

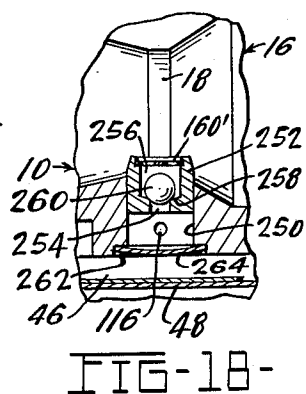
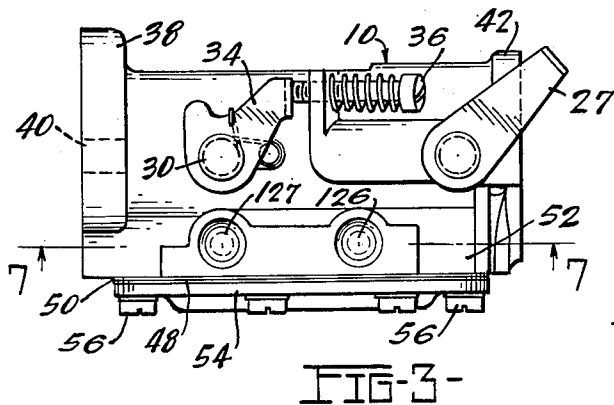
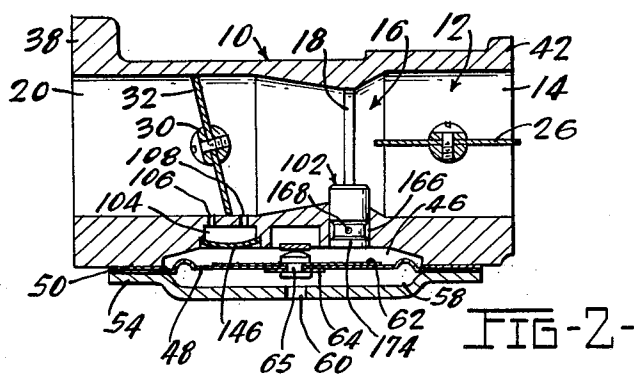
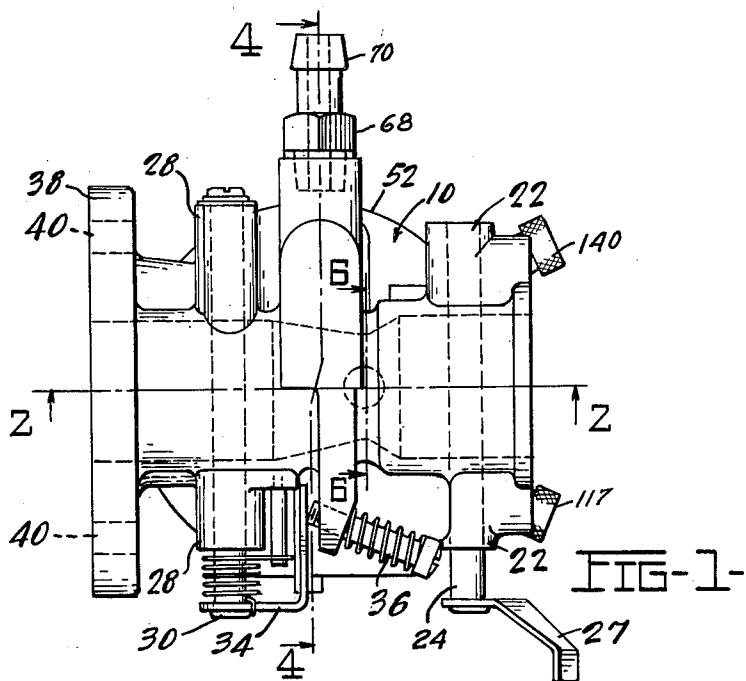
April 16, 1963

B. C. PHILLIPS
CHARGE FORMING APPARATUS

3,085,791

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3 Sheets-Sheet 1



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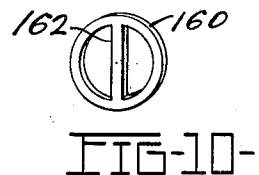
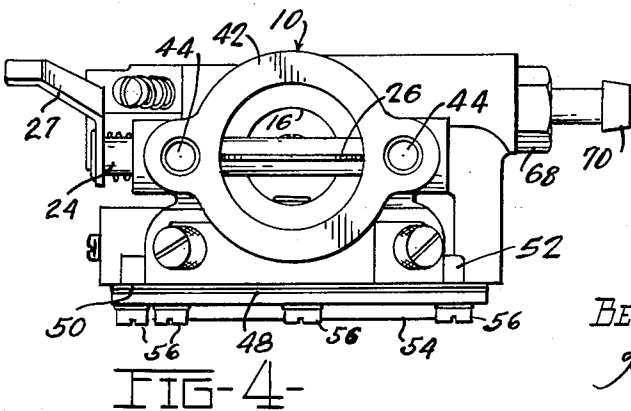
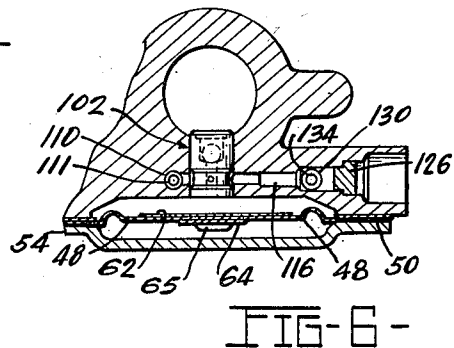
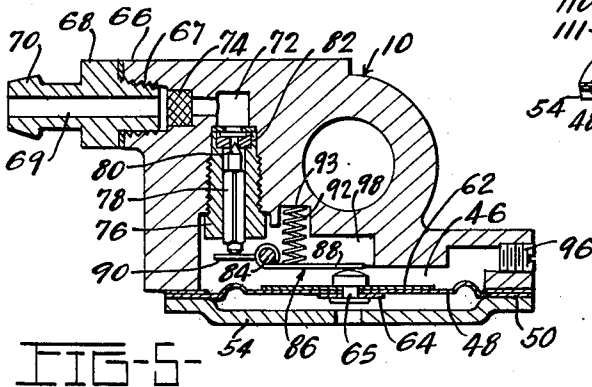
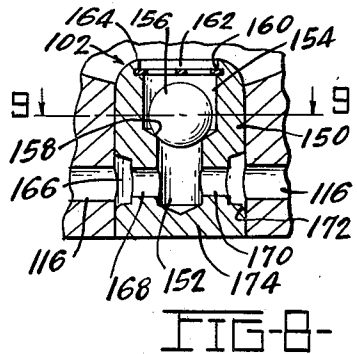
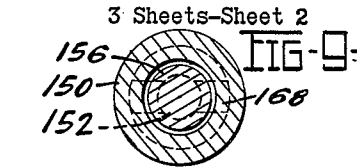
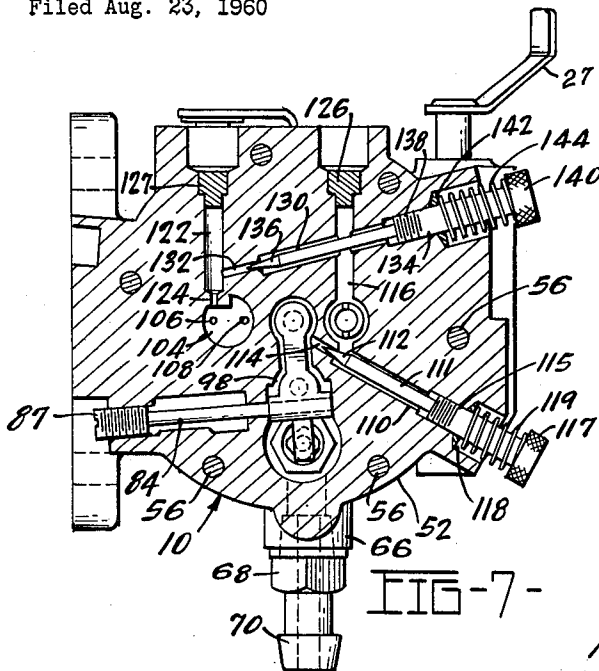
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3 Sheets-Sheet 3

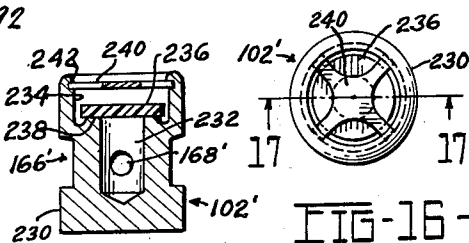
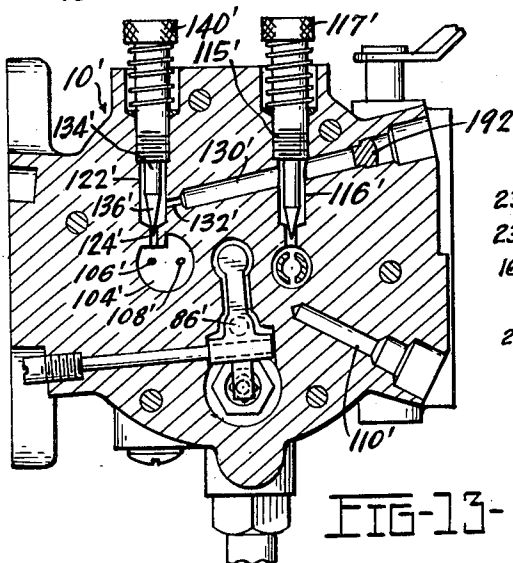
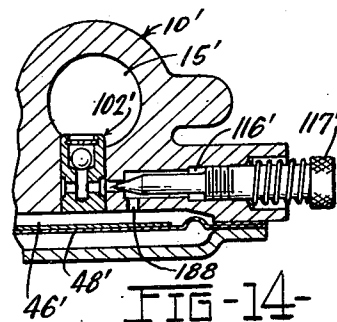
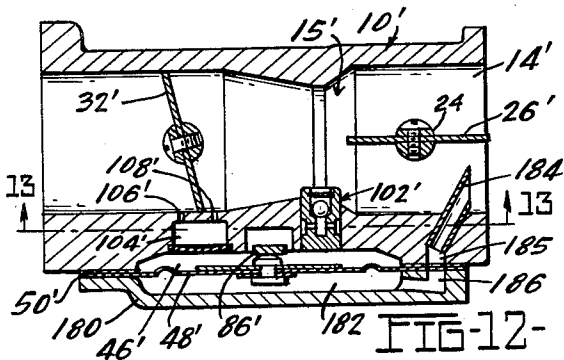
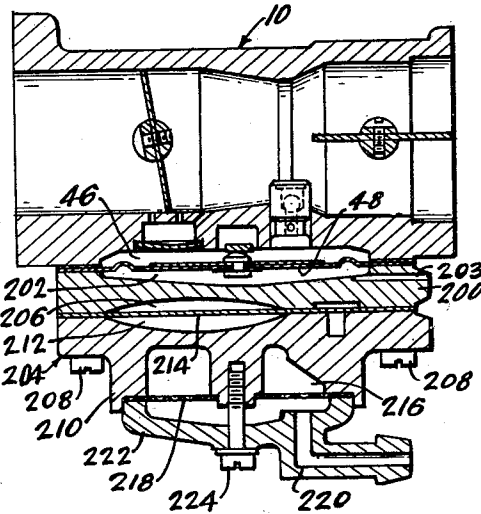
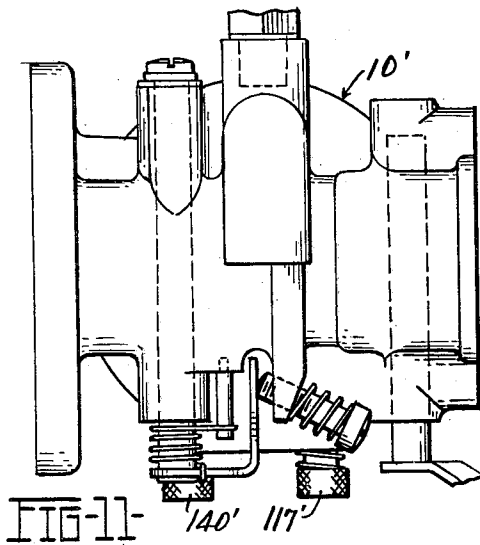


FIG-17-

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3,085,791

CHARGE FORMING APPARATUS

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12 Claims. (Cl. 261—35)

This invention relates to charge forming apparatus for delivering fuel and air mixtures to an internal combustion engine and more especially to a charge forming apparatus or carburetor embodying a flexible diaphragm arranged to be influenced or actuated by aspiration in the mixing passage for automatically regulating the delivery of fuel from a supply into the mixing passage in accordance with the requirements of the engine.

Charge forming devices or carburetors of the diaphragm type have been employed with internal combustion engines and are particularly advantageous for use with engines adapted to be operated in extreme angular or inverted positions as the diaphragm is not appreciably affected by gravity and sensitive control of the fuel flow into the diaphragm chamber is obtained.

Diaphragm carburetors of this character have been employed in which the fuel conveying channels in the carburetor have been arranged at various angles and in different planes and wherein the main orifice and supplemental orifices have been arranged in different radial positions in the mixing passage necessitating a carburetor body of substantial size to accommodate the various components and fuel conveying channels.

The present invention embraces a charge forming apparatus or carburetor wherein the major fuel conveying channels are arranged in one plane whereby the size of the carburetor body is reduced.

Another object of the invention resides in the provision of a diaphragm carburetor construction wherein the main fuel delivery system embodies a combined orifice and check valve unit pressed into a suitable aperture providing a main fuel delivery orifice.

Another object of the invention resides in a carburetor construction embodying a compact arrangement for controlling a fuel inlet valve under the influence of a diaphragm, the inlet being provided with a screen or filter to prevent foreign matter entering into the carburetor.

Another object of the invention resides in the provision of a carburetor of the diaphragm type wherein all the major metering channels and fuel conveying ducts are contained in a comparatively thin, generally circular portion of the carburetor body whereby the lengths of the fuel conveying ducts are reduced to a minimum.

Another object of the invention embraces the provision of a carburetor wherein the metering and fuel conveying channels are located substantially in a single plane whereby little hydrostatic change occurs irrespective of whether the carburetor is operated in upright, tilted or inverted positions.

Another object of the invention resides in the provision of a carburetor of compact construction wherein extensive savings in material are effected enabling the production of the carburetor at a greatly reduced cost.

Another object of the invention is the provision of a combined check valve and main fuel delivery means contained in a unit fitting which may be readily inserted or removed from a bore in the carburetor and wherein a portion of the unit provides a closure means for an end of the bore accommodating the unit fitting and eliminating the use of a separate closure.

A further object is the provision of a diaphragm type carburetor having a body member fashioned to facilitate the positioning of the fuel metering means in various

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regions of the carburetor body whereby the carburetor may be accommodated to various installations with engines of different sizes.

A further object of the invention resides in positioning the main and supplemental fuel delivery orifices in a common vertical plane lengthwise of the mixing passage, the arrangement including a main nozzle and valve unit constructed and arranged to provide a shallow fuel chamber disposed close to the mixing passage thereby reducing the lift required to effect delivery of fuel into the mixing passage rendering the carburetor more sensitive and reliable in operation.

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

FIGURE 1 is a top plan view of a charge forming device or carburetor of the invention;

FIGURE 2 is a longitudinal sectional view through the carburetor, the view being taken substantially on the line 2—2 of FIGURE 1;

FIGURE 3 is a side elevational view of the carburetor shown in FIGURE 1;

FIGURE 4 is an end elevational view of the carburetor illustrated in FIGURES 1 through 3;

FIGURE 5 is a transverse sectional view taken substantially on the line 5—5 of FIGURE 1;

FIGURE 6 is a detail sectional view taken substantially on the line 6—6 of FIGURE 1;

FIGURE 7 is a sectional view taken substantially on the line 7—7 of FIGURE 3;

FIGURE 8 is an enlarged detail sectional view illustrating a nozzle and valve unit forming a component of the carburetor;

FIGURE 9 is a transverse sectional view taken substantially on the line 9—9 of FIGURE 8;

FIGURE 10 is an isometric view of an element of the nozzle and valve unit;

FIGURE 11 is a top plan view showing a modified form of the carburetor;

FIGURE 12 is a longitudinal sectional view of the carburetor illustrated in FIGURE 11 showing a modified form of venting means for the chamber beneath the diaphragm;

FIGURE 13 is a sectional view similar to FIGURE 6 illustrating the adjustable fuel metering means positioned in a side region of the carburetor, the view being taken substantially on the line 13—13 of FIGURE 12;

FIGURE 14 is a detail sectional view taken substantially on the line 14—14 of FIGURE 11;

FIGURE 15 is a longitudinal sectional view similar to FIGURE 2 illustrating a fuel pump associated therewith;

FIGURE 16 is an enlarged top plan view showing a modified form of nozzle and check valve unit;

FIGURE 17 is a sectional view taken substantially on the line 17—17 of FIGURE 16, and

FIGURE 18 is a sectional view illustrating another form of nozzle and check valve unit.

While the charge forming apparatus of the invention has particular utility for supplying combustible mixture to engines of the two cylinder type, it is to be understood that invention may be employed with four cycle engines. The charge forming apparatus is particularly adaptable for use with internal combustion engines for operating equipment such as marine motors, mowers, air compressors, generators, ventilating fans, power hammers and

portable engine operated equipment and is usable wherever the carburetor is subjected to extreme positions of tilt or inverted positions.

Referring to the drawings in detail and particularly to the arrangement shown in FIGURES 1 through 10, the charge forming apparatus or carburetor is inclusive of a body or a body member 10 which may be formed of cast metal or other suitable material of a nonporous character which is resistant to deterioration by hydrocarbon fuels. The body member 10 is formed with a mixing passage 12 which includes an air inlet region 14, a Venturi 16 having a choke band or region of restriction 18 and a mixture outlet region 20.

The portion of the body 10 adjacent the air inlet region is formed with bosses 22 bored to journally support a shaft 24 which is equipped with a generally circular disc-type valve 26 serving as a choke valve for starting the engine. The choke valve shaft 24 is provided with a manipulating arm 27. The body 10 is provided with bosses 28 bored to journally receive a shaft 30 which supports a generally circular disc-type throttle valve 32 for regulating the flow of fuel and air mixture to an engine with which the carburetor may be used.

An exterior portion of the throttle shaft 30 is provided with a manipulating arm 34, an adjustable abutment screw 36 being supported by the body 10 and engageable with the arm 34 for adjusting the engine idling position of the throttle valve 32. The carburetor body 10 is provided with a mounting flange 38 having openings 40 to accommodate bolts (not shown) for securing the carburetor to the crankcase of a two cycle engine or to an intake manifold of an engine of a four cycle type.

A flange 42 adjacent the air inlet region 14 is formed with threaded openings 44 to receive bolts or threaded members (not shown) for securing an air cleaner or air filter (not shown) to the carburetor body. The body member 10 is fashioned with a shallow recess disposed in close proximity to the mixing passage 12, the recess providing a fuel chamber 46 adapted to contain liquid fuel. Extending across the fuel chamber 46 and forming a flexible wall of the fuel chamber is a flexible member, diaphragm or membrane 48.

The diaphragm 48 is preferably of generally circular shape, and an annular gasket 50 is disposed between the peripheral region of the diaphragm 48 and a generally circular, disc-like portion 52 of the body member 10. The inner circular edge of the gasket 50 is preferably in registry with the circular side wall defining the fuel chamber 46. A closure or cover plate 54 embraces the exterior major surface of the diaphragm 48.

The peripheral region of the closure plate 54 is provided with openings which are in registry with threaded bores in the portion 52 of the body 10 to accommodate securing screws 56 which serve to secure the diaphragm 48, gasket 50 and closure plate 54 in assembled relation with the body member 10. The central region of the cover or closure plate 54 is depressed or recessed providing a clearance space or chamber 58 to accommodate flexing movements of the diaphragm. The space or chamber 58 is vented to the atmosphere through an opening 60 as shown in FIGURE 2. The closure member 54 may be formed of sheet metal or other suitable material.

The flexible diaphragm 48 is fashioned of a highly flexible, comparatively thin material which is impermeable or formed of a material which is impregnated to render the same impermeable and which is resistant to deterioration by hydrocarbon fuels. The diaphragm 48 is reinforced by a disc-like member 62 formed of sheet metal or molded resin and is disposed contiguous with the major surface of the diaphragm adjacent the chamber 46. A second circular disc-like member 64 is disposed at the opposite side of the diaphragm, the discs 62 and 64 being held in assembled relation with the diaphragm by a rivet or member 65.

The diaphragm 48, in the embodiment illustrated in FIGURES 1 through 7 is arranged to regulate or control the flow of liquid fuel from a supply into the chamber 46. The carburetor body is formed with a boss 66 provided with a threaded bore 67 accommodating the threaded portion of a fitting 68 formed with a passage 69 to accommodate fuel flow. The fitting 68 is provided with a nipple portion 70 which receives a flexible fuel supply hose or tube (not shown).

The passage 69 in the fitting 68 is in communication with a chamber or passage 72 formed in the carburetor body 10, a screen or filter 74 being disposed adjacent the end of the fitting 68 for preventing foreign particles that may be contained in the fuel entering the carburetor body. The body 10 is provided with a threaded bore adapted to accommodate a fitting or valve cage 76 having a central passage in which is slidably disposed a valve body 78 formed with a cone-shaped valve portion 80 at one end thereof.

An annularly shaped valve seat 82 is disposed at the end of the fitting and is adapted for cooperation with the cone-shaped valve 80 to regulate or control fuel flow into the chamber 46. Pivotaly supported or fulcrumed upon a pin 84 is a lever member 86, the pin 84 being provided with a portion 87 threaded into a bore in the body 10 for securing the pin in position as shown in FIGURE 7. The long arm 88 of the lever 86 is adapted to be engaged by the head of the rivet 65 carried by the diaphragm 48, the short arm 90 of the lever 86 engaging the lower end of the valve body 78 as shown in FIGURE 5.

An expansive coil spring 92 is seated in a bore 93 formed in an upper wall of the fuel reservoir or chamber 46 as shown in FIGURE 5. The spring 92 engages the long arm 88 of the lever 86 and biases the lever for movement in a clockwise direction as viewed in FIGURE 5, which action normally urges the valve 80 into seating position with the annular valve seat 82 to interrupt fuel flow into the fuel chamber 46.

The fuel chamber 46 is unvented and the diaphragm is flexed solely by aspiration or reduced pressure in the mixing passage 12 set up by air flow through the mixing passage. It is preferable to dispose the spring 92 close to the fulcrum 84 of the lever 86, as a comparatively stiff spring may be employed and yet retain a high degree of sensitivity of control of the fuel control valve 80 by the diaphragm. A drain screw 96 is provided for the fuel chamber 46 as shown in FIGURE 5 in the event that it is desired to drain the fuel from the chamber 46.

It should be noted that the fuel chamber 46 is made as shallow as is practicable and as close to the mixing passage 12 as possible to effect a lifting of fuel from chamber 46 by low or reduced aspiration acting on the diaphragm 48 and to reduce to a minimum the hydrostatic head of liquid fuel on the diaphragm so that comparatively low velocity of air in the mixing passage initiates delivery of fuel through the nozzle 102. The upper wall of the chamber 46 is fashioned with a recess 98 of a configuration to accommodate pivotal movement of the lever 86 as shown in FIGURES 5 and 7.

The carburetor of the invention is inclusive of a main nozzle or orifice construction for high speed engine operation which is fabricated as a removable unit 102 and a secondary fuel delivery system including engine idling and low speed orifices to facilitate idling of the engine and for low speed engine operation. The fuel conveying channels and fuel regulating or metering means for the main orifice and secondary orifice system are illustrated in FIGURES 6 and 7. The check valve and main nozzle unit construction 102 is illustrated in FIGURES 8 and 9 and will be hereinafter described in further detail.

The main nozzle unit construction 102 is pressed into a bore formed in the body 10 whereby fuel for high speed engine operation is delivered into the mixing passage in the zone of the choke band or restricted region 18 of the

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Venturi construction 16. The supplemental or secondary fuel delivery system is inclusive of a chamber 104, shown in FIGURES 2 and 7, an engine idling orifice 106 and a low speed orifice 108 in communication with the chamber 104 being arranged to deliver fuel into the mixing passage adjacent the region of the throttle valve 32.

The fuel conveying channels and fuel regulating or metering means are illustrated in FIGURES 6 and 7. As will be noted from FIGURE 7, the axes of the several fuel conveying channels or passages are arranged substantially in a single plane and are contained in a circular disc-like portion 52 of the carburetor body, providing for a compact arrangement and a smaller body construction than has heretofore been possible.

Angularly arranged in the disc-like portion 52 of the carburetor body is a passage or duct 110 in which is disposed a high speed fuel metering valve body 111 terminating in a needle valve portion 112, the needle valve portion extending into and cooperating with a restricted passage 114. The passage 114 is in communication with the recess 98 formed in a wall of the fuel chamber 46 and facilitates fuel flow from the fuel chamber 46 to the main orifice construction and to the supplemental or secondary fuel delivery orifices.

A passage 116 intersects the passage 110 and conveys fuel to the main orifice construction 102 and to the engine idling and low speed orifices 106 and 108. The valve body or member 111 has a threaded portion 115 threaded into a bore in the body 10 for regulating or adjusting the position of a needle valve portion 112 and is provided with a knurled knob 117 for the purpose. A sealing gasket 118 is disposed in a counterbore for preventing leakage of fluid along the valve member, a coil spring 119 engaging the knurled knob 117 for exerting biasing pressure upon the seal 118 and establishing friction so as to maintain the valve member 111 in adjusted position.

Arranged in parallelism with the passage 116 is a passage or duct 122, the passage 122 being in communication with the chamber 104 of the secondary fuel delivery system through a restricted passage 124. The passages 116 and 122 are cored or molded into the carburetor body and, in the fuel passage arrangement illustrated in FIGURE 7, have their outer ends closed by means of soft metal or lead plugs 126 and 127.

The passages 116 and 122 are connected by a passage or channel 130 and a restricted passage 132, as shown in FIGURE 7. The passage 130 accommodates a valve member or body 134 formed with a needle valve portion 136 arranged for cooperation with the restricted passage 132 for metering or regulating fuel flow to the secondary orifices 106 and 108. The valve body 134 is provided with a threaded portion 138 threaded into a bore in axial alignment with the passage 130 for adjusting the position of the needle valve 136.

The valve body 134 is provided with a knurled knob 140 for manipulating the metering valve 136. A sealing gasket 142 is disposed in a counterbore formed in the body and an expansive coil spring 144 engages the gasket and the knurled knob 140 to bias the gasket into sealing engagement with the valve body and to establish friction for maintaining the valve body in adjusted position. As shown in FIGURE 2 the end of the chamber 104 adjacent the fuel chamber 46 is closed by means of a plug or cap 146.

From FIGURE 7 it will be seen that fuel flows from the fuel or diaphragm chamber 46 through the recess 98, restricted passage 114 past the needle valve 112 to the main orifice construction 102, the latter delivering fuel into the choke band region 18 of the Venturi 16. Fuel for the idle and low speed fuel delivery system flows through the same channels, and through the passage 116, passage 130 past the needle valve 136 through the passage 132 and through the passages 122 and 124 into the chamber 104, which supplies fuel to the engine idling orifice 106 and the low speed orifice 108 depending upon

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the position of the throttle 32 and hence the velocity of air flow through the mixture passage.

From FIGURE 7 it will be seen that the needle valve 112 meters or regulates the fuel delivered to both the main orifice construction 102 and the secondary orifices 106 and 108, and the needle 136 meters or regulates fuel flow to the secondary orifices.

The carburetor of the invention is of a character which is operable in various angular positions as well as inverted positions, these conditions being encountered where the carburetor is used with engines powering chain saws which are adaptable for use in any position. In order to secure satisfactory operation in all positions of the carburetor, a check valve means is provided in the main orifice construction to prevent back bleeding of air from the mixing passage into the secondary orifice or fuel delivery system when the latter is in operation.

As particularly shown in FIGURES 8 and 9, the main or primary nozzle arrangement and valve construction are constructed as a unit 102 which may be readily inserted and removed from a bore in the carburetor body which opens into the mixing passage and into the fuel reservoir or chamber 46. The nozzle unit 102 is inclusive of a cylindrically-shaped fitting or cage formed of metal such as brass or other suitable material. The fitting 150 is provided with an axial bore 152 which does not extend entirely through the fitting. Arranged axially with the bore 152 is a counterbore 154 of slightly larger diameter which accommodates a valve means such as a ball check valve 156.

The passage 152 is of a diameter such that at the juncture of the passage with the counterbore 154 provides an annular seat 158 for the ball valve 156. The counterbore 154 opens into the choke band region 18 of the Venturi 16 and functions as the main or primary fuel delivery nozzle for high speed engine operation. The fuel delivery end region of the fitting 150 is formed with a second counterbore accommodating an annularly shaped member 160 formed of thin sheet metal or the like which is integrally formed with a diametrically arranged bar or abutment 162 shown in FIGURES 8 and 10.

In assembly, the check ball 156 is disposed in the counterbore 154, the annularly shaped member 160 positioned in the second counterbore and the end region of the fitting 150 swaged over the periphery of the member 160, as shown at 164 in FIGURE 8, to retain the member 160 in the end region of the fitting.

The abutment provided by the diametrically extending bar or grid 162 is normally spaced above the ball valve 156 a sufficient distance to facilitate movement of the valve away from the seat 158 to provide for fuel flow through passage 152 around the valve 156 and into the mixing passage.

The fitting 150 is provided with a circumferential or peripheral recess 166, as shown in FIGURE 8 and with aligned transversely extending bores forming passages 168 which establish communication between the central bore 152 and the peripheral recess 166 formed in the fitting. The circumferential recess 166 is arranged so as to be in communication with or intersect the passage 116. Thus, during high speed engine operation, fuel flowing past the metering needle 112 enters the circumferential recess 166 flowing through the passages 168 into the central bore 152, past the check valve 156 and into the mixing passage. When one or both of the secondary orifices 106 and 108 are delivering fuel into the mixing passage, the check valve 156 is seated to block the flow of air from the mixing passage through the main nozzle and thus prevent air bleeding into the fuel conveyed to the secondary orifices.

The check valve 156 is preferably fashioned of lightweight material such as nylon (polyamid resin) or polyoxymethylene resin (Delrin) rendering it operable under the influence of a minimum lift to elevate the ball from its seat 158. The relation between the diameter of the

counterbore 154 and the diameter of the ball check 156 is such that the annular region between the periphery of the ball and the counterbore provides a cross-sectional area sufficient to admit passage of the maximum fuel flow required for high speed engine operation.

It should be noted that the circular edge region 172 of the recess 166 is rounded or chamfered as shown in FIGURE 8. In assembling the nozzle and check valve unit 102 in the bore formed in the carburetor body, the fitting with the check ball and check ball retainer 160 in preassembled relation is pressed into the bore through the end of the bore opening into the fuel chamber 46. If it is desired to remove and replace the check valve and nozzle assembly 102, the fitting 150 may be driven entirely through the bore in the body 10 to extrude the fitting into the Venturi.

The fitting may thus be replaced by another fitting assembly of the same character. By rounding or chamfering the region 172 defining the circular recess 168, the fitting may be driven through the bore in the body and replaced with another fitting without damage to the bore surface. Heretofore it has been a practice of providing a separate threaded plug or closure for the bore accommodating a threaded nozzle fitting at the region of opening of the bore into the fuel chamber.

In the construction illustrated in FIGURE 8, the lower portion 174 of the fitting is imperforate and forms, as a part of the fitting, a closure for the end of the bore adjacent the fuel chamber 46. By providing the diametrically arranged passages 168 between the peripheral recess 166 and the central bore 152, the fitting 150 may be assembled in the bore in the body with assurance that fuel may flow through the main nozzle or through the circumferential recess and passages 168 to the secondary fuel delivery system irrespective of the radial position of the passages 168.

From the foregoing it will be apparent that there is provided a main nozzle and check valve unit construction which may be quickly and easily assembled in a carburetor body and which provides a closure of the end of the bore into which the fitting is assembled. FIGURES 1 through 7 illustrating the carburetor are slightly enlarged for purposes of illustration as the carburetor for use with engines of low horsepower is smaller than the scale shown in the drawings.

The operation of the charge forming apparatus or carburetor of the invention is as follows: As the fuel chamber 46 is unvented, the diaphragm is flexed or moved under the influence of aspiration or reduced pressure set up in the mixing passage by air flow therethrough. Reduced pressure effective in the chamber 46 flexes the diaphragm upwardly, as viewed in FIGURES 2 and 5, causing the lever 86 to be swung in a counterclockwise direction, as viewed in FIGURE 5, whereby the valve 80 moves away from its annular seat 82, facilitating flow of liquid fuel through the inlet fitting 68 past the valve 80, the polygonally shaped valve body 78 and into the chamber 46.

Fuel from the chamber flows through the recess 98, the restricted passage 114 past the high speed metering needle valve 112, through the circular recess 166 and passages 168 into the central bore 152, past the check valve 156 and is discharged into the Venturi of the mixing passage 12 for high speed engine operation. The amount of fuel flowing past the inlet valve 80 is regulated by the relative position of the diaphragm and is only sufficient to satisfy the requirements of the engine.

When the throttle is moved toward closed position, air velocity through the mixing passage decreases, and the pressure increases in the fuel chamber 46, and in conjunction with the pressure of the spring 92, the valve 80 is moved toward closed position as the diaphragm 48 moves downwardly, as viewed in FIGURES 2 and 5.

Fuel for the idling and low speed orifices flows through the peripheral recess 166 in the fitting 150 or through

passages 168, through passages 116 and 130, past the metering needle 136, through the restriction 132, passages 122 and 124 into the chamber 104. If the throttle valve 32 is in engine idling position, fuel is delivered through the orifice 106. If the throttle valve 32 is partially opened, fuel may be delivered through both orifices 106 and 108. When the throttle is opened a greater distance, the main orifice 154 comes into operation and the secondary orifices gradually decrease fuel delivery into the mixing passage.

FIGURES 11 through 14 illustrate certain modifications of the construction shown in FIGURES 1 through 7. In the arrangement shown in FIGURES 11 through 14, the body 10' is of the same construction as the body 10 hereinbefore described. The fuel inlet control arrangement of the construction shown in FIGURES 11 through 14 is identical with the fuel inlet valve mechanism shown in FIGURES 1 through 6. The diaphragm 48' influences the position of a lever 86' for controlling the fuel inlet valve mechanism.

The carburetor in this form of the invention is inclusive of a choke valve 26', a throttle valve 32' and a Venturi 16'. The carburetor includes the main fuel delivery nozzle and check ball unit 102' and the secondary engine idling and low speed orifices 106' and 108' which are in the same relative positions as illustrated in FIGURE 2. As illustrated in FIGURE 12, a modified form of closure plate 180 is provided for securing the diaphragm 48' and the gasket 50' to the carburetor body 10'.

In this form of the invention the chamber 182, between the lower or obverse face of the diaphragm and the cover plate 180, is vented to the air inlet region 14' of the mixing passage. As shown in FIGURE 12 an angularly arranged air inlet or vent tube 184 is disposed in a bore formed in the wall of the air inlet region 14'. The tube 184 is in communication with the space or chamber 182 by means of registering passageways 185 and 186 formed respectively in the body 10 and closure 180 whereby the space 182 is vented through the air inlet region 14' of the mixing passage.

In the usual arrangement, an air cleaner is secured to the carburetor body at the air inlet region and hence the space 182 is thus vented to air adjacent the air cleaner and the liability of dust or foreign matter entering the space 182 is substantially eliminated. Furthermore this form of venting maintains pressure balance of the carburetor against the restriction of the air cleaner if partial clogging should occur.

In the form of the invention illustrated in FIGURES 11 through 14, the adjustable fuel metering controls for the high speed or main orifice and the secondary fuel delivery system are disposed in a side region of the carburetor body. This arrangement is illustrated in FIGURES 11 and 13.

As particularly shown in FIGURE 13, the passage 116' has a threaded portion to accommodate a threaded valve body 115' similar in construction to the valve 115 shown in FIGURE 7, the valve body having a knurled manipulating knob 117'. The passage 122' is formed with a threaded region to accommodate the threaded portion of a valve body 134' which is of lesser length than the metering valve 134 shown in FIGURE 7 but functions in the same manner as valve member 134, viz. to meter or regulate fuel flow to the chamber 104' for delivery through the secondary orifices 106' and 108'. The valve body 134' is provided with a knurled manipulating knob 140'.

As shown in FIGURE 14, a passage 188 connects the fuel chamber 46' with the duct or passage 116' whereby fuel flows to the main orifice and ball valve unit 102' for delivery into the Venturi of the mixing passage, or fuel may flow through passage 116', angularly arranged passage 130', restricted passage 132', past the needle valve portion 136' of the valve body 134', thence through the

restriction 124' into the chamber 104' for delivery through the secondary orifices.

The operation of the modified form of the invention illustrated in FIGURES 11 through 14 is substantially the same as the operation of the form of the invention shown in FIGURES 1 through 7 as hereinbefore explained. The passage 110' shown in FIGURE 13 which is cored or cast in the carburetor body 10 is not drilled for communication with any other passage or duct and performs no function in this form of carburetor. The passage 130' which establishes communication between passages 116' and 122' has its outer end region closed by means of a soft metal plug 192.

It will be apparent from the foregoing description that the carburetor body of the type shown in FIGURE 7 and in FIGURE 13 may be cast or molded and the passages 110', 116', 130' and 122' may be fashioned in part in molding the carburetor body and certain of these passages subsequently machined or processed to provide the fuel conveying and metering arrangement shown in FIGURE 7, or machined to provide the fuel conveying and metering arrangement illustrated in FIGURE 13.

In the arrangement shown in FIGURE 7, the high speed adjusting valve member 115 and the metering valve member 134 are disposed in the convergently arranged passages 110 and 130 and are arranged to be manipulated from the air entrance end of the carburetor, while in the arrangement shown in FIGURE 13 the metering valve members 115' and 134' are arranged in parallel relation and are accessible from a side of the carburetor body. Other arrangements of fuel ducts or passages than those illustrated in FIGURES 7 and 13 may be employed. For example, in FIGURE 13, separate fuel supply ports for passages 116' and 122' directly to chamber 46' may be used and passage 130' eliminated.

FIGURE 15 illustrates a diaphragm type pump construction associated with the carburetor for feeding fuel to the inlet valve region of the carburetor body. In the arrangement shown in FIGURE 15, the cover member 54, shown in FIGURE 2, is replaced with a disc-like member 200 formed with a space 202 to accommodate flexing movements of the diaphragm 48 and is vented by a vent passage 203. The disc-like member 200 forms one section of a pump construction 204, the disc 200 being formed with a recess 206 providing a pumping chamber.

Secured to the member 202 by means of screws 208 is a second pump body section 210 which is formed with a recess providing a fuel chamber 212 adapted to receive fuel from a supply to be pumped into the carburetor. Disposed between the pump body sections 200 and 210 is a pumping diaphragm 214. The pumping chamber 206 is connected with a source of varying fluid pressure such as the crankcase of a two cycle engine for effecting vibration of the pumping diaphragm 214 setting up a pumping action in the fuel chamber 212. The pump construction illustrated in FIGURE 15 may be of the character illustrated in my Patent 2,796,838, granted June 25, 1957.

The pump body section 210 is provided with a chamber 216 which receives fuel through a strainer or screen 218 from a supply through an inlet fitting 220 formed on a closure member 222 secured to the lower portion of the pump section 210 by means of a screw 224.

The pump body section 210 is provided with fuel conveying ducts or passages (not shown) which communicate with ports controlled by flap valves (not shown) provided as integral parts of the pumping diaphragm 214 to establish fuel flow through the fuel chamber 212 to the region of the inlet valve in the carburetor.

Thus it will be apparent that the forms of carburetor of the invention illustrated may be supplied with fuel from a tank or fuel receptacle by gravity, or the fuel may

be pumped into the carburetor chamber 46 through an arrangement of the character illustrated in FIGURE 15.

FIGURES 16 and 17 illustrate a modified form of main or primary nozzle and check valve construction 102' adapted to be pressed into a bore in the carburetor body for delivering fuel into the Venturi of the mixing passage. The unit 102' includes a cylindrically shaped fitting or cage 230 formed of brass or other suitable material. The fitting 230 is formed with an axial bore 232 which does not extend entirely through the fitting. The upper region of the fitting is provided with a counterbore 234 which accommodates a circular disc-shaped valve member 236 of lesser diameter than that of the counterbore 234.

The region of transition between the upper terminus of the axial bore 232 and the counterbore 234 is shaped to provide an annular ledge 238 forming a seat for the disc valve 236. The upper end region of the fitting is formed with a second counterbore which receives a valve retainer member or abutment 240 generally of the shape of a Maltese cross. In assembling the components, the disc valve 236 is inserted in the counterbore 234, the retainer disposed in the second counterbore in the fitting, and the upper edge of the fitting swaged or deformed as at 242 over the ends of the arms of the retainer 240 to secure the retainer to the fitting.

The check valve 236 is arranged for unimpeded movement in the space provided by the counterbore 234 between the valve seat 238 and the retainer 240 to facilitate fuel flow through the bore or passage 232 around the periphery of the valve member 236 past the arms of the retainer 240 and into the mixing passage of the carburetor. The fitting 230 is provided with a peripheral recess 166' and aligned transversely extending bores forming passages 168' to facilitate fuel flow as hereinbefore described in connection with the nozzle and check valve unit 102.

The valve member 236 is preferably made of comparatively lightweight material. The valve member 236 may be made of polyoxymethylene (Delrin), phenolformaldehyde resin (Bakelite), polyester resin (Mylar), polytrifluorochloroethylene (Kel-F) polyamid resin (nylon) or other suitable material.

FIGURE 18 illustrates another form of combined nozzle and check valve arrangement for delivering fuel into the mixing passage for high speed engine operation. A portion of the carburetor body 10 is illustrated in FIGURE 18 and is provided with a bore 250 between the fuel chamber 46 of a carburetor and the restricted region 18 of the Venturi 16. A casing or housing 252 having a smooth exterior circular cylindrical configuration or shape is of a diameter whereby the same may be pressed or forced into the bore 250. The casing 252 is provided with a bore 254 and with a counterbore 256, the juncture of the bore and counterbore forming an annular valve seat 258. The spherical or ball-shaped valve 260 is contained within the counterbore 256 and is adapted to engage the annular seat 258. An abutment member 160', of the same type shown at 160 in FIGURE 10, is disposed in the fuel outlet end region of the casing 252 to prevent dislodgement of the valve member 260. A disc valve member of the character illustrated at 236 in FIGURE 17 may be used in lieu of the ball type valve member.

The entrance of the bore 250 adjacent the fuel chamber in the carburetor is formed with a counterbore 262 to accommodate a disc-type closure member or plate 264 which may be in the form of a Welsh plug. The space between the closure plate 264 and the end of the casing 252 within the bore is in communication with the passage 116 formed in the body 10 of the carburetor and is adapted to convey fuel into the space provided by the bore 250 through the bore 254 past the ball valve 260 for delivery into the Venturi of the mixing passage.

It is desirable that the diaphragm fuel chamber be

disposed close to the mixing passage so that low air velocity in the mixing passage establishes sufficient aspiration or reduced pressure to actuate the diaphragm and effect delivery of fuel into the mixing passage.

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

I claim:

1. In combination, charge forming apparatus including a body formed with a mixing passage, an unvented fuel chamber formed in the body, a flexible diaphragm forming a wall of the fuel chamber, a fuel inlet for the fuel chamber, a valve member for the fuel inlet, means including a lever establishing operative connection between the valve member and the diaphragm for controlling the position of the valve member for regulating fuel flow from a supply into the fuel chamber, said body being formed with a bore opening into the mixing passage, a fitting having a smooth cylindrical exterior surface pressed into said bore, an end region of the fitting extending into the mixing passage, said fitting having a fuel passage formed therein opening into the mixing passage, a secondary fuel delivery orifice formed in said body opening into the mixing passage, duct means formed in the body for conveying fuel from the fuel chamber to the secondary orifice, and means in said fitting to prevent air bleeding through the passage in the fitting into the duct means when the secondary orifice is delivering fuel into the mixing passage.

2. In combination, charge forming apparatus including a body formed with a mixing passage, an unvented fuel chamber formed in the body, a flexible diaphragm forming a wall of the fuel chamber, a fuel inlet for the fuel chamber, a valve member for the fuel inlet, means including a lever establishing operative connection between the valve member and the diaphragm for controlling the position of the valve member for regulating fuel flow from a supply into the fuel chamber, said body being formed with a smooth surfaced bore between the fuel chamber and the mixing passage, a fitting having a smooth cylindrical exterior surface pressed into said bore, said fitting having a fuel passage formed therein opening into the mixing passage, a secondary fuel delivery orifice in said body opening into the mixing passage, duct means formed in the body for conveying fuel from the fuel chamber to the secondary orifice, a ball valve in said fitting to prevent air bleeding through the passage in the fitting into the duct means when the secondary orifice is delivering fuel into the mixing passage, and means closing the end of the bore adjacent the unvented fuel chamber.

3. An apparatus of the character disclosed, in combination, a carburetor body formed with a mixing passage, a fuel chamber in said body, a flexible diaphragm forming a wall of the fuel chamber, means controlled by said diaphragm for admitting liquid fuel from a supply into said chamber, a bore in said body between the chamber and the mixing passage, primary means for delivering liquid fuel from the chamber into the mixing passage including a combined fuel delivery nozzle and check valve unit in said bore comprising a casing having a smooth circular cylindrical surface, a fuel conveying passage formed axially in said casing, a counterbore of greater cross-sectional area than said passage formed in said casing, a ball valve member disposed in said counterbore and adapted to obstruct air flow from the mixing passage into the passage in said casing, abutment means arranged to maintain the ball valve member in the counterbore, a peripheral recess formed in the exterior cylindrical wall of the casing, a transverse bore in the casing in communication with the passage in said casing, means formed integrally on said casing for closing the end of the bore adjacent the fuel chamber, and sec-

ondary orifice means for delivering liquid fuel into the mixing passage at low engine speeds.

4. An apparatus of the character disclosed, in combination, a carburetor body formed with a mixing passage, a fuel chamber in said body, a flexible diaphragm forming a wall of the chamber, means controlled by the diaphragm for admitting liquid fuel into said chamber from a supply, a bore of uniform diameter in said body between the chamber and mixing passage, a combined fuel delivery nozzle and check valve unit in said bore comprising a fitting having a smooth circular cylindrical exterior surface, an end of said fitting extending through the bore into the mixing passage, a fuel conveying duct formed axially in said fitting, a counterbore formed in said fitting, a valve member disposed in said counterbore and adapted to obstruct air flow from the mixing passage into the duct in the fitting, a recess formed in the exterior cylindrical surface of the fitting, a transverse bore in the casing in communication with the recess and the duct for conveying fuel to the duct for delivery from the fitting into the mixing passage, means for closing the end of the bore accommodating the fitting, and a secondary orifice in said body opening into the mixing passage arranged to deliver liquid fuel into the mixing passage at low engine speeds.

5. In combination, charge forming apparatus including a body formed with an air and fuel mixing passage, a fuel chamber formed in the body, a flexible diaphragm forming a wall of the fuel chamber, a fuel inlet for the fuel chamber, a valve member for the fuel inlet, means establishing operative connection between the valve member and the diaphragm for controlling the position of the valve member for regulating fuel flow from a supply into the fuel chamber, said body being formed with a bore opening into the mixing passage, a fitting having a smooth cylindrical exterior surface pressed into said bore, said fitting having an end portion extending into the mixing passage and having a fuel passage formed therein opening into the mixing passage, a secondary fuel delivery orifice in said body opening into the mixing passage, duct means formed in the body for conveying fuel from the fuel chamber to the recess in the fitting and the secondary orifice, said fitting having a peripheral recess formed therein, a channel in said fitting between the recess and the passage in the fitting, and check valve means in said fitting arranged to close the passage in the fitting to prevent air bleeding through the passage in the fitting into the duct means when the secondary orifice is delivering fuel into the mixing passage.

6. In combination, charge forming apparatus including a body formed with an air and fuel mixing passage, a comparatively shallow unvented fuel chamber formed in the body, a flexible diaphragm forming a wall of the fuel chamber, a fuel inlet for the fuel chamber, a valve member for the fuel inlet, means establishing operative connection between the inlet valve member and the diaphragm for controlling the position of the valve member for regulating fuel flow from a supply into the fuel chamber, said diaphragm being actuated by aspiration in the mixing passage, said body being formed with a bore opening into the mixing passage, a nozzle member formed with a smooth cylindrical exterior surface pressed into the bore, said nozzle member having a fuel passage formed therein opening into the mixing passage and forming a main fuel discharge orifice, a secondary fuel delivery orifice in said body opening into the mixing passage, duct means formed in said body arranged to convey liquid fuel from the fuel chamber to the main and secondary fuel delivery orifices, manually adjustable means for metering fuel flow to the passage in the nozzle member, and an element in said nozzle member arranged to prevent air bleeding through said main orifice into the duct means when the secondary orifice is delivering fuel into the mixing passage.

7. In combination, charge forming apparatus including

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a body formed with a mixing passage, an unvented fuel chamber formed in the body, a flexible diaphragm forming a wall of the fuel chamber, a fuel inlet for the fuel chamber, a valve member for the fuel inlet, said diaphragm being arranged to control the position of the inlet valve member for regulating fuel flow from a supply into the fuel chamber, said body being formed with a bore opening into the mixing passage, a fitting formed with a smooth cylindrical exterior surface pressed into said bore, a portion of the fitting projecting into the mixing passage, said fitting having a fuel passage formed therein opening into the mixing passage, a secondary fuel delivery orifice in said body opening into the mixing passage, duct means formed in the body for conveying fuel from the fuel chamber to the secondary orifice, and a disc valve in said fitting to prevent air bleeding through the passage in the fitting into the duct means when the secondary orifice is delivering fuel into the mixing passage.

8. In combination, charge forming apparatus including a body formed with an air and fuel mixing passage, an unvented fuel chamber formed in the body, a flexible diaphragm forming a wall of the fuel chamber, a fuel inlet for the fuel chamber, a valve member for said fuel inlet, said diaphragm being arranged to control the relative position of the valve member for regulating fuel flow from a supply into the fuel chamber, said body being formed with a bore opening into the mixing passage, a fitting formed with a smooth cylindrical exterior surface pressed into said bore, said fitting having a fuel passage formed therein opening into the mixing passage providing a main orifice for delivering fuel into the mixing passage, said fitting having a channel in communication with the passage and the bore in the body, a second fuel delivery orifice in said body opening into the mixing passage, duct means formed in said body arranged to convey fuel from the fuel chamber to the channel in the fitting and the second fuel delivery orifice, means associated with the duct means for metering fuel flow through the duct means, check valve means in said fitting to prevent air bleeding through the main orifice into the duct means when said second orifice is delivering fuel into the mixing passage, said fitting being formed with a portion closing the region of the bore opening into the fuel chamber.

9. In combination, charge forming apparatus including a body formed with an air and fuel mixing passage, an unvented fuel chamber formed in the body, a flexible diaphragm forming a wall of the fuel chamber, a fuel inlet for the fuel chamber, a valve member for said fuel inlet, means including a lever arranged to be actuated by movement of the diaphragm for controlling the valve member for regulating fuel flow from a supply into the fuel chamber, said body being formed with a bore opening into the mixing passage, a fitting having a smooth cylindrical exterior surface pressed into said bore, said fitting having a fuel passage formed therein opening into the mixing passage providing a main orifice for delivering fuel into the mixing passage, said fitting having a channel in communication with the passage and the bore in the body, a second fuel delivery orifice in said body opening into the mixing passage, duct means formed in said body arranged to convey fuel from the fuel chamber to the passage in the fitting and the second fuel delivery orifice, means associated with the duct means for metering fuel flow through the duct means, a ball check valve in said fitting to prevent air bleeding through the main orifice into the duct means when said second orifice is delivering fuel into the mixing passage, said fitting being formed with a portion closing the region of the bore opening into the fuel chamber.

10. In combination, charge forming apparatus including a body formed with an air and fuel mixing passage, a comparatively shallow unvented fuel chamber formed in the body, a flexible diaphragm forming a wall of the fuel chamber, a fuel inlet for the fuel chamber, a valve

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member for the fuel inlet, means including a lever establishing operative connection between the inlet valve member and the diaphragm for controlling the position of the valve member for regulating fuel flow from a supply into the fuel chamber, said diaphragm being actuated by aspiration in the mixing passage, said body being formed with a smooth surfaced bore opening into the mixing passage, a nozzle member having a smooth cylindrical surface pressed into the bore, said nozzle member having a fuel passage formed therein opening into the mixing passage and forming a main fuel discharge orifice, a secondary fuel delivery orifice in said body opening into the mixing passage, closure means for the region of the smooth surfaced bore opening into the fuel chamber, duct means formed in said body arranged to convey liquid fuel from the fuel chamber to the main and secondary fuel delivery orifices, a counterbore formed in said nozzle member, check valve means movably disposed in said counterbore arranged to prevent air bleeding through said main orifice into the duct means when the secondary orifice is delivering fuel into the mixing passage, and an abutment carried by the nozzle member for retaining the valve means in said counterbore.

11. In combination, charge forming apparatus including a body formed with an air and fuel mixing passage, a comparatively shallow unvented fuel chamber formed in the body, a flexible diaphragm forming a wall of the fuel chamber, a fuel inlet for the fuel chamber, a valve member for the fuel inlet, said diaphragm being arranged to control the relative position of the valve member for regulating fuel flow from a supply into the fuel chamber, said diaphragm being actuated by aspiration in the mixing passage, said body being formed with a smooth surfaced bore opening into the mixing passage, a nozzle member having a smooth cylindrical surface pressed into the bore, said nozzle member having a fuel passage formed therein opening into the mixing passage and forming a main fuel discharge orifice, a secondary fuel delivery orifice in said body opening into the mixing passage, closure means for the region of the smooth surfaced bore opening into the fuel chamber, duct means formed in said body arranged to convey liquid fuel from the fuel chamber to the main and secondary fuel delivery orifices, a counterbore formed in said nozzle member, an element disposed in said counterbore arranged to prevent air bleeding through said main orifice into the duct means when the secondary orifice is delivering fuel into the mixing passage, and an abutment carried by the nozzle member for retaining the disc valve in said counterbore.

12. In combination, charge forming apparatus including a body formed with an air and fuel mixing passage, a comparatively shallow unvented fuel chamber formed in the body, a flexible diaphragm forming a wall of the fuel chamber, a fuel inlet for the fuel chamber, a valve member for the fuel inlet, said diaphragm being arranged to control the relative position of the valve member for regulating fuel flow from a supply into the fuel chamber, said diaphragm being actuated by aspiration in the mixing passage, said body being formed with a smooth surfaced bore opening into the mixing passage, a nozzle member having a smooth cylindrical surface pressed into the bore, said nozzle member having a fuel passage formed therein opening into the mixing passage and forming a main fuel discharge orifice, a secondary fuel delivery orifice in said body opening into the mixing passage, closure means for the region of the smooth surfaced bore opening into the fuel chamber, duct means formed in said body arranged to convey liquid fuel from the fuel chamber to the main and secondary fuel delivery orifices, a first adjustable means for metering fuel flow from the fuel chamber to the main fuel discharge orifice, a second adjustable means for metering fuel flow to said second fuel delivery orifice, a counterbore formed in said nozzle member, check valve means movably dis-

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posed in said counterbore arranged to prevent air bleeding through said main orifice into the duct means when the secondary orifice is delivering fuel into the mixing passage, and means associated with the nozzle member for retaining the valve means in said counterbore.

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