Dec. 8, 1964 E. A. JOHNSON 3,160,681

CARBURETOR

Filed Nov. 15, 1961 3 Sheets-Sheet 1

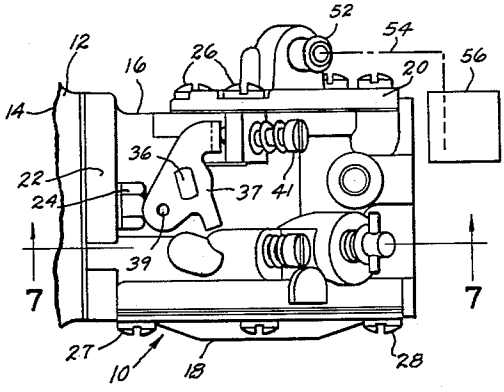


FIG. 1.

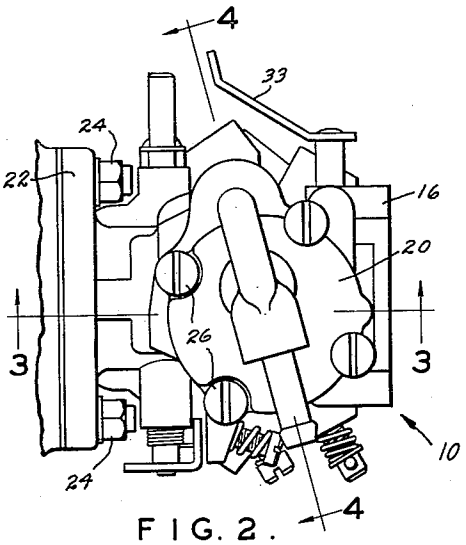


FIG. 2.

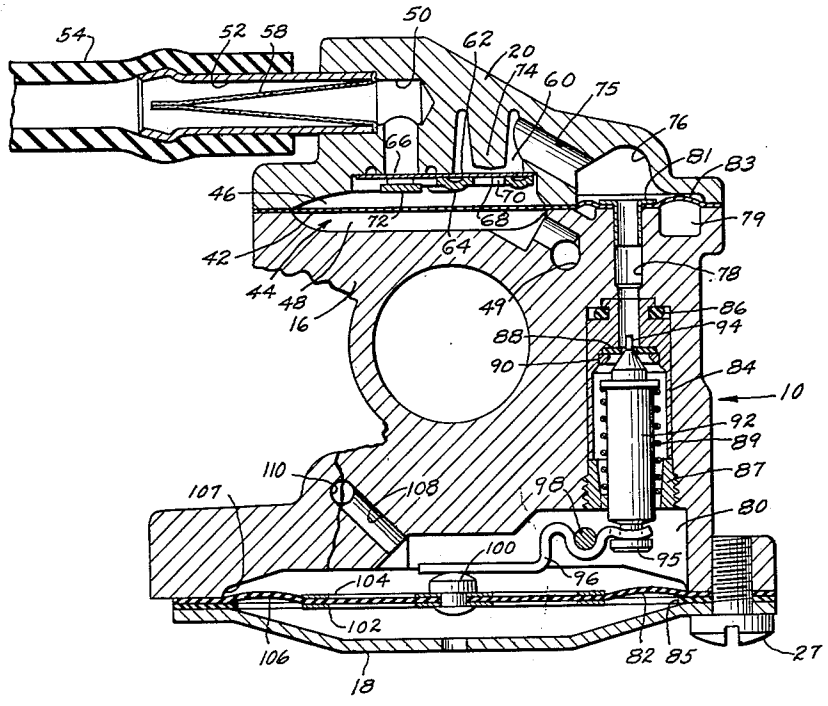


FIG. 4.

INVENTOR.
ELDON A. JOHNSON
BY

AGENT

Dec. 8, 1964 E. A. JOHNSON 3,160,681

CARBURETOR

Filed Nov. 15, 1961 3 Sheets-Sheet 2

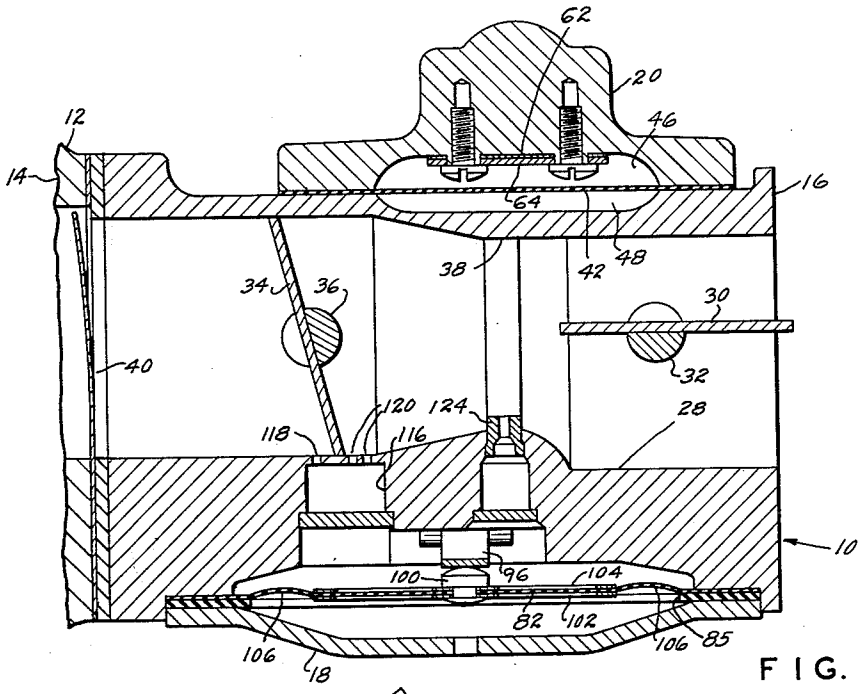


FIG. 3.

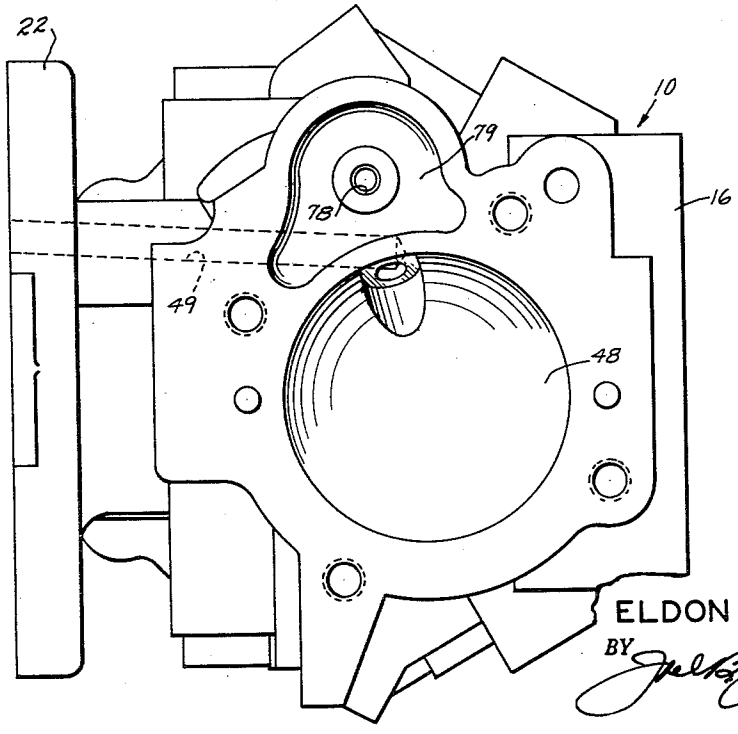


FIG. 8.

INVENTOR.
ELDON A. JOHNSON
BY

AGENT

Dec. 8, 1964 E. A. JOHNSON 3,160,681

CARBURETOR

Filed Nov. 15, 1961 3 Sheets-Sheet 3

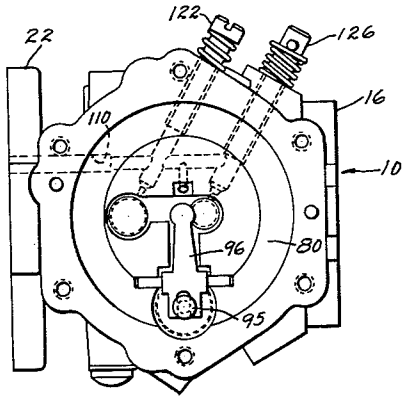


FIG. 6.

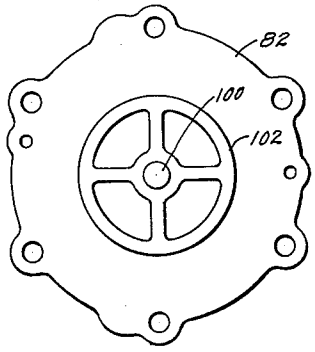


FIG. 5.

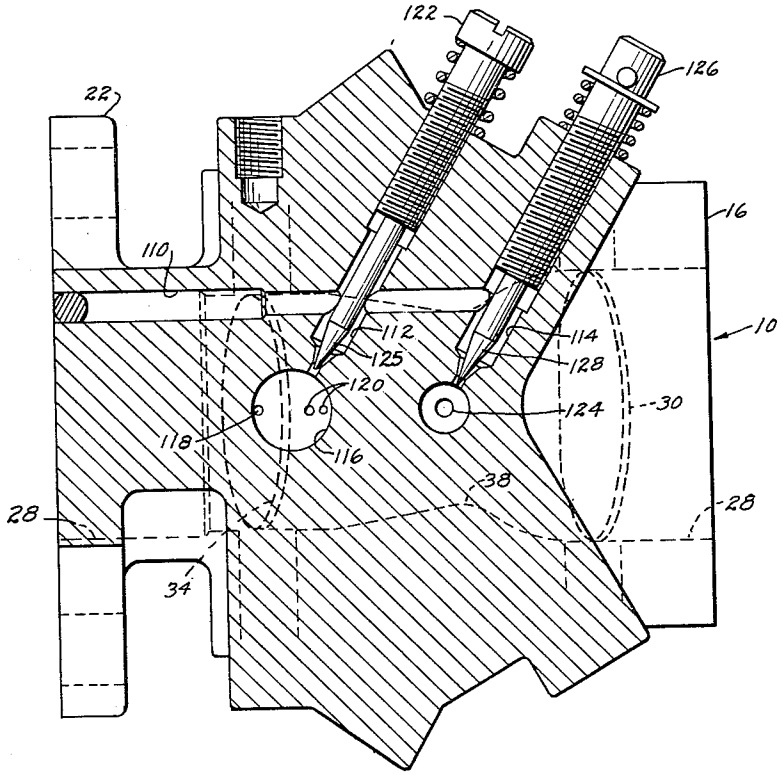


FIG. 7.

INVENTOR.
ELDON A. JOHNSON
BY

AGENT

United States Patent Office 3,160,681 Patented Dec. 8, 1964

3,160,681

CARBURETOR

Eldon A. Johnson, Sunset Hills, Mo., assignor to ACF Industries, Incorporated, New York, N.Y., a corporation of New Jersey

Filed Nov. 15, 1961, Ser. No. 152,560
5 Claims. (Cl. 261—35)

This invention is directed to a carburetor for small engines used with power tools. The application of carburetors of this type is with engine driven devices such as chain saws and other portable power tools as well as gocarts and outboard motors.

In applications with engines used with portable power tools, as well as small vehicles, the carburetor is expected to be a rather simple device but yet provide all of the advantages of a more sophisticated carburetor. The power tool is used in all positions and the carburetor must be one which can supply an optimum mixture of fuel and air to the engine under conditions varying from idle speeds to high speeds at wide open throttle. Carburetors of this type, because of the nature of their application, are provided with a built-in fuel pump, which supplies fuel under pressure to a fuel chamber from which the fuel is conducted to the air and fuel mixture conduit of the carburetor. The first requisite of such carburetors is that the fuel pump be efficient and have a sufficiently large capacity to provide the required fuel at all times.

The fuel chamber of carburetors of this type may have a flexible wall operatively connected through a valve operating mechanism to an inlet valve for supplying fuel from the pump portion of the carburetor to the fuel chamber. It is necessary that the flexible wall and its valve operating structure be sufficiently sensitive so that under differing conditions of operation the required amount of fuel will be supplied for proper operation of the engine. The valve operating mechanism must be one which is sufficiently consistent in its operation so that small changes in pressure within the fuel chamber will be operative to open or close the inlet valve. Thus, the diaphragm valve control mechanism can quickly sense operative conditions within the mixing conduit of the carburetor and respond accordingly to supply more fuel or to close off the fuel supply. Thus, a sensitive fuel supply will quickly respond to instant demands of the engine upon acceleration to full speed from a low speed idle condition.

It is thus an object of this invention to provide a novel carburetor of the type described having a built-in fuel pumping system and a fuel chamber which will provide sufficient fuel flow to an engine under all conditions of operation.

It is another object of this invention to provide a novel carburetor of the type described having a pump portion which is sufficiently large and efficient in output to provide an engine with sufficient fuel for operation.

It is a further object of this invention to provide a novel carburetor structure having a fuel chamber with a diaphragm operated inlet valve in which the operating structures are sensitive to small demands of the engine.

The invention is directed specifically to a carburetor having fuel pump and fuel chamber portions. The design of the fuel pump portion is such as to increase the capacity of the fuel pump, as well as to dampen pulsations of the pump so that the efficiency and output of the pump is increased to a point that sufficient fuel is provided under all conditions of engine operation. The carburetor also is provided with a fuel chamber, one wall of which is movable and formed by a flexible diaphragm operatively connected to an inlet valve. The operating structure connecting the diaphragm and valve are modified to provide an operating assembly which is sensitive

in its operation and which effectively provides sufficient fuel for all conditions of engine operation.

FIGURE 1 is an elevational view of the carburetor in accordance with this invention and connected to the intake manifold of an engine shown partly in section.

FIGURE 2 is a top plan view of the carburetor of FIGURE 1.

FIGURE 3 is a longitudinal sectional view of the carburetor of FIGURES 1 and 2 and taken on section line 3—3 of FIGURE 2.

FIGURE 4 is an enlarged sectional view of the carburetor of FIGURES 1 and 2 and taken on the section line 4—4 of FIGURE 2.

FIGURE 5 is a plan view of the fuel chamber diaphragm and vacuum plate structure of the carburetor of FIGURES 1–4 and in accordance with the invention.

FIGURE 6 is a bottom plan view of the carburetor of FIGURES 1–4 with the fuel chamber plate and diaphragm removed to show the interior of the fuel chamber.

FIGURE 7 is an enlarged sectional view of the carburetor of FIGURES 1–4 showing the interconnected idle and main fuel systems and taken on the section line 7—7 of FIGURE 1.

FIGURE 8 is a top plan view of the carburetor of FIGURES 1–4 with the pump chamber cap removed to show the interior of the pulsation chamber.

The carburetor in accordance with the invention is indicated at 10 in FIGURES 1 to 4. It is connected to the intake manifold 12 of an engine 14, which may be a two cycle engine in which, during the intake cycle of the engine, air and fuel is drawn through the carburetor 10 into the crankcase of the engine. During the compression stroke of the engine, the mixture of gas and fuel is bled by a passageway from the engine crankcase into the engine cylinder. During the operation of engines of this type the pressure of the gases within the crankcase of the engine undergoes a change from sub-atmospheric to above atmospheric pressure. These pressure changes are conducted by an appropriate passage to a pumping portion of the carburetor 10 to operate the fuel pump of the carburetor.

The carburetor shown in the figures of the drawing consists of a main body portion 16, to the underside or bottom of which is attached a fuel chamber cover plate 18 and to the upper side or top of which is attached a pumping chamber cap 20. The carburetor body portion has a flange section 22 which is connected directly to the intake manifold 12 of the engine in any appropriate manner, such as by bolts extending from the intake manifold through the flange 22 with retaining nuts 24 holding the carburetor to the manifold. The pump cap 20 is retained and held to the main body 16 by machine screws 26 threaded into the body 16. In a similar manner the fuel chamber cover plate 18 is fixed to the carburetor body 16 by threaded screws 27 extending through the plate 18 into threaded portions of the carburetor body.

As shown specifically in FIGURE 3, the carburetor has an air and fuel mixture passage 28 therethrough and in line with an opening into the intake manifold 12 of the engine 14. Mounted within the mixture conduit 28 is a choke valve 30 fixed for rotational movement on a choke shaft 32. Also mounted within the mixture conduit 28 of the carburetor between choke valve 30 and the intake manifold 12 is a throttle valve 34 fixed for movement therewith to a throttle shaft 36 journaled for rotation in the body 16 of the carburetor. Between the choke valve 30 and the throttle valve 34, the mixture conduit 28 is formed with a restriction or venturi portion 38. A reed valve plate structure 40 is mounted between the throttle 34 and the intake manifold 12. The reed valve prevents compressed gases within the crankcase from blowing back

through the mixture conduit 28 when the engine exhausts. The intake cycle of the engine sucks air through the mixture conduit 28 of the carburetor and the valve 40 opens at this time.

To provide fuel to the engine, the carburetor 10 is formed with a fuel pump structure fixed between the pumping chamber cap 20 and the body 16 of the carburetor. As shown more clearly in FIGURE 4, the pumping chamber cap 20 and the carburetor body 16 are both provided with oppositely disposed cavities or recesses which together form a hollow chamber 44. A pumping diaphragm 42 fixed across chamber 44 divides it into a pumping chamber 46 and a pulsation chamber 48. The attachment of the cap 20 to the carburetor body 16 by the screws 26 is sufficiently tight to seal the diaphragm 42 around its peripheral edge between the cap 20 and the body portion 16. A fuel inlet passage 50 is formed in cap 20 extending from the fuel chamber 46 upwardly and outwardly to the outer surface of the cap. With the inlet passage 50 is press-fitted an inlet nipple structure 52 to which may be attached in any appropriate manner a flexible tubing 54 extending into a fuel tank 56, as shown schematically in FIGURE 1. Mounted within the nipple 52 is a tubular mesh structure 58 having an open end press-fitted into the free end of the nipple 52. The other end of the tubular filter 58 is closed to the passage of fuel.

An outlet chamber 60 is formed within the pump cap 20 and above the pumping chamber 46, as viewed in FIGURE 4. A flexible valve diaphragm 62 is fixed between portions of the pumping cap 20 and a retainer plate 64. The valve diaphragm has partially cutout portions forming a pair of flap valves 66 and 68. Valve 66 is fitted over the inlet passage 50 to provide an inlet check valve for fuel flowing into the pumping chamber 46, while the valve flap 68 is fitted over a short outlet passage 70 between the pumping chamber 46 and the outlet chamber 60. An aligned portion 72 of retainer 64 provides a stop means for the movement of the inlet valve flap 66 in a downward direction as fuel passes into the pumping chamber 46. In a similar manner, an extension 74 of the cap 20 provides a stop means for the valve flap 68, as it moves in an upward direction for the passage of fuel into the outlet chamber 60, and as viewed in FIGURE 4.

Leading from the outlet chamber 60 is a passage 75 formed in the pumping cap 20 and extending into a second chamber 76 within the cap, which connects with a fuel passage 78 extending downwardly, as viewed in FIGURE 4, to a fuel chamber 80. Fuel chamber 80 is formed by a depression in the carburetor body 16 which is closed on one side by a flexible diaphragm 82 fastened and sealed between the body casting 16 and cover plate 18.

Fitting in the lower end of the fuel passage 78 is a valve assembly consisting of a sleeve 84 sealed by an O-ring 86 to the body casting 16. Within the sleeve 84 there is positioned a resilient valve seat 88 retained by a ring 90 press-fitted into sleeve 84. Valve seat 88 may be an annular synthetic rubber washer into the center of which is fitted one end of a needle valve 92. A threaded fitting 87 locks sleeve 84 within the body 16 and also retains a light spring 89 between its flanged end and the flange of the needle valve 92. The valve 92 has a tapered upper end 94 which has an extension, as shown in FIGURE 4, extending through the annular rubber seat 88. The lower end of needle 92 has a headed end 95 in which is positioned the forked end of a lever 96 pivoted on a shaft 98 journaled within the body casting 16. The other end of lever 96 is in operative contact with a metallic button 100 fixed to the center of the diaphragm 82. Button 100 consists substantially of a headed rivet, which is used to tightly hold a pair of backing plates 102 and 104 on opposite sides of the diaphragm 82 for retaining the center of the diaphragm rigid and substantially in the plane of the periphery of the diaphragm during operation. The backing plates 102 and 104 extend close to the peripheral edge of

diaphragm 82, but provide an unsupported annular portion or bight 106, between the backing plates and the portion of the diaphragm 82 which is held between the cover plate 18 and carburetor body 16.

A fuel passage 108 extends from the fuel chamber 80 to a cross passage 110 in the carburetor body 16 and shown in FIGURES 4, 6 and 7, for example. The cross passage 110 connects with an idle passage 112 and the main fuel passage 114. The idle passage 112 extends into an idle fuel chamber 116, from which an idle port 118 extends into the mixture conduit 28 downstream of the throttle valve 34. Also, a pair of additional idle ports 120 are formed through the wall of the mixture conduit 28 above the throttle valve 34 in its closed position. An idle screw 122 is threaded into the carburetor body 16 and has a tapered end 125 extending into a restricted portion of the idle passage 112. Adjustment of screw 122 in and out of this restricted passage portion controls the amount of fuel and air passing into the idle chamber 116.

The main fuel passage 114 connects with a main fuel jet, which consists of a tubular fitting or nozzle 124 extending into the restricted or venturi portion of the mixture conduit 28 (FIGURE 3). A second adjustment screw 126 having a tapered end portion 128 extends into a restricted portion of the main fuel passage 114 to control the amount of fuel passing into the main fuel nozzle 124.

In operation, cranking of the engine 14 pumps air through the mixture conduit 28 of the carburetor into the intake manifold 12 of the engine; the reed valve 40 being opened under the pumping suction of the engine. Flow of air past the main fuel nozzle 124 with the throttle valve 34 open provides a subatmospheric pressure at the mouth of nozzle 124 due to the venturi effect of the restriction 38. This low pressure at the mouth of nozzle 124 is transferred back through passages 114, 110 and 108 to the fuel chamber 80. Atmospheric pressure on the outer surface of diaphragm 82 causes the diaphragm to be pressed inwardly or upwardly, as viewed in FIGURE 4, to rock the valve lever 96 in a clockwise direction. This pulls the needle valve 92 downwardly and the end of needle valve 94 off of the resilient valve seat 88.

Pulsations in the crankcase of the engine are transferred through a passage 49 (FIGURES 4 and 8) to the pulsation chamber 48. The pumping diaphragm 42 flexes back and forth under the effect of the engine pulsations transferred into pulsation chamber 48. This causes a pumping action in the pumping chamber 46 which sucks fuel from tank 56 through the conduit 54 into the inlet chamber 50 of the carburetor cap 20. Fuel passes into the pumping chamber 46 and out past the outlet check valve 68 into the passages 60, 75 and 78. Continual pumping forces fuel down past the open valve 92 into the fuel chamber 80 and out through the fuel passages 108, 110 and 114 to the nozzle 124. The capacity of the pump section of the carburetor supplies fuel at a higher rate than used by the engine. Accordingly, fuel accumulates in the fuel chamber 80 to fill it. Then the fuel reacts against the diaphragm 82 to move it outwardly against atmospheric pressure. The fuel pressure in chamber 80 is aided by the valve spring 89 which, as the diaphragm moves away from lever 96, forces the needle upwardly into a closed position in seat 88. In fuel chamber 80, the fuel pressure within the chamber and the valve spring 89 work together against the atmospheric pressure on the outer surface of the diaphragm 82. The fuel pressure in the fuel chamber 80 varies within a small range of valves to open and close the needle valve 92.

An idling or low speed operation of the engine takes place when the throttle 34 is closed. At this time, there is insufficient air flow through the carburetor conduit 28 to pull fuel from chamber 80 through the nozzle 124. Accordingly, the manifold pressure downstream of throttle 34 is at a subatmospheric pressure and a large pres-

sure depression is created at the idle jet opening 118, which pulls fuel from the fuel chamber 80 through passages 108, 110 and the idle chamber 116. Simultaneously sufficient air for mixing with this fuel and to operate the engine at low speed is sucked through the idle ports 120 upstream of the closed throttle 34. This air is pulled into the idle chamber 116 to mix with the fuel coming from the fuel chamber 80. Under some conditions of operations, additional air may be pulled in through the main fuel nozzle 124 and back through the fuel passage 114 and the cross passage 110 into the idle fuel passage 112 to mix with the idle fuel passing out of the idle jet 118. Adjustment of screw 122 is used to provide the optimum fuel and air mixture for idling or low speed conditions.

In accordance with the invention, the pumping structure of the carburetor is modified to provide a more efficient pump and one which will provide adequate fuel pumping capacity for maximum fuel requirements during engine operation. The cap 20 is formed with the chamber or hollow 76 to provide a large reservoir of fuel between the outlet valve 68 of the pump and the control valve 92 into the fuel chamber. Also, in accordance with the invention, the pumping diaphragm 42 is extended across the reservoir chamber 76 and encloses an arcuate hollow or cavity 79 formed within the body casting 16 (FIGURES 4 and 8). A rivet 81 is press-fitted into the upper portion of fuel passage 78 and the flange head of the rivet is forced downwardly against the pumping diaphragm 42 to tightly seal the diaphragm at this point to the body block 16. Thus, cavity 79 is sealed in a fuel tight manner to trap air therein. Furthermore, the aperture through the pumping diaphragm 42 and through which the eyelet 81 is forced, is formed somewhat smaller than the outside diameter of eyelet 81 so that as the eyelet is pressed through diaphragm 42, it forces the diaphragm material outwardly to provide an annular wrinkle or bight formation 83. Air trapped within hollow 79 provides a dampening or pulsation chamber. The diaphragm on its pumping stroke moves a column of fuel filling the fuel passages extending from the pumping chamber 46 into the fuel chamber 80. This fuel resists the pumping action of the diaphragm and thus tends to cut down and limit its pumping motion or movement. The dampening chamber 79 provides an air cushion which absorbs the pumping pulses and provides a certain give in the liquid fuel so that the pumping diaphragm does not push against a solid column of fuel in its pumping action. This then permits the diaphragm 42 to move against less fuel resistance to a greater extent during pumping.

The lever mechanism used for opening and closing the needle valve 92 is designed to operate with greater sensitivity than previous designs of carburetors of this type. The large size of backing plates 102 and 104 provide a greater rigidity to the diaphragm 82, which thus does not tend to absorb and dissipate the pressure of the fuel within chamber 80. A small backing plate 102, for example, would permit diaphragm to flex outwardly below the large plate 104 and provide space that would absorb fuel entering chamber 80, which fuel, as it flows out, permits the diaphragm to move without acting on lever 96. A rigid diaphragm senses fuel pressure within chamber 80 more closely. Thus, the large backing plates provide a diaphragm assembly then which is much more reactive to the fuel coming in and leaving the chamber and the diaphragm acts more quickly on lever 96 to open the fuel chamber upon demands of the engine. As shown in FIGURE 5, the plates 102 and 104 are skeletonized or provided with a minimum of spokes and a maximum of open spaces to cut down the weight of the diaphragm assembly. Between cover plate 18 and diaphragm 82 is a hard fiber gasket 85 which forces diaphragm 82 upwardly away from the plane of its periphery, as viewed in FIGURE 4, into a directed loop or bight 106. This allows freer movement of diaphragm 82 inwardly under the pressure of the atmosphere. Maintaining the bight 106 at all times with the configuration shown in FIGURE 4 provides a greater response of the diaphragm to fuel pressure changes within chamber 80, as reversal of the bight upon increase in chamber pressure would tend to absorb fuel entering chamber 80 without a full response of the diaphragm assembly to the pressure increase. Also, fuel leaving chamber 80 would permit flexing of the bight without a full response of the diaphragm to the drop in fuel pressure. Thus, the large backing plates 102 and 104 give the diaphragm a maximum rigidity for optimum pressure response. The bight 106 is kept at a minimum required for optimum resiliency and response to pressure changes and for maintaining the bight 106.

The fuel chamber 80 adjacent to the peripheral edge of bight 106 is cut away, as shown at 107. This permits a freer flexing of the bight portion 106 and as the diaphragm moves inwardly into the chamber 80, the edge of the bight 106 does not contact the housing body 16. If the bight portion 106 rolled down onto a slanting surface adjacent to 107, the diameter of the diaphragm would tend to be reduced as the diaphragm moved inwardly. Thus, the effective atmospheric pressure on the diaphragm would change and the needle 92 would not open to the extent it would if the diaphragm were completely free for movement inwardly and outwardly.

The choke shaft has fixed thereto a manual choke operating lever 33, as shown in FIGURE 2. By the use of this lever, the choke may be closed during cold starting of the engine to provide an enriched mixture of fuel and air. When the engine has started, the choke valve is moved to an open position, as shown in FIGURE 3. Also, the throttle valve 34 is operated by means of a manually operable throttle lever 37 (FIGURE 1) fixed to the throttle shaft 36. Normally, the throttle lever 37 is attached to a Bowden cable or operative linkage through an aperture 39 in the lever 37. An adjustment screw 41 is threaded through an embossment of the carburetor body 16 to provide at its threaded end a stop for lever 37. In this manner the amount of closing of the throttle can be controlled to provide a slightly open throttle under certain conditions of low engine speed.

The carburetor structure described above is one which provides a large capacity of fuel in the pumping section. The passages 75, as well as the outlet chamber 60 and chamber 76, provide for the storage of fuel in sufficient quantities so that upon the opening of the valve 92 and with a large fuel demand by the engine, there is stored adjacent to the fuel chamber 80 a sufficient supply of fuel. The pulsation dampening chamber 79 permits the pumping diaphragm 42 to have a greater displacement during the pumping stroke which increases the efficiency of the pump.

The needle seat assembly provides for quick replacement of the needle and its seat by the simple removal of the fitting 87 and dropping out sleeve 84 with the seat. The insertion of a new sleeve 84 and seat are in the reverse order. The end 94 of needle 92 operates within the valve seat aperture of seat 88 continuously during operation. The needle end 94, as shown in FIGURE 4, is a rod-like construction and provides a means for metering the flow of fuel through the valve seat 88.

I claim:

1. A carburetor comprising a body, a fuel and air mixture conduit through said body, said body formed with a fuel pumping chamber and an inlet and an outlet connected thereto, a pump diaphragm fixed to said body across said pumping chamber to form a movable wall thereof to pump fuel through said pumping chamber, means forming a fuel chamber within said body, a fuel passage in said body extending from said pumping chamber outlet to said fuel chamber, an outlet valve in said passage adjacent to said pumping chamber, an inlet valve in said fuel passage between said outlet valve and said fuel chamber, said body having a fuel connection between said

fuel chamber and said mixture conduit, said body formed with a substantially annular cavity encircling said fuel passage between said outlet and inlet valves, and a resilient pulse diaphragm portion extending across and separating said cavity from said fuel passage, and means sealing said resilient diaphragm portion to said carburetor body, said fuel passage extending through said diaphragm portion, whereby a closed pulse chamber is formed between said diaphragm portion and said cavity to dampen pump pulsations.

2. The invention of claim 1 including means for operating said inlet valve including a sensing diaphragm sealed at its periphery to said body across said fuel chamber to form a wall thereof, and an operative connection between said sensing diaphragm and said inlet valve.

3. A carburetor comprising a body, a fuel and air mixture conduit through said body, said body formed with a fuel pumping chamber and an inlet and an outlet connected thereto, a pump diaphragm fixed to said body across said pumping chamber to form a movable wall thereof to pump fuel through said pumping chamber, means forming a fuel chamber within said body, said body being formed with a fuel passage extending from said pumping chamber outlet to said fuel chamber, an outlet valve in said fuel passage adjacent to said pumping chamber, an inlet valve in said fuel passage between said outlet valve and said fuel chamber, said body having a fuel connection between said fuel chamber and said mixture conduit and a substantially annular cavity formed in said body encircling said fuel passage between said outlet valve and said inlet valve, a resilient portion of said pump diaphragm extending across and separating said cavity from said fuel passage, said fuel passage extending through said resilient diaphragm portion, and means sealing said resilient diaphragm portion to said carburetor body around said fuel passage to prevent fuel leakage between said passage and said cavity, whereby a closed pulse chamber is formed between said diaphragm portion and said cavity to dampen pump pulsations.

4. The invention of claim 3 wherein said resilient diaphragm portion has an aperture therethrough and said sealing means includes a tubular member press-fitted through said diaphragm aperture into said fuel passage part, said tubular member having a flanged head pressing said diaphragm portion around said fuel passage part tightly against said body to seal said diaphragm portion to said body.

5. The invention of claim 4 wherein said diaphragm aperture is smaller than said tubular member whereby said diaphragm portion is forced outwardly from said aperture and is formed loosely over said cavity.

References Cited in the file of this patent

UNITED STATES PATENTS

2,203,464	Harry	June 4, 1940
2,232,351	Udale	Feb. 18, 1941
2,250,932	Kittler	July 29, 1941
2,430,151	Whitted	Nov. 4, 1947
2,918,046	Teagarden	Dec. 22, 1959
2,926,894	Price	Mar. 1, 1960
3,030,084	Phillips	Apr. 17, 1962