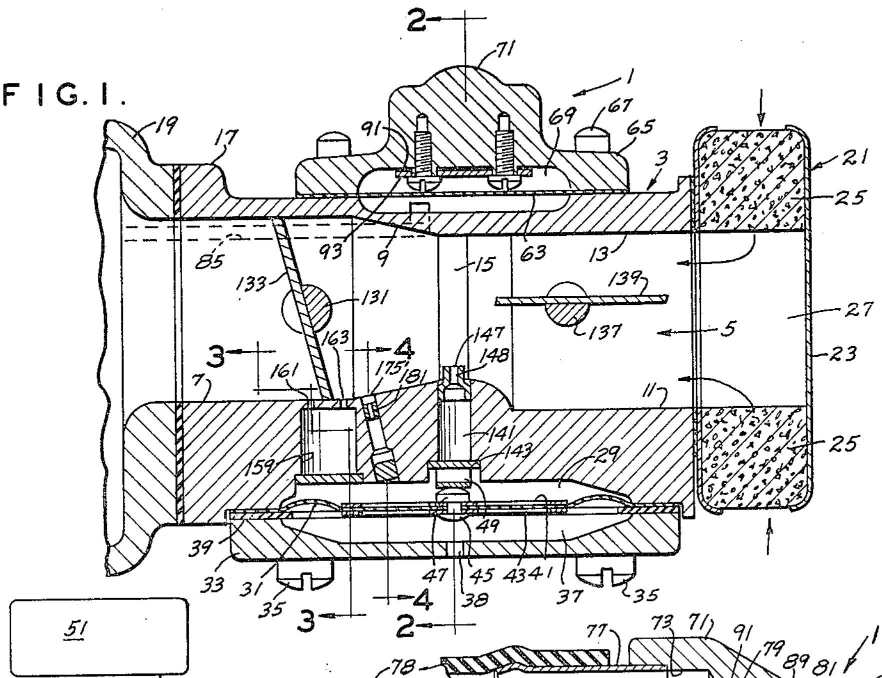
Jan. 26, 1965 — M. C. BROWN ETAL — 3,167,599

CARBURETOR

Filed Sept. 28, 1962

FIG. 1.



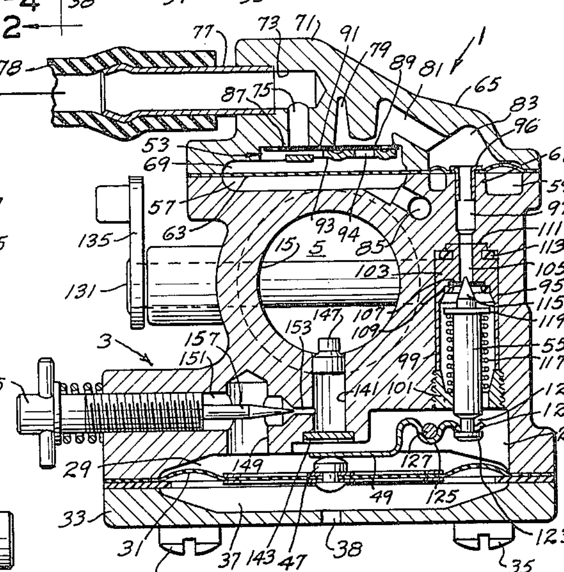


FIG. 2.

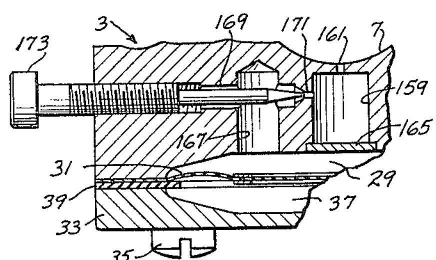


FIG. 3.

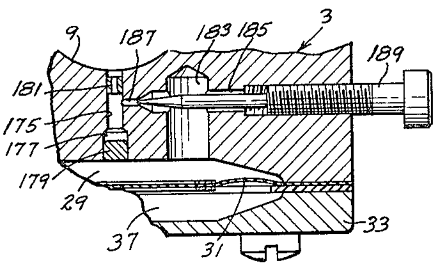


FIG. 4.

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CARBURETOR

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This invention relates to carburetors, and more particularly to carburetors of the diaphragm type, by which is meant a carburetor as to which delivery of fuel to a fuel chamber of the carburetor is controlled by a diaphragm, as distinguished from being controlled by a float.

The invention is particularly applicable to a small diaphragm-type carburetor for small internal combustion engines such as are used in portable tools (chain saws, for example), in lawn mowers, small automotive vehicles such as are sometimes called go-carts, etc.

Peak performance of any carburetor requires that the carburetor include an acceleration system for supplying additional fuel to the mixture conduit of the carburetor when the throttle of the carburetor is opened quickly to produce rapid acceleration of the engine, in order to avoid leaning of the air/fuel mixture and lag in response. In a conventional carburetor, the acceleration system includes a pump actuated on opening the throttle to pump fuel into the mixture conduit. Among the several objects of this invention may be noted the provision in a diaphragm-type carburetor, and particularly a small carburetor of this class, of an acceleration system adapted without any pump to supply additional fuel to the mixture conduit on opening of the throttle for fast acceleration; and the provision, in a carburetor of the class described having a high speed fuel system for delivery of fuel to the mixture conduit when the throttle is opened and an idle system for delivery of fuel and air to the mixture conduit downstream from the throttle when the throttle is at idle, of an acceleration system such as described which is reliable in operation and economical to provide. In general, the acceleration system of this invention is characterized in that it comprises a passage independent of the idle and high speed systems of the carburetor interconnecting the fuel chamber of the carburetor and the mixture conduit and opening into the mixture conduit at a point located upstream from the throttle idle position. 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 one of various possible embodiments of the invention is illustrated:

FIG. 1 is a longitudinal section of a diaphragm-type carburetor having an acceleration system of this invention;

FIG. 2 is a transverse section taken generally on line 2—2 of FIG. 1; and

FIGS. 3 and 4 are fragmentary sections taken generally on lines 3—3 and 4—4, respectively, of FIG. 1.

Corresponding reference characters indicate corresponding parts throughout 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 have 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, as indicated by the arrows in FIG. 1, 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 shallow recess **29** of circular outline in one side thereof (its bottom side as appears in the drawings). This recess, which constitutes a fuel chamber, has its center generally in the plane of the venturi throat **15**, and 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 members **41** and **43** lying on opposite faces of the diaphragm, and held in assembly with the diaphragm by a rivet **45** having its shank entered in 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 **51** as shown in FIG. 2, 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 vertical 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 **51**. The pump cap is also formed with an outlet dome **79** which opens upward from pumping chamber **69** alongside hole **75**, 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 the recess or fuel chamber 29 alongside the mixture conduit 5, this pocket 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 an upward extension 29*a* 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 fuel chamber 29 to mixture conduit 5, this hole being closed at its lower end by a plug 143 to form a fuel well. A nozzle 147 is pressed in the upper end of hole 141. Nozzle 147 is restricted as indicated at 148 and extends up into the venturi throat 15.

Body 3 has a cavity 149 extending up from fuel chamber 29 alongside the hole or fuel well 141 (on the side thereof opposite the needle valve pocket 95). This cavity is intersected by a lateral horizontal hole 151 which at its inner end is in communication with the fuel well 141 via an orifice 153. Cavity 149, hole 151, orifice 153, fuel well 141 and nozzle 147 constitute the high speed fuel system of the carburetor, fuel being adapted to flow therethrough from chamber 29 to the mixture conduit 5 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 155 threaded in hole 151 and having a small-diameter pointed-end extension 157 reaching to the orifice 153.

Downstream from fuel well 141, body 3 has a cavity 159 (see FIGS. 1 and 3) in the central longitudinal plane of the mixture conduit 5 extending up from fuel chamber 29 and forming a fuel well. An idle port 161 opens from the upper end of this cavity into the mixture conduit 5 downstream from the closed throttle 133. An idle air bleed 163 opens into the upper end of this cavity from mixture conduit 5 upstream of the closed throttle. The lower end of cavity 159 is closed by a plug 165. Body 3 has a cavity 167 extending up from fuel chamber 29 alongside cavity 159. Cavity 167 is intersected by a lateral horizontal hole 169 which at its inner end is in communication with cavity 159 via an orifice 171. Cavity 167, hole 169, orifice 171, cavity 159 and port 161 constitute the low speed or idle system or circuit of the carburetor, fuel being adapted to flow therethrough from fuel chamber 29 to the mixture conduit 5, air mixing with the fuel via port 163. The flow of idle fuel is adapted to be metered by an idle adjusting screw 173 threaded in hole 169 reaching to the orifice 171.

In accordance with the invention, means are provided to permit rapid acceleration of the engine upon rapid opening of the throttle. Between hole 159 and fuel well 141, body 3 is formed with an inclined hole 175 (FIGS. 1 and 4) extending up from fuel chamber 29 to mixture conduit 5. The lower end of the hole has an enlarged portion 177 and is plugged as indicated at 179. A restriction 181 is pressed into hole 175 adjacent its upper end. Body 3 has a cavity 183 extending up from fuel chamber 29 alongside hole 175. This is intersected by a lateral horizontal hole 185 which at its inner end is in communication with hole 175 below restriction 181 via an orifice 187. Cavity 183, hole 185, orifice 187, hole 175 and restriction 181 constitute the acceleration system for the carburetor, fuel being adapted to flow therethrough from fuel chamber 29 directly to the mixture conduit 5 when the throttle is opened for fast acceleration. The flow of fuel through the acceleration system is adapted to be metered by an acceleration adjusting screw 189 threaded in hole 185 reaching to the orifice 187. It is to be noted that the acceleration system is entirely independent of the idle and high speed fuel systems.

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 system, i.e., cavity 149, hole 151, orifice 153 (metered by screw 155), fuel well 141 and nozzle 147, via the low speed circuit, i.e., cavity 167, hole 169, orifice 171 (metered by screw 173), cavity 159 and ports 161 and 163, and via the acceleration system, i.e., cavity 183, hole 185, orifice 187 (metered by screw 189), hole 175 and restriction 181. This fuel mixes with air flowing through mixture conduit 5 to provide 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 the high speed nozzle 147. This induces flow of fuel from fuel chamber 29 to mixture conduit 5 via cavity 140, hole 151, orifice 153, fuel well 141 and nozzle 147. The air flowing through mixture conduit 5 is mixed with the fuel emitted from nozzle 147.

Diaphragm 31 is subject on its outerside to atmospheric pressure via vent 38, and is adapted to move inward against the bias of spring 117 (exerted on the button 47 through lever 49 and valve 55) in response to decrease in pressure in fuel chamber 29 as results upon delivery of fuel from chamber 29 to mixture conduit 5. Upon inward movement of the diaphragm, lever 49 is rocked clockwise as viewed in FIG. 2, pulling needle valve 55 open for delivery of fuel to chamber 29 to replace fuel delivered from the chamber to the mixture conduit.

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 the fuel chamber 29 to mixture conduit 5 downstream from the throttle via cavity 167, hole 169, orifice 171 (metered by screw 169), hole 159 and port 161. Air bleeds through port 163 into hole 159 for mixture with fuel flowing therethrough to port 161.

A disadvantage of some curburetors of the type described is that, during low speed operation with the throttle closed, the flow of fuel from the fuel chamber 29 through the idle passages may tend to lower the fuel level in the main fuel well 141, immediately adjacent to the nozzle 147. When, upon quick acceleration, the throttle 133 is moved to a full open position, fuel delivery to the engine goes through a transition of fuel flow from the idle fuel circuit to fuel flow through the main fuel circuit. If the fuel level in the main fuel well 141 is low, there is no immediate flow of fuel from the nozzle 147 when needed and a stumbling of the engine takes place, or, if there is insufficient fuel flow from the nozzle, the engine may stop completely. Thus when there is a demand for rapid acceleration of the engine, the carburetor inherently should provide a sufficient amount of fuel for this purpose.

Therefore, in accordance with the invention, the accelerating system described above, operates so that as the throttle 133 moves from its idle or low speed position, shown in FIG. 1, an additional source of fuel from passage 175 will be supplied through the restriction 181 to mix with the additional air flow through the mixture conduit 5. This additional flow of fuel is provided by the fact that as the throttle moves between the idle bleed port 163 and the accelerating fuel passage 175, air flowing rapidly around the edge of the throttle provides a pressure depression at this point such that the greater fuel pressure within the fuel chamber 29 forces fuel up through passage 175 and into the air stream. This result occurs even before the edge of the throttle 133 reaches the opening of passage 175 and while the throttle is still somewhat downstream of passage 175. Flow of fuel through passage 175 continues as the throttle sweeps past the opening of the passage 175 to a point upstream of the passage. At full open throttle or at high speed there is still provided some fuel delivery through passage 175 due to the lower pressure within the mixture conduit at that point. However, the maximum flow of fuel through the passage 175 is when the edge of the throttle is in the region adjacent to the oepning of passage 175 so that the rapid flow of air between the edge of the throttle 133 and passage 175 sucks a maximum amount of fuel into the mixture passage.

In this manner then sufficient fuel is provided to the engine during the opening of the throttle from its low speed position in FIG. 1. This additional fuel through the accelerating passage 175 prevents any stumbling or

loss in speed of the engine and instead provides a rapid acceleration of the engine. This then results in a smooth transition from low speed to high speed operation of the engine and enables sufficient time for the nozzle 147 to go into operation and to deliver fuel to the engine as intended.

The size of the restriction 181 and the adjustment of needle 189 are chosen to provide the desired amount of fuel for engine acceleration and are determined by the engine characteristics. The accelerating system is entirely independent of the idle system. The idle system operates at closed or nearly closed throttle and the operation of the accelerating system only occurs as the throttle moves within a region adjacent to the accelerating orifice 175'. Adjustment of the idle screw 173 thus has no effect on the operation of the accelerating circuit.

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 comprising a body having a mixture conduit extending therethrough and a fuel chamber at one side of said body, a diaphragm closing said fuel chamber, means for delivering fuel to said chamber controlled by said diaphragm, said mixture conduit being formed to provide a venturi, a rotatable throttle shaft extending across said mixture conduit downstream from said venturi, a throttle on said shaft, an independent high speed fuel system comprising a first fuel well in said body located between said fuel chamber and mixture conduit, a high speed fuel nozzle connecting said first fuel well with the mixture conduit at the throat of the venturi, a passage connecting said fuel chamber and fuel well, a first means for metering the flow of fuel through said passage to the fuel well, an independent acceleration system comprising a second well and an accelerating port opening from said second well into the mixture conduit at a point between said nozzle and said throttle when in closed position at which said accelerating port is traversed by the edge of said throttle when the throttle is moved toward wide open position, a separate passage connecting the second well and said fuel chamber, a second and separate means for metering the flow of fuel through said last-named passage, and an independent idle system including an idle port downstream from the high speed fuel nozzle for delivery of fuel from the fuel chamber to the mixture conduit when the throttle is at idle position, a third separate passage connecting said idle port and said fuel chamber, and third and separate means for metering flow of fuel through said idle passage, whereby fuel flow is accelerated from said fuel chamber through said accelerating system independently of the flow of fuel in said high speed and idle systems when said throttle moves to its wide open position and the accelerating port is relatively on the downstream side of the throttle.

2. A carburetor as set forth in claim 1 wherein the first, second and third metering means are each manually adjustable.

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