon opening throttle **133** and resultant flow of air through the mixture conduit. The flow is adapted to be metered by a high speed system adjusting screw **163** threaded in hole **155** and having a small diameter pointed-end extension **165** reaching to the orifice **157**.

In accordance with this invention, body **3** is formed with a small bleed passage **167** extending from the upper part of the dome-shaped chamber **29** to the upper part of the fuel well **147**. Air and fuel vapor are adapted to escape through bleed **167** from dome-shaped fuel chamber

29 to the space around nozzle 151 at the upper part of hole 141, and thence pass through ports 159 and out of the nozzle 151 into the mixture conduit.

Downstream from hole 141, body 3 has a cavity 171 (see FIGS. 1 and 3) in the central longitudinal plane of the mixture conduit 5 extending up from fuel chamber 29. An idle port 173 opens from the upper end of this cavity into the mixture conduit 5 downstream from the closed throttle 133. An idle air bleed hole 175 opens into the upper end of this cavity from mixture conduit 5 upstream of the closed throttle. The lower end of cavity 171 is closed by a plug 177. Body 3 has a downwardly extending tubular projection 178 extending down into the fuel chamber alongside cavity 171 to a point adjacent diaphram 31. The downwardly extending projection 178 and body 3 form a cavity 179 extending up from the fuel chamber 29. It will be seen that cavity 179 opens into the fuel chamber in close proximity to diaphragm 31. Cavity 179 is intersected by a lateral horizontal hole 181 which at its inner end is in communication with cavity 171 via an orifice 183. Cavity 179, hole 181, orifice 183, cavity 171 and port 173 constitute the low-speed or idle system of the carburetor, fuel being adapted to flow therethrough from fuel chamber 29 to the mixture conduit 5, and air mixing with the fuel via port 175. The flow is adapted to be metered by an idle adjusting screw 185 threaded in hole 181 reaching to the orifice 183.

Operation is as follows:

On starting the engine (choke 139 set in starting position for limited supply of air to mixture conduit 5, and throttle 133 opened), fuel for starting is delivered from fuel chamber 29 to mixture conduit 5 via the high-speed circuit, i.e., cavity 153, hole 155, orifice 157, fuel well 147 and the passage in nozzle 151, and via the low-speed circuit, i.e., cavity 179, hole 181, orifice 183, cavity 171 and ports 173 and 175. The fuel mixes with air flowing through the mixture conduit. The large amount of fuel delivered to the mixture conduit 5 through the high-speed and idle systems provides a relatively rich air/fuel mixture for starting.

After the engine has started and warmed up, choke 139 may be fully opened, and throttle 133 controlled as desired for high speed operation. As previously noted, intermediate section 9 of mixture conduit 5 is restricted to provide a venturi effect such as to generate a partial vacuum in the mixture conduit in the region of high speed fuel nozzle 151 to draw fuel out of chamber 29. Diaphragm 31 is subject on its outer side to atmospheric pressure through vent hole 38. As fuel is taken out of chamber 29, diaphragm 31 moves inwardly against the bias of spring 117 to open the valve 55 through the action of lever 49. Fuel flows into chamber 29 to replace fuel leaving through nozzle 151.

It is to be noted that any air bubbles in the fuel in the fuel chamber will rise into the upper dome portion of the chamber 29. Similarly, fuel vapor resulting from volatilization of fuel collects in the dome. During high speed engine operation with the throttle away from its closed position, air pressure in the venturi throat 15 is less than that in chamber 29, as described. Therefore, in accordance with this invention, air and vapor are forced through the bleed passage 167 and the holes 159 in the nozzle 151 to be discharged into the mixture conduit with the fuel. Thus, the fuel chamber is purged of air and fuel vapor to maintain a better solid fuel condition in fuel chamber 29 . During high speed operation, after air and vapor are purged through passage 167, fuel from chamber 29 will pass through passage 167 into the fuel well 147.

Also, in accordance with this invention, the lower extremities of the tubular projections 152 and 178 reach down well below the level of the fuel in the fuel chamber 29 so as to tend to prevent air and fuel vapor from being drawn directly into the tubular extensions from above the level of the fuel.

For engine idling, throttle 133 is returned to its FIG. 1 position. A partial vacuum is drawn downstream from the throttle, and this induces a flow of fuel from fuel chamber 29 to mixture conduit 5 downstream from the throttle via cavity 179, hole 181, orifice 183, hole 171 and port 173.

During idle operation, the air in mixture conduit 5 upstream of throttle 133 is substantially atmospheric. The fuel pressure in chamber 29 is subatmospheric due to the manifold vacuum acting through the idle circuit. Thus there is a pressure differential across the main fuel circuit between nozzle 151 and chamber 29, which tends to bleed small amounts of air into the chamber 29 during idle operation. This air passes through nozzle 151 and the main fuel circuit into chamber 29. The close spacing between needle end 165 and passage 157 minimizes this air flow. Air which thus bleeds into chamber 29 during idle will pass upwardly in chamber 29 and collect in the upper pockets of the dome of chamber 29.

During engine idle operation, air is prevented from bleeding into chamber 29 through passage 167, by forming passage 167 with a diameter around 0.040 inch. With the passage 167 filled with fuel, capillary action of the fuel tends to seal passage 167 to block the flow of air into chamber 29. However, at high speed engine operation, the pressure drop across passage 167 is greater than during idle operation so that the capillary seal is broken for purging chamber 29, as described.

Thus, with the above described construction, bubbles of air and fuel vapor are purged from the fuel chamber 29 into the mixture conduit in the region of nozzle 151 to maintain a better solid fuel condition in the chamber and back bleeding is minimized for more accurate sensing of fuel demand and so that lag in fuel delivery on acceleration is avoided.

FIG. 4 illustrates a modification which in all respects is the same as the embodiment of the invention shown in FIGS. 1–3 except that chamber 29 has a somewhat different shape, and the bleed specially designated 167*a* extends from the upper portion of the dome-shaped chamber 29 to the mixture conduit 5, opening into mixture conduit immediately upstream of the nozzle 151.

FIG. 5 illustrates another modification which is in all respects the same as the embodiment of the invention shown in FIGS. 1–3 except that the bleed specially designated 167*b* extends from the upper portion of the dome-shaped fuel chamber 29 to the mixture conduit 5 immediately downstream from the nozzle 151.

FIG. 6 illustrates another modification which is in all respects the same as the embodiment of the invention shown in FIGS. 1–3 except that the bleed specially designated 167*c* extends from the upper portion of the dome-shaped fuel chamber 29 to the mixture conduit 5 generally in the same transverse plane as the nozzle 151 and alongside the nozzle.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A carburetor having a mixture conduit, a fuel source, means defining a dome-shaped fuel chamber, a diaphragm closing the bottom of said fuel chamber and means for moving said diaphragm by differential pressure, a fuel inlet delivering fuel from said source to said fuel chamber, means including a valve for controlling said fuel inlet, means including a lever controlled by movement of said diaphragm for sensing the fuel requirements and controlling said inlet valve, means defining a high speed fuel system for delivery of fuel from said fuel chamber to said mixture conduit, said means defining said high speed

system including a tubular fuel inlet conduit extending downward from the means defining said dome-shaped fuel chamber and terminating at a level between said lever and said diaphragm and a high speed fuel nozzle extending into said mixture conduit, means defining a passage connecting said tubular inlet conduit with said nozzle, and a bleed passageway having an opening immediately adjacent said fuel nozzle at one end and opening into the uppermost portion of said dome-shaped fuel chamber at its other end for purging air and vapor from said fuel chamber to maintain a solid fuel condition therein for more accurate sensing of the fuel demand.

2. A carburetor as set forth in claim 1 wherein said high speed system further comprises a fuel well in communication with said chamber, said nozzle extends into said well, and said bleed opens into said well.

3. A carburetor as set forth in claim 1 wherein said bleed opens into said mixture conduit adjacent said nozzle.

4. A carburetor as set forth in claim 1 wherein said bleed opens into said mixture conduit generally in the transverse plane of the fuel nozzle.

5. A carburetor as set forth in claim 1 wherein said high-speed fuel system further comprises a hole forming a fuel well, said hole having an upper portion smaller in diameter than said fuel well, said nozzle having an upper portion extending through the upper portion of said hole and a lower portion of larger diameter than the upper portion of the nozzle and in engagement with the wall of the fuel well to close the upper portion of the fuel well, said nozzle having ports therein between the upper portion of said hole and the lower portion of said nozzle, said bleed opening into the upper portion of said fuel well.

6. A carburetor as set forth in claim 1 wherein said high-speed fuel system further comprises a hole forming a fuel well, said hole having an upper portion smaller in diameter than said fuel well, said nozzle having an upper portion extending through the upper portion of said hole and a lower portion of larger diameter than the upper portion of the nozzle and in engagement with the wall of the fuel well to close the upper portion of the fuel well, said nozzle having ports therein between the upper portion of said hole and the lower portion of said nozzle.

References Cited by the Examiner

UNITED STATES PATENTS

2,724,585	11/1955	Armstrong	261—69
2,979,312	4/1961	Phillips.	
2,984,465	5/1961	Hazzard.	
3,090,608	5/1963	Phillips.	

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