Sept. 13, 1966 O. E. NEWMAN 3,272,485

CARBURETOR

Filed Sept. 21, 1964 2 Sheets-Sheet 1

FIG. 1.

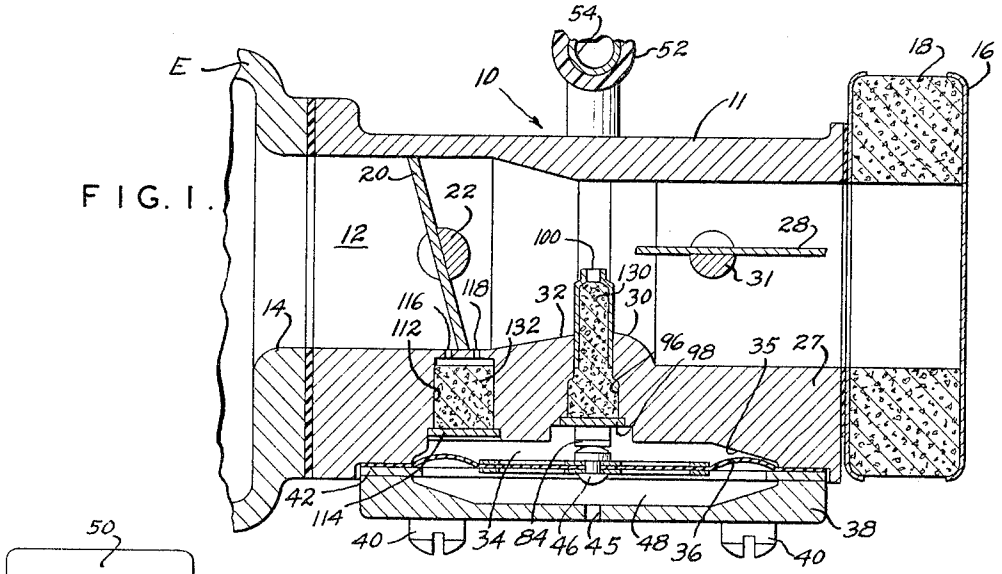



FIG. 2.

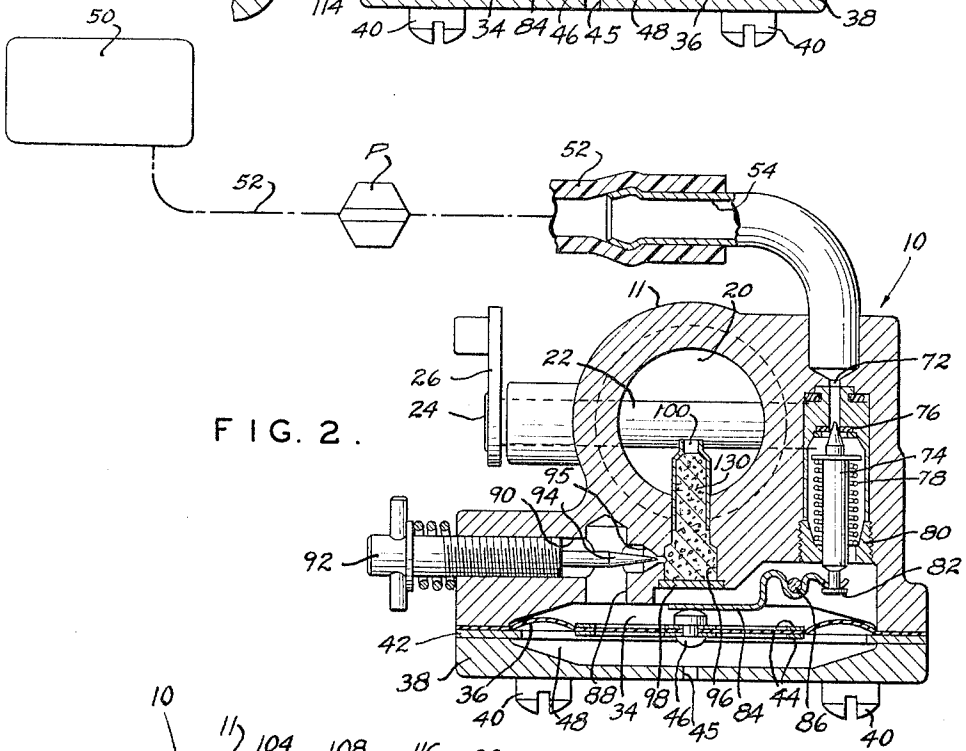
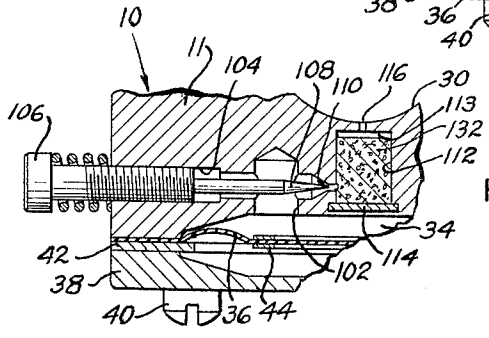



FIG. 3.



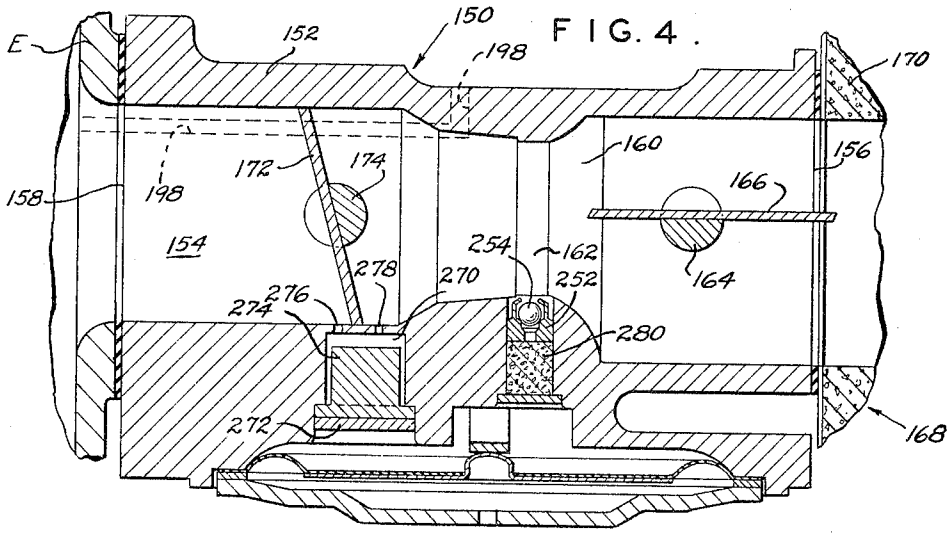

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CARBURETOR

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FIG. 4.



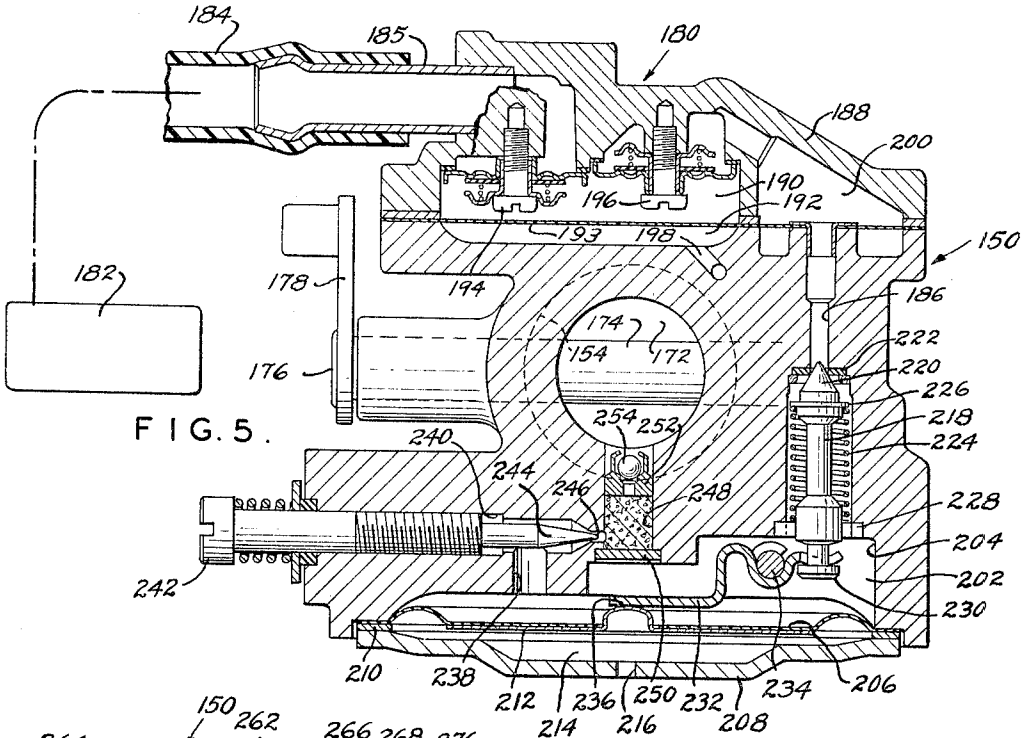




FIG. 5.

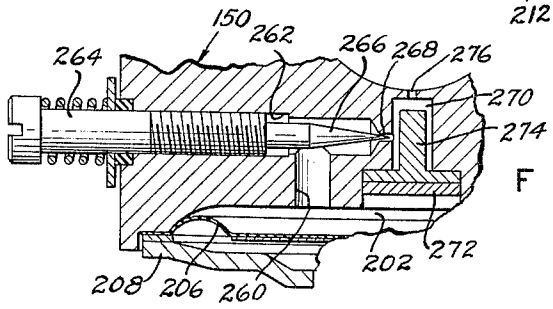



FIG. 6.

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United States Patent Office 3,272,485
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3,272,485

# CARBURETOR

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Filed Sept. 21, 1964, Ser. No. 397,724
4 Claims. (Cl. 261—35)

This invention is directed to a carburetor having a diaphragm fuel chamber for use with small engine applications.

A type of carburetor used with small engines is one in which the fuel is fed to the carburetor through an inlet valve controlled by an air operated diaphragm. The diaphragm also provides a movable wall of a fuel chamber or reservoir supplying fuel to both the high speed nozzle as well as the low speed fuel systems. The use of a diaphragm fuel chamber is to enable the use of the carburetor with internal combustion engines which are installed on tools, which may be operated in various positions. A fuel bow carburetor would not lend itself to such manipulations as readily as a diaphragm carburetor.

A basic requisite in the operation of small internal combustion engines used with some power tools is that there is instant acceleration when the operator opens the throttle quickly from a low speed position to a wide open high speed position. At this time, the operator usually is simultaneously applying a work load to the engine. It is thus necessary that the carburetor instantaneously supply to the engine sufficient fuel that the engine will not falter or stall in its acceleration and with the simultaneous application of a work load.

For optimum rapid acceleration characteristics, it is desirable that the main fuel nozzle of the carburetor open into the venturi throat as nearly as possible to the center thereof because the area of maximum pressure depression exists at the center of the venturi. Placement of the nozzle in the area of maximum pressure depression within the venturi throat allows the flow of fuel from the main fuel nozzle into the mixture conduit to start at the lowest possible speed of air flow through the venturi, thereby causing the reaction time of fuel flow (the elapsed time between opening of the throttle and the flow of fuel out of the nozzle) upon sudden opening of the throttle to be minimized.

A problem of fuel lift arises when the main fuel nozzle is extended to the center of the venturi because of the distance through which the fuel must be moved prior to reaching the nozzle outlet. The time required to move the fuel in the main fuel well from a static fuel level to the nozzle outlet is a portion of the reaction time and must be considered when the carburetor design concerns rapid acceleration. Heretofore it has not been practical to locate the main fuel nozzle outlet at the center of the venturi. It has been found that a minimum reaction time is generally accomplished if the main fuel nozzle opens near the surface of the venturi throat even though a minimum of pressure depression exists in this area of the venturi. The reason for this design is that the time involved in lifting the fuel from the static fuel level to the nozzle outlet at the center of the venturi causes a greater reaction time than the shorter lift of nozzle outlets at the surface of the venturi throat.

It is, therefore, an object of this invention to provide means, in a small diaphragm type carburetor used with manually operated power tools, to provide instant acceleration of the engine from low speed to high speed without danger of stoppage of the engine.

It is a further object of this invention to provide a carburetor for small internal combustion engines which has a main fuel supply able to deliver sufficient fuel instantaneously upon the opening of the throttle to a wide open position.



The invention is directed to a diaphragm carburetor in which the fuel chamber is closed by an inlet valve operated by a movable diaphragm which is responsive to the changes in pressure in the fuel chamber for opening and closing the inlet valve. Between the fuel chamber and the main nozzle of the carburetor is a fuel passage having an enlarged recess therein. A mass of synthetic foam material is pressed into the recess to form a sponge-like structure which will readily absorb the fuel passing through to the main nozzle.

The foregoing, along with additional objects and advantages, will be apparent from the following description of a specific embodiment of the invention, the description being taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a longitudinal sectional view of a carburetor in accordance with the invention connected to an engine.

FIGURE 2 is a sectional view laterally of the carburetor structure of FIGURE 1.

FIGURE 3 is a partial sectional view of a portion of the carburetor of FIGURES 1 and 2 showing a portion of the low speed circuit of the carburetor.

FIGURE 4 is a longitudinal sectional view of an alternate carburetor construction embodying the invention.

FIGURE 5 is a sectional view taken laterally of the carburetor structure of FIGURE 4.

FIGURE 6 is a partial sectional view of a portion of the carburetor of FIGURES 4 and 5, illustrating a portion of the low speed circuit of the carburetor.

FIGURE 1 shows a carburetor **10** in accordance with the invention connected to an engine E partially shown in the figure. The carburetor **10** consists substantially of a tubular member **11** having a longitudinal passageway **12** extending therethrough in alignment with an opening **14** into the engine E. The opening **14** may be a portion of the intake manifold of a four cycle engine or may consist of a portion of the engine crankcase of a two cycle engine. At the other end of the passage **12** from the engine there is mounted an air filter **16** consisting of a sheet metal annular housing filled with an air filtering material **18** which may consist of a type of fiber matting or synthetic plastic foam material through which air may readily pass.

Mounted within the tubular mixture passage is a throttle valve **20** of a circular configuration, which fits across the passage **12** when in its closed position shown in FIGURE 1. To rotate the throttle **20** between an open and a closed position, the throttle is mounted on a shaft **22** journaled in the wall of the tubular conduit **12** and having one end **24** (FIGURE 2) extending outwardly of the carburetor to which is attached an operating lever **26** for throttle operation. Between the throttle **20** and the air filter **18** and within the air horn section **27** of the conduit **12**, there is mounted a circular choke valve structure **28** which is fixed for movement on a choke shaft **31** journaled in the wall of conduit **12**. Manual means are also provided for opening and closing the choke valve **28** when desired. This manual means is not shown in the figures but may be of any well-known and conventional structure. Between the choke shaft **31** and the throttle shaft **22**, the mixture conduit **12** is formed with a restricted portion having a venturi surface **30**, which provides a throat or constriction of the conduit **12** and which is also provided with a flaring skirt portion **32** between the venturi surface **30** and the downstream end of the conduit **12**.

A fuel chamber **34** is provided below the mixture conduit **12**, as viewed in FIGURES 1 and 2. The fuel cham-

ber is formed between a recess 35 in the body 11 of the carburetor and a flexible diaphragm 36 stretched across the recess 35 and sealed around its periphery by the rim of a cap structure 38 fixed to the carburetor body by machine screws 40, as indicated. A fiber washer 42 is fitted between the rim of cap 38 and the periphery of the diaphragm 36. To the center of the diaphragm 36 are fixed a pair of backing plates 44, which are fastened together with the diaphragm inbetween by a rivet 46. Between the diaphragm assembly and the cap 38 is an air chamber 48 to provide control of the diaphragm 36. An aperture 45 through cap 38 connects the air chamber 48 to the atmosphere.

Fuel is delivered into the fuel chamber 34 from a fuel tank or reservoir 50 schematically indicated in FIGURE 2 through an inlet line 52 connected to one end of an inlet fitting 54. Fitting 54 is fitted at its other end into the carburetor body 11 and in connection with an inlet fuel passage 72. Fuel will flow from the tank 50 to the carburetor 10 either by gravity or by means of a fuel pump P placed in line 52 as schematically represented in FIGURE 2. Fuel passage 72 is controlled by a needle valve 74 operating against a resilient seat 76 to control the flow of fuel from the pump P into the fuel chamber 34. The valve 74 is operated in a closed direction by a coil spring 78 axially mounted around the valve 74 and pressing the pointed end of the valve onto the seat 76. The spring 78 is mounted between a flanged end of the valve 74, as shown in FIGURE 2, and a portion of a fitting 80 enclosing the valve 74. The lower end of the valve 74 is formed with a nail head 82 into which a bifurcated end of a lever 84 is fitted. The lever 84 is fulcrumed on a pin 86 mounted within the body cavity 35. The other end of lever 84 rests against the rivet 46 of the diaphragm assembly.

The high speed circuit of the carburetor consists of a recess 88 extending from the fuel chamber 34 into the body 11 of the carburetor to a cross passage 90, in which is threaded an adjustment needle 92. Needle 92 has a tapered end 94 extending into a restricted passage 95 between the bore 90 and a fuel well 96 drilled into the body 11 and separated from the fuel chamber 34 by a disk 98 press-fitted into the body 11. Restricted passage 95 may have an inside diameter of 0.052 inch. A nozzle tube structure 100 having a minimum inside diameter around 0.040 inch at the top, is fitted through the wall of the mixture passage 12 separating it from the fuel well 96. The free end of the tubular nozzle 100, as shown, extends through the venturi surface 30 well into the mixture conduit as shown.

A low speed circuit of the carburetor is shown specifically in FIGURES 1 and 3 and consists of a recess 102 connecting the fuel chamber 34 with a cross passage 104 in which is threaded a low speed control needle 106. In a manner similar to the control needle 92, needle 106 has a tapered end 108 extending into a restricted passage 110 of about 0.035 inch inside diameter connecting the cross passage 104 with a low speed fuel well 112. Well 112 is separated from the fuel chamber 34 by a press-fitted disk 114. An idle port 116 extends from the low speed fuel well 112 into the mixture passage 12 downstream of the throttle 20 in its closed position, as shown in FIGURE 1. A second idle air port 118 connects the idle fuel chamber 112 with the mixture conduit upstream of the closed position of throttle 20.

In operation, turning over the engine E provides a suction within the manifold or crankcase 14 which tends to draw air through the air filter 18 down the mixture passage 12. With the choke valve 28 closed and the throttle valve 20 opened, low manifold pressure downstream of the closed choke 28 will provide a suction or low pressure in the nozzle 100 which is reflected through the fuel passages to the fuel chamber 34. Atmospheric pressure against the underside of the diaphragm 36, as viewed in FIGURES 1 and 2, will press the diaphragm upwardly to open valve 74 and permit fuel to enter the fuel chamber 34. The fuel is then sucked through the recess 88, passage 90 into the fuel well 96 and through the nozzle 100. Fuel will also flow through the low speed system through recess 102, passage 104 into the idle well 112 and out the idle ports 116 and 118. Air sucked around and through the choke valve will mix with this fuel in the mixture conduit to provide an enriched starting air and fuel mixture for the engine.

After the engine starts, the choke valve 28 is opened and for low speed operation, the engine is allowed to operate with the throttle in the closed position shown in FIGURE 1. The area in the mixture passage in the region of the venturi 30 is now substantially at atmospheric pressure so no fuel is urged through the nozzle 100. However, low pressure in the mixture passage 12 downstream of the closed throttle 20 will continue to suck fuel out of the idle port 116. Idle air will flow through the port 118 into the idle well 112 to mix with this fuel to provide air and fuel mixture sufficient for low speed operation of the engine. The optimum amount of fuel flow out of the port 116 is obtained by the adjustment of needle 106.

Upon opening of the throttle 20 to a full open position, air will flow rapidly through the mixture passage in response to the engine. At the venturi restriction 30, the air flow will provide a low pressure region so that the fuel will be urged out of the nozzle 100 by atmospheric pressure on the diaphragm 30. The amount of fuel for optimum high speed engine operation is obtained by the adjustment of the high speed needle 92.

During operation of the engine, the subatmospheric conditions in the region of the venturi 30 or at the idle port 116 are reflected in the fuel well 34, which keeps the fuel in chamber 34 at a subatmospheric pressure. This results in the atmospheric pressure on the lower side of the diaphragm 36 pressing the diaphragm inwardly against the bias of spring 78 to rotate the lever 84 in a clockwise direction, as viewed in FIGURE 2, and holding the valve 74 open. During low speed operation, since the flow of fuel out of the idle port 116 is relatively small, the opening of the valve 74 is to a much less degree than during high speed operation of the engine when a greater amount of fuel flows through the main nozzle 100. During operation of the engine, however, the diaphragm and needle assembly occupy a substantially static or equilibrium position at which the fuel flow past the valve 74 into the fuel chamber 34 equals the flow of fuel out of the chamber 34 into either the high speed circuit or the low speed circuit of the carburetor.

In accordance with the invention, means are incorporated in the carburetor which provide a rapid acceleration of the engine upon sudden opening of the throttle 20. As pointed out above, the carburetor is of the type used with power tools and often with a trigger control for the throttle 20. In such applications the engine is operated either at a low speed which is around 2000 r.p.m. or at a high power speed around 6500 r.p.m. It is desirable that the engine have immediate acceleration when the throttle is moved from closed to wide open position on pulling the manual trigger. It is also desirable that, if the load is applied during the engine speed-up from low speed to high speed it will not stall out.

Therefore, in accordance with one feature of the invention, a mass of fuel absorbent sponge material 130 is forced into nozzle chamber 96 to substantially fill the chamber and the nozzle 100. This material may consist of a plastic foam such as a polyurethane elastomer having a skeletal three dimensional structure resulting in a foam which is fully porous. The material has small passages through the material and is relatively unaffected by aliphatic hydrocarbons. For example, it has been found that polyurethane foam having a porosity of 60 to 80 pores per inch and having an air resistance of from 0.40 to 0.95 inch water pressure at 350 feet per minute for a sample ½ inch thick will operate in a manner to be de-

scribed below. This material will absorb fuel entering the nozzle chamber **96** and retain the fuel within the chamber. However, upon the opening of throttle **20** and with air flow through the mixture conduit **12**, the low pressure depression at nozzle **100** will suck fuel from the chamber **96**. The foam material **130** apparently does not restrict in any manner the flow of fuel through it to the nozzle **100**. Thus, the foam material **130** retains a column of fuel within the chamber **96** and nozzle tube **100**. The foam material provides a number of advantages which are not readily apparent from a mere description of the structure of the same. The foam material allows the interior dimension of the nozzle chamber to be quite large so that a large volume of fuel is positioned immediately adjacent to the nozzle outlet to provide the initial surge of fuel needed by the engine for rapid acceleration. A small nozzle chamber may not be able to supply the initial surge of fuel and a large or small nozzle chamber without the sponge material therein would incur fuel lift difficulties discussed hereinabove so that the reaction time of the carburetor would be slow. The sponge material effectively eliminates the fuel lift problem by forming a static fuel level adjacent the outer end of the nozzle. Since fuel can be retained in this manner, the nozzle tube **100** can be extended to any amount into the mixture conduit **12** so that the end of the nozzle **100** can be positioned at any point within the venturi providing the optimum operating conditions. The fuel which is forced to flow through the sponge material by atmospheric pressure, in response to engine suction, emerges from the sponge material in small droplets or as a mist which enables the fuel to be more quickly drawn into the firing chamber of the engine by the air flowing through the mixture conduit. This provides for an optimum fuel/air mixture ratio, especially if the fuel is drawn directly from the carburetor into the engine crankcase as is the case with two cycle engines.

A further advantage of the foam material within the fuel chamber **96** is that low speed operation of the engine will not drain fuel from the fuel chamber **96** and the main fuel passages but rather the foam material **130** remains saturated and presents a ready reservoir of fuel immediately adjacent to the nozzle opening. All of the main fuel passages are also retained full of solid fuel. When the throttle **20** is suddenly opened for rapid engine acceleration, the fuel within the chamber **96** held there by the foam material **130** will immediately flow out of the nozzle **100** and be instantaneously available for mixing with air passing through the conduit **12**. This rapid availability of fuel to engine operation upon acceleration prevents the engine from stalling or faltering as it is speeded up, even if a work load is simultaneously applied.

An optional feature of the invention is that the idle fuel chamber **112** may also be substantially filled with the foam material **132** of the same type as that in the main nozzle chamber **96**. Fuel flowing into the chamber **112** saturates the foam material and is retained therein unless it is forced through the foam out through the idle ports **116** and **118** during engine operation and by fuel under pressure in the fuel chamber **34**. The saturated foam **132** within the chamber **112** provides again an instantaneous source of fuel for operation of the engine at low speed.

As illustrated in FIGURE 3, the sponge material **132** is spaced slightly from the inner wall **113** of the low speed fuel chamber **112**. This allows air to flow through the port **118** from the mixture conduit **12** into the low speed fuel chamber **112** and out through the idle port **116** into the mixture conduit downstream of the throttle **20**. Air in flowing through the ports **118** and **116** causes violent agitation of the fuel emerging from the idle port **116**, thus breaking up the fuel and forming the correct air/fuel mixture for proper low speed operation of the engine.

The particular urethane foam material described above and used in the fuel chambers **96** and **112** effectively retains fuel within the main nozzle chamber **96** and the low speed fuel chamber **112** to provide a source of fuel having instant accessibility to the demands of the engine. The particular material that has been successfully used in carburetors of the type described is the urethane plastic foam. However, it is possible to employ other materials of a synthetic or plastic nature without departing from the spirit or scope of this invention. Any appropriate material may be used which thus has a characteristic of retaining the liquid therein but permitting the free flow of liquid therethrough. Such materials may be of any type, such as vegetable or animal fiber material closely packed together or of a synthetic sponge-like composition.

Referring now to FIGURES 4, 5 and 6, a modified embodiment of the invention is illustrated which comprises a carburetor **150** in accordance with the invention connected to an engine E partially shown in FIGURE 1. The carburetor **150** is shown as comprising a body **152**, having a mixture conduit **154**, provided with an air inlet **156**, an outlet **158** and having a venturi **160**, having a throat **162** formed therein. A choke valve shaft **164** is journaled in bearing apertures formed in the body **152** and supports a choke valve **166** for pivotal movement within the air inlet **156**. An air filter **168** consisting of a sheet metal annular housing filled with an air filtering material **170**, which may consist of a type of fiber matting or synthetic foam material through which air may readily pass, is provided to cover the air inlet **156**. All of the air entering the air intake **156** of the carburetor **150** must pass through the filter **168**, thereby eliminating the possibility of drawing dust or other foreign matter into the engine.

Mounted within the tubular mixture passage is a throttle valve **172** of circular configuration which fits across the passage **154** when in its closed position, as illustrated in FIGURE 4. To rotate the throttle **172** between open and closed positions, the throttle is mounted on a shaft **174**, which is journaled in bearing apertures in the carburetor body **152** and has one end **176** thereof extending outwardly of the carburetor, to which is attached an operating lever **178** for throttle operation.

The carburetor **150** is provided with a pulsation type fuel pump **180**, which is responsive to operation of the engine to induce the flow of fuel from a fuel storage reservoir **182** through a fuel line **184** connected to a fuel inlet fitting **185** and to force the fuel into an inlet passageway **186**, formed in the carburetor body **152**. The fuel pump **180** comprises a pump body **188**, having recesses formed therein and fitting a recess portion of the valve body **152** to define a pumping chamber **190** and a pulsation chamber **192**, separated by flexible diaphragm **193**. A pair of check valves **194** and **196** are positioned within the pumping chamber **190** to control the direction of fuel flow within the pump. The pulsation chamber **192** is connected by a passageway **198** to the crankcase of the engine so that pressure variations within the crankcase will be reflected to the pulsation chamber to cause the diaphragm **193** to be flexed or pulsed to alternately increase and decrease the pressure in the pumping chamber **190**. In response to a reduced pressure condition in the pulsation chamber **192**, the diaphragm **193** will move in a direction toward the pump body **152** thereby causing a reduced pressure condition or partial vacuum condition within the pumping chamber **190**. The partial vacuum condition in the pumping chamber **190** causes the fuel within the fuel conduit **184** to be forced past the inlet check valve **194** by atmospheric pressure as a result of the pressure differential between the atmospheric pressure within the conduit **184** and the partial vacuum within the pumping chamber **190**. The partial vacuum condition within the pumping chamber **190** will cause the outlet check valve **196** to seat tightly to prevent back-flow of fuel from

an outlet chamber **200**, also formed in the pump housing **188**. A high pressure condition within the pulsation chamber **192**, which is caused by firing of the engine for example, will cause the diaphragm **193** to be forced in a direction away from the carburetor body **152** and will develop a pressure in excess of atmospheric pressure within the pumping chamber **190**. This excessive pressure will cause the inlet check valve **194** to be tightly closed to prevent back-flow of fuel from the pulsation chamber **190** to the conduit **184** and will cause the outlet check valve **196** to be forced open to allow the flow of fuel into the outlet chamber **200**.

A fuel chamber **202** is provided below the mixture conduit **154**, as illustrated in FIGURE 5. The fuel chamber is defined by a recess **204** formed in the body **152** of the carburetor. A flexible diaphragm **206** forming a wall of the fuel chamber **202** is positioned across the recess **204** and sealed about its periphery by the rim of a cap structure **208** fixed to the carburetor body. A fiber washer **210** is fitted between the rim of the cap **208** and the periphery of the diaphragm **206**. A backing plate **212** is fixed to the central portion of the diaphragm **206** by bonding or the like and serves to rigidify the central portion of the flexible diaphragm. An air chamber **214** is formed between the cap **208** and the diaphragm **206** and is in communication with the atmosphere through an aperture **216** to provide for control of the diaphragm **206** by atmospheric pressure.

The flow of fuel from the outlet chamber **200** of the fuel pump **180** through the fuel inlet passageway **186**, is controlled by a needle valve **218** positioned for reciprocation between closed and open positions within the inlet passageway. The valve **218** is biased in a closed direction by a coil compression spring **224**, which is axially mounted around the valve needle **218** and biased between a flange **226** formed on the needle **218** and a spider **228** which surrounds the lower portion of the valve **218**. The lower extremity of the valve **218** is formed with a reduced diameter portion defining a head **230**. A lever **232**, which is pivoted on a pin **234** mounted within the body cavity **202**, has a bifurcated end thereof surrounding the reduced diameter portion of the needle **218** and contacting the head **230** to control actuation of the needle away from the seat **222**. The other end of the lever **232** is positioned in the path of movement of a boss **236** formed on the backing plate **212** and is engageable by the boss **236** to cause pivotal movement of the lever **232**.

As illustrated in FIGURES 5 and 4, a high speed fuel circuit of the carburetor consists of a recess **238** extending from the fuel chamber **202** into the body **152** of the carburetor to a cross passage **240** in which is threaded an adjustment needle **242**. The adjustment needle **242** has a conical tip **244** thereof extending into a restricted passage **246** between the bore **240** and a fuel well **248**, opening into the mixture conduit **154**. The lower end of the bore **248** is closed by a disk **250**, which is press-fitted into the body **150**. To prevent any tendency of the carburetor to "back bleed," a small check valve assembly comprising a valve seat **252** and a ball **254** is press-fitted at the outer extremity of the fuel well bore **248** adjacent the mixture conduit **154**.

"Back bleeding" is the term generally employed in the industry to indicate an undesirable fuel/air bleed phenomenon which occurs in some carburetors. In various types of carburetors, especially those with short passages between the main fuel nozzle and the fuel chamber, it is difficult to retain fuel within the main fuel passages during low speed operation of the engine. With the throttle closed, the engine operates on fuel and air passing into the engine from the low speed fuel circuit of the carburetor. The engine suction is reflected through the low speed fuel passages into the fuel chamber and tends to draw the fuel located in the main fuel passages back into the fuel chamber. This also causes air to be drawn through the main fuel nozzle into the fuel chamber, and the air during low speed operation will pass on into the low speed circuit leaning the low speed mixture sufficiently to cause stalling or rough operation of the engine. If the throttle should be suddenly opened for fast acceleration after "back bleeding" has occurred, there will be no fuel immediately available in the main fuel nozzle to be injected into the mixture conduit. The engine will falter until the fuel starts to flow out of the high speed nozzle or it will starve and cease to operate. The ball check valve illustrated in FIGURES 4 and 5 is responsive to engine suction to positively seat during low speed engine operation thereby preventing air from entering the high speed fuel circuit and maintaining a quantity of fuel in the high speed fuel circuit which is immediately available for discharge into the mixture conduit upon opening of the throttle.

As illustrated in FIGURES 4 and 6, a low speed fuel circuit of the carburetor **150** comprises a recess **260**, extending from the fuel chamber **202** into a cross passage **262** formed in the carburetor body **152**. A low speed adjustment needle **264** is threadedly received within the bore **262** and extends into a reduced diameter restricted passage between the bore **262** and a low speed fuel well **270**. The needle **264** has a tapered tip **266**, which extends through a restricted orifice **268** connecting the passage or bore **262** with a low speed or idle fuel well **270**. In a manner similar to the control needle **242**, the needle **264** has a tapered end portion **266** thereof extending into a restricted passage **268** of approximately 0.035 inch inside diameter connecting the cross passage **262** with a low speed fuel well **270**. The fuel well **270** is separated from the fuel chamber **202** by a press-fitted disk **272** and is provided with a controlled internal diameter by a plug member **274**, which is maintained in position within the fuel well **270** by the disk **272**. An idle port **276** extends from the low speed fuel well **270** into the mixture conduit **154** downstream of the throttle **172** in the closed position of the throttle as illustrated in FIGURE 4. A second idle port **278** connects the idle fuel chamber **270** with the mixture conduit **154** upstream of the closed position of the throttle **172**.

Operation of the diaphragm assembly of the carburetor **150** is essentially identical to the operation of the diaphragm assembly of the carburetor illustrated in FIGURES 1 through 3. Negative pressure, which is provided by the engine with the throttle **172** in its closed position as illustrated in FIGURE 4, is reflected through the idle port **176** into the idle fuel well **270**, thereby causing fuel within the low speed fuel well to flow out of the port **276** into the mixture conduit **154** for low speed operation of the engine. Air in the mixture conduit **154** and anterior of the throttle **172** is drawn by engine suction through the port **278** into the idle fuel well **270**. This causes a turbulent condition within the low speed fuel well causing the fuel to be partially broken or partially atomized with the air. An air/fuel mixture, the ratio of which is controlled by the adjustment of the needle **264**, is drawn from the fuel well **270** through the idle port **276** into the mixture conduit **154**.

As fuel is drawn out of the fuel chamber **202** through either the high speed or low speed fuel circuits, the diaphragm **206** will be forced by atmospheric pressure in the air chamber **214** to follow the fuel. As the fuel level within the fuel chamber **202** diminishes to a predetermined level, the boss **236** of the backing plate **212** will contact the free end of the lever **232** causing the lever to force the needle **218** away from the seat **222**, thereby allowing the flow of fuel through the passage **186** from the fuel outlet chamber of the pump **180** to replenish the fuel supply within the fuel chamber. The fuel and air chambers, therefore, are essentially fuel level sensing structures which automatically maintain an optimum fuel supply within the fuel chamber **202**.

In accordance with another feature of this invention, the fuel well bore **248** between the plate **250** and the

valve body **252** is filled with a mass of fuel absorbent sponge material **280** to provide for rapid acceleration of the engine. As indicated hereinabove, the sponge material may consist of a plastic foam, such as a polyurethane elastomer having a skeletal three dimensional structure resulting in a foam which is fully porous. The foam material will absorb fuel entering the high speed fuel well **248** and will retain this fuel immediately below the check valve **254** so that the fuel is immediately available for introduction into the mixture conduit **154**. It has been found that filling the high speed chamber **248** with the foam material **280** allows the practical size of the high speed fuel chamber to be greatly increased, thereby increasing the volume of fuel immediately available to the engine for fast acceleration. Positioning the ball check valve at the outer extremity of the high speed fuel well permits the retention of the fuel within the foam material **280** against the tendency of back bleeding as described above. The foam material is extremely porous, thus allowing free flow of fuel therethrough, which will not restrict engine operation at conditions of maximum rate of fuel consumption. The foam material **280** provides for a large volume of fuel under all operating conditions, and allows the carburetor to be tilted to any position or violently agitated witthout the probability of the engine faltering due to a poor fuel supply.

It will be evident, from the foregoing, that I have provided a novel carburetor for a small internal combustion engine which is uniquely adapted to provide instant fuel flow from the main fuel nozzle into the mixture conduit in response to sudden opening of the throttle. The main fuel nozzle is provided with an enlarged chamber which is filled with a sponge material which will absorb a large quantity of fuel and thereby effectively locates a substantial volume of fuel for immediate access to the mixture conduit. The sponge material effectively increases the height of the static fuel level within the nozzle fuel chamber and makes possible the positioning of the main fuel nozzle outlet at the area of greatest pressure depression within the venturi throat. This structure effectively eliminates any fuel lift delays and provides for optimum carburetor sensitivity and reaction time charcteristics. The sponge material also provides for maximum acceleration characteristics by breaking up the fuel into a mist as it emerges from the interstices of the sponge material. The engine, therefore, will not falter during acceleration from the lack of a proper fuel volume or the lack of a proper air/fuel mixture ratio. In carburetors for small engines where "back bleeding" is a problem, it is seen that means has been provided to effectively prevent any possibility of "back bleeding." A check valve is placed at the nozzle outlet to prevent air from entering the main fuel nozzle and, therefore, a supply of fuel will be immediately available for rapid acceleration at all times. Therefore, it is seen that this invention is one well adapted to obtain all of the objects hereinabove set forth, together with other advantages which become obvious and inherent from the description of the apparatus itself.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations.

This is contemplated by and is within the scope of the claims. As many possible embodiments may be made of the invention without departing from the spirit or scope thereof, it is to be understood that all matters herein set forth or as shown in the accompanying drawings are to be interpreted as illustrative and not in a limiting sense.

I claim:

**1.** A carburetor comprising a body, a fuel and air mixture conduit through the body, a fuel inlet passageway formed in the body, said body formed with a pulsation pump, means for pulsing said pump, said pump being connected to a source of fuel and adapted to deliver fuel under pressure to the fuel inlet passageway, said body formed with a fuel chamber in communication with the fuel inlet passageway, an inlet valve in said fuel inlet passageway for controlling the flow of fuel into the fuel chamber, means for operating said inlet valve, said body having a fuel connection between the fuel chamber and said mixture conduit, said fuel connection including an enlarged recess opening into said mixture conduit, a check valve fitted within the outer extremity of said recess to prevent the flow of air from the mixture conduit into said recess, a mass of fuel absorbent sponge material filling the inner extremity of said recess, said sponge material having small passages therethrough of a size to permit substantially free flow of fuel therethrough, said sponge material causing partial breaking up of said fuel as the fuel is ejected into the mixture conduit from the nozzle.



**2.** A carburetor comprising a body, a fuel and air mixture conduit through the body, a fuel inlet passageway formed in the body, said body formed with a pulsation pump, means for pulsing said pump, said pump being connected to a source of fuel and adapted to deliver fuel under pressure to the fuel inlet passageway, said body formed with a fuel chamber in communication with the fuel inlet passageway, an inlet valve in said fuel inlet passageway for controlling the flow of fuel into the said fuel chamber, means for operating said inlet valve, said body having a fuel connection between the fuel chamber and said mixture conduit, said fuel connection including an enlarged recess opening into said mixture conduit, a mass of fuel absorbent sponge material filling the inner extremity of said recess, said sponge material being of polyurethane foam and having about 60–80 connected pores per inch whereby to permit substantially free flow of fuel therethrough, said sponge material causing partial breaking up of said fuel as the fuel is ejected into the mixture conduit from the nozzle.

**3.** A carburetor according to claim **2** in which the said fuel connection comprises the main fuel nozzle of said carburetor.

**4.** A carburetor according to claim **2** in which the said fuel connection comprises the idle fuel system for said carburetor and in which said sponge material only partially fills the said recess, the remainder of said recess being open to provide a space into which air may enter.


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