Feb. 22, 1966 B. C. PHILLIPS 3,236,505

CHARGE FORMING APPARATUS

Filed July 18, 1962 3 Sheets-Sheet 1

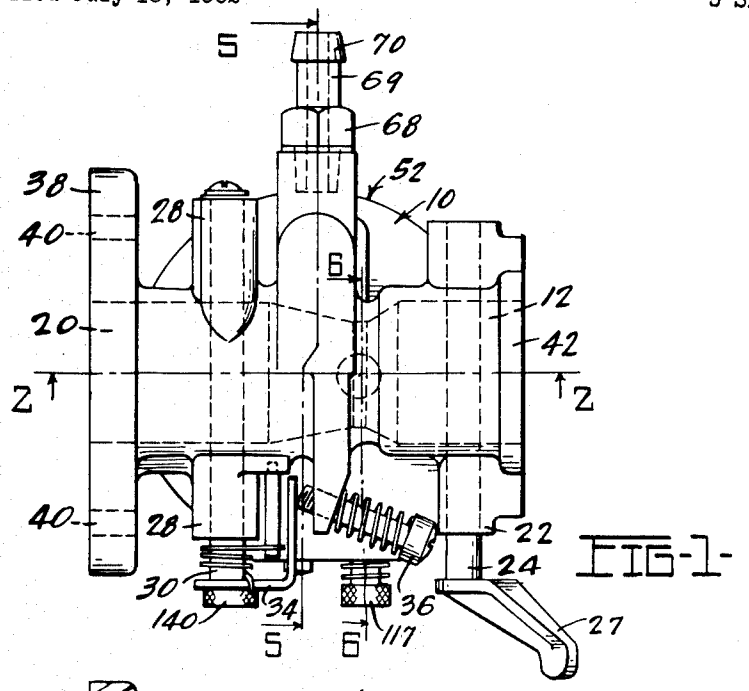


FIG-1-

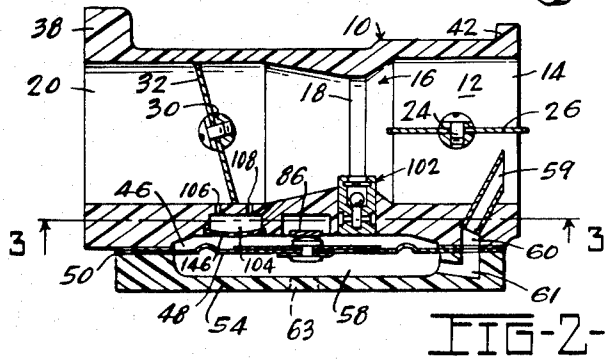


FIG-2-

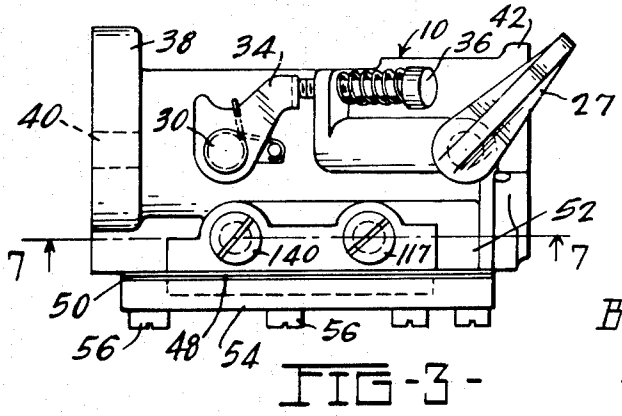


FIG-3-

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CHARGE FORMING APPARATUS

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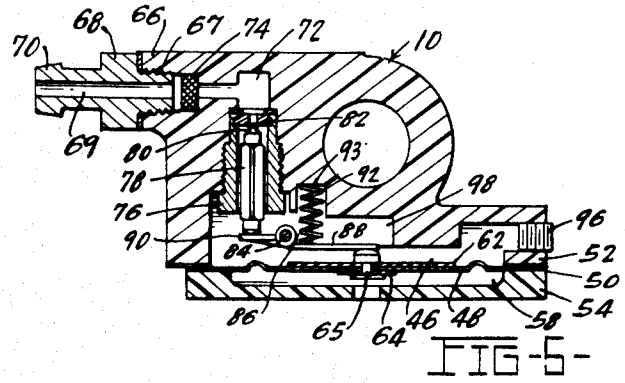


FIG-5-

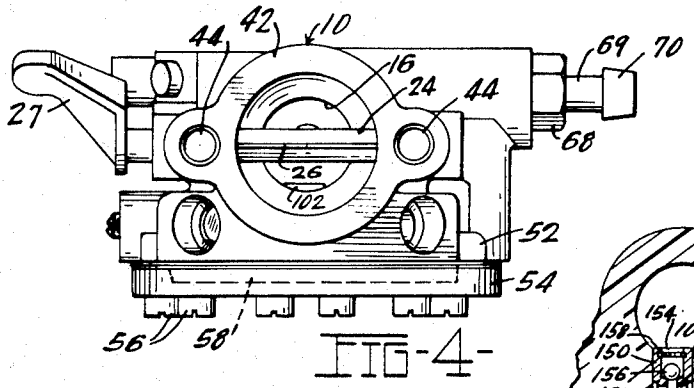


FIG-4-

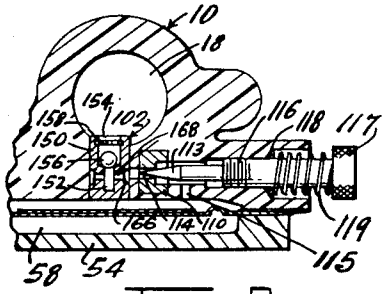


FIG-6-

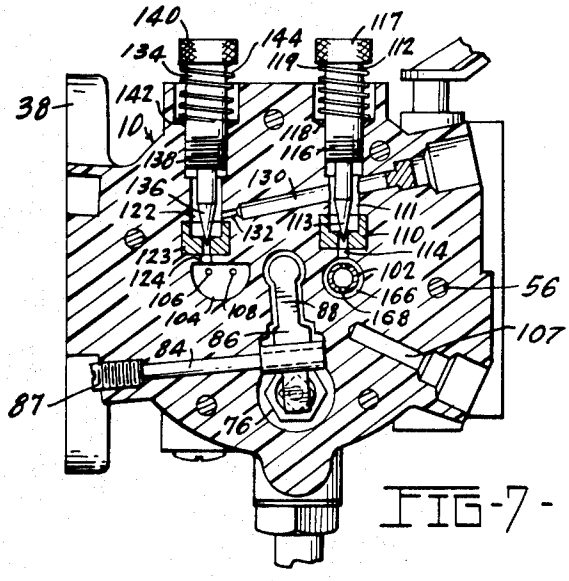


FIG-7-

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CHARGE FORMING APPARATUS

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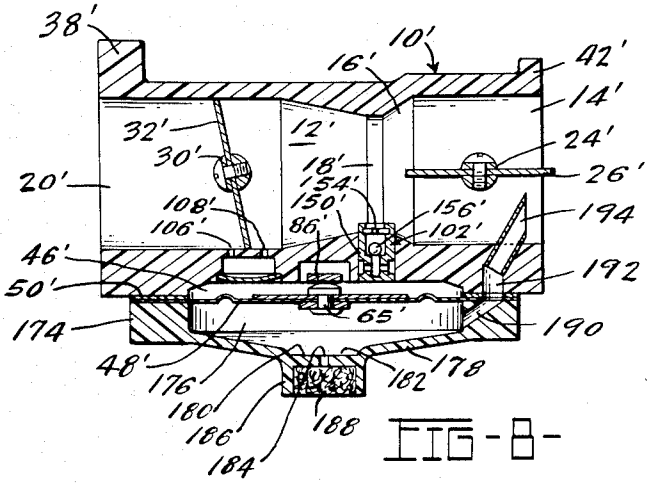


FIG-8-

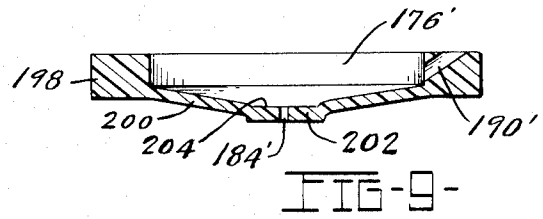


FIG-9-

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United States Patent Office

3,236,505

Patented Feb. 22, 1966

3,236,505

CHARGE FORMING APPARATUS

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Filed July 18, 1962, Ser. No. 210,706
1 Claim. (Cl. 261—42)

This application is a continuation-in-part of my application, Serial No. 51,414, filed August 23, 1960 and now abandoned.

This invention relates to charge forming apparatus for supplying fuel and air mixture 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 or reduced pressure in the mixing passage of the carburetor for automatically regualting 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 extensively for supplying combustible fuel and air mixture for two cycle engines of the types having particular utility for powering chain saws, outboard motors, lawnmowers, air compressors, generators, ventilating fans, small portable engine operated equipment and wherever a diaphragm carburetor has been found to have utility.

An object of the invention is the provision of an arrangement in a carburetor body fashioned of resinous plastic or of metal for venting the air space adjacent the diaphragm to avoid accumulation of fuel that may enter the space under certain operating conditions.

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 structures, 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 carburetor wherein the body member and other components are formed or fabricated of resinous plastic materials;

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

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

FIGURE 4 is an elevational view of the air inlet end of the carburetor illustrated in FIGURE 1;

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 a longitudinal sectional view of a carburetor illustrating one form of venting arangement for the air space adjacent the diaphragm, and

FIGURE 9 is a sectional view of a diaphragm closure embodying a vent arrangement without a filter.

While the charge forming apparatus or carburetor of the present invention has particular utility for supplying combustible mixture to engines of the two cycle type, it is to be understood that this invention may be employed with four cycle engines. The charge forming apparatus or carburetor 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 the charge forming apparatus or carburetor is inclusive of a body or a body member **10** formed or molded of resinous plastic of nonporous character which is inert or resistant to deterioration by hydrocarbon fuels.

The body member **10** is molded or fashioned of a resinous plastic commercially known as Delrin, identified chemically as polyoxymethylene which has high strength characteristics, is nonporous, and is highly resistant to deterioration by hydrocarbon fuels. This material is a highly crystalline thermo-plastic resin. 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 boss portions **22** bored to receive a shaft **24** journally mounted in the bores which supports a generally circular disc-type valve **26** as a choke valve for starting the engine. The choke valve shaft **24** is integrally formed with a manipulating arm **27** as a unit construction. The choke valve shaft **24** and the arm **27** may be molded of polyoxymethylene (Delrin).

The body **10** is formed with boss portions **28** bored to journally receive a metal shaft **30** which supports a generally circular disc-type valve **32** providing a throttle valve 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 the 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 to the carburetor body.

The body member **10** is fashioned with a shallow circular 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 chamber is a flexible member, diaphragm or membrane **48**. The diaphragm **48** is preferably of generally circular shape and is disposed adjacent a generally circular portion **52** of the body **10**. An annular gasket **50** is disposed between the circular portion **52** of the body and the peripheral region of the diaphragm **48**. A closure or cover plate **54** embraces the exterior major surface of the diaphragm and is provided with openings which are in registry with threaded bores in the annular 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 air entrance end **14** of the mixing passage by a tube **59** and registering passageways **60** and **61** as shown in FIGURE 2. If desired, the space or chamber **58** may be vented by eliminating the tube **59** and passageways **60** and **61** and providing an opening **63** illustrated in broken lines in FIGURE 2. The closure member **54** may be molded

of polyoxymethylene (Delrin) or phenolformaldehyde resin (Bakelite).

The flexible diaphragm 48 is fashioned of a highly flexible, thin material which is imperforate. The diaphragm may be made of resin film commercially known as Kel–F, identified chemically as polytrifluorochloroethylene. This material has high strength characteristics, will withstand elevated temperatures to about 200° centigrade and is chemically inert to liquid hydrocarbon fuels. The diaphragm may be made of polyvinyl fluoride film commercially known as "Teslar." The diaphragm may also be made of a material commercially known as "Gentron" which is identified chemically as chlorotrifluoroethylene.

The diaphragm 48 is reinforced by a disc-like member 62 formed of sheet metal or molded resin and is disposed on 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 65 or other suitable means.

The diaphragm 48, in the embodiment illustrated in FIGURES 1 through 7 is arranged to control the flow of liquid fuel into the chamber 46. The carburetor body is formed with a boss portion 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 in the body adjacent the end of the fitting 68 for preventing entrance of foreign particles into 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.

Pivotally fulcrumed or supported upon a pin 84 is a lever member 86, the pin 84 being provided with a threaded 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. The lever 86 may be molded of polyoxymethylene (Delrin).

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 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 inlet valve 80 into seating position with the annular valve seat 82 to interrupt fuel flow into the fuel chamber 46. While it is preferable to dispose the spring 92 close to the pivot pin 84 as it enables the use of a stiffer spring and obtain sensitive control of the diaphragm over the inlet valve 80, the spring may be positioned to engage any region of the lever arm 88.

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. A drain screw 96 is provided for the fuel chamber 46, shown in FIGURE 5, in the event that it is desired to drain fuel from the chamber 46.

Both the valve guide or cage 76 and the inlet valve member 78 may be formed or molded of polyoxymethylene (Delrin). The annular valve seat 82 may be formed or molded of polytrifluorochloroethylene (Kel–F). The

utilization of a valve member or body 78 formed of molded plastic or resin attains several important advantages over the use of metals for the valve member. For certain uses it is desirable to operate engines and particularly two cycle engines at higher speeds upwards of 8000 revolutions or more per minute.

Engine vibrations are necessarily transmitted to the carburetor body by reason of attachment of the carburetor directly to the engine. The inlet needle valve, which is subject to relative movement with respect to the carburetor, is biased toward closed position by means of the expansive coil spring 92, the valve being opened by upward flexure of the diaphragm 48 under the influence of aspiration in the mixing passage. At comparatively high engine speeds a metal valve body will not move or vibrate in synchronism with the carburetor and such out-of-phase condition results in the valve member or body not following the movements of the valve seat in the carburetor and remains open whereby an excess amount of fuel flows into the carburetor impairing the fuel-air mixture ratio in the mixing passage. The spring 92 engaging the lever and biasing the inlet valve member toward closed position is a potential energy storage medium or reservoir. If the inlet valve is formed of relatively dense material such as metal, it may develop an asynchronous or out-of-phase bouncing movement relative to the carburetor body under the influence of engine vibration, and the pressure or potential energy of the spring at certain engine speeds may not be sufficient to overcome the inertia bouncing of the valve.

By utilizing a valve formed of plastic such as polyoxymethylene (Delrin) having a comparatively low specific gravity and therefore being but a fraction of the weight of a valve member fashioned of stainless steel or brass, the effect of engine vibration on the inlet valve at high speeds is greatly reduced and inertia bouncing eliminated so that an effective control or regulation of fuel flow into the carburetor is attained providing for the delivery of a proper fuel and air mixture to the engine at high engine speeds.

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 is possible to reduce the amount of pneumatic "lift" required for fuel delivery and flexing the diaphragm 48. 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 orifice construction which is fabricated as a removable unit 102 and a secondary fuel delivery system including engine idling and low speed orifices 106 and 108 to facilitate idling of the engine and for low speed engine operation. The fuel conveying channels and adjustable fuel controlling or metering means for the main orifice and secondary orifice system are illustrated in FIGURES 6 and 7. The main nozzle unit construction 102 is pressed into a bore formed in the body 10 in the position shown in FIGURES 1 and 6 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 Venturi construction.

The supplemental or secondary fuel delivery system is inclusive of a chamber 104 shown in FIGURES 2 and 7 from which the engine idling orifice 106 and a low speed orifice 108 convey or 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 fuel conveying channels are arranged in a single plane and are contained in the circular disc-like portion 52 of the carburetor body providing for a compact arrangement and small body construction.

Arranged in the disc-like portion 52 of the carburetor

body is a passage **111** as shown in FIGURE 7. Disposed axially of the passage and adjacent the high speed orifice construction **102** is a metal insert **110**, preferably formed of brass. The insert or fitting **110** is formed with a bore forming a continuation of the passage **111** and extending partially through the insert, the insert having a restricted passage **114** in communication with the passage **111** and a circumferential recess **166** forming a fuel conveying channel in the body of the unit **102**.

Disposed in the passage **111** is a high speed fuel metering valve body **112** terminating in a needle valve portion **113**, the needle valve portion extending into and cooperating with the restricted passage **114** provided in the metal fitting **110**. As shown in FIGURE 6, the passage **111** is in communication with the fuel chamber **46** by means of a passage **115** formed in a wall of the insert **110**, the passage facilitates fuel flow from the fuel chamber **46** to the main orifice construction **102** and to the supplementary or secondary fuel delivery orifices **106** and **108**.

The valve body **112** has a threaded portion **116** cooperating with a threaded region in the wall of the passage **111**, the valve body being rotatable for regulating the position of the needle valve portion **113** to regulate or meter fuel flow to the main orifice construction **102**. The valve member **112** is provided with a knurled knob **117** for adjusting the position of the valve body **112**. A sealing gasket **118** is disposed in a counterbore formed in the outer end region of the passage **111** for preventing leakage of fluid along the valve member. A spring **119** engages the knurled knob **117** for exerting biasing pressure upon the seal **118** and sets up friction sufficient to maintain the valve member **112** in adjusted position.

Arranged in substantial parallelism with the passage **111** is a passage or duct **122**. Disposed axially of the passage **122** is a metal insert **123**. The insert or fitting **123** is formed with a bore forming a continuation of the passage **122** and extending partially through the insert. The insert **122** is fashioned with a restricted passage **124** in communication with the chamber **104** of the secondary fuel delivery system. The passages **111** and **122** are cored or molded into the carburetor body during the body molding operation. The passages **116** and **122** are in communication by means of a passage **130** and a restricted passage **132** as shown in FIGURE 7.

The passage **122** accommodates a valve member or body **134** terminating in a needle valve portion **136** arranged for cooperation with the restricted passage **124** 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 the body **10** in axial alignment with the passage **122** for adjusting the position of the needle valve **136**. The valve body **134** is provided with a knurled knob **140** for manipulating the valve body **134**.

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 establish friction for maintaining the valve body in adjusted position. As shown in FIGURE 2 the end of the bore forming the chamber **104** adjacent the fuel chamber **46** is closed by means of a plug or cap **146**.

From FIGURES 6 and 7, it will be seen that fuel flows from the chamber **46** through the passage **115**, passage **111**, restricted passage **114** past the needle valve **113** to the main orifice construction **102** for delivery into the choke band region **18** of the Venturi **16**. Fuel for the idle and low speed fuel delivery system flows from passage **111** through the passage **130**, past the needle valve thence through the restriction **124** into the chamber **104**, which supplies fuel to the engine idling orifice **106** and the low speed orifice **108**, depending upon the relative position of the throttle valve **32** and hence the velocity of air flow through the mixing passage.

From FIGURE 7, it will be apparent that the needle valve **113** meters or regulates the fuel delivered to the main orifice construction **102**, and the needle **136** meters or regulates fuel flow into the chamber **104** for the secondary orifices.

The carburetor of the invention is of a character which is operable in various angular positions as well as inverted positions, conditions which are encountered where the carburetor is used with engines powering chain saws which must be 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 2, 6 and 7, the main or primary nozzle arrangement and check valve means are constructed as a unit **102** which may be readily inserted and removed from a bore formed in the carburetor body which opens into the mixing passage and into the diaphragm or fuel chamber **46**. The nozzle unit is inclusive of a cylindrically shaped fitting or cage **150** 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 this passage with the counterbore **154**, an annular seat is provided for the check ball **156**.

The counterbore **154** opens into the choke band **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 cage or fitting **150** is provided with an abutment bar **158** for retaining the ball valve **156** in the fitting **150**.

The abutment member **158** is spaced above the ball valve **156** a sufficient distance to facilitate movement of the valve away from its seat 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 recess **166** shown in FIGURES 2 and 7. The fitting **150** is provided 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 the restricted passage **114**. Thus during high speed engine operation fuel flows past the metering needle **113** enters the circumferential recess **166** thence through the passages **168** into the central bore **152**, past the check valve **156** and is delivered or discharged from the fitting **150** into the mixing passage.

The check valve **156** is preferably fashioned of lightweight material such as nylon (polyamid resin) or Delrin (polyoxymethylene) requiring a minimum lift to elevate the ball from its seat. The relation between the diameter of the counterbore **154** and the diameter of the check ball **156** is such that the annular region between the periphery of the ball and the counterbore provides a cross-sectional area sufficient to permit the maximum fuel flow required for high speed engine operation.

If it is desired to remove and replace the check ball 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 and replaced by another fitting assembly.

The lower portion of the fitting **150** is imperforate and forms, as a part of the fitting, a closure for the end of the bore adjacent the fuel chamber **46** as shown in FIGURES 2 and 6. FIGURES 1 through 7 illustrat-

ing the carburetor are on a slightly enlarged scale 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 illustrated is as follows: As the fuel chamber 46 is unvented, the diaphragm is flexed or moved under the influence or 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 member 80 moves away from its annular seat 82, facilitating fuel flow through the inlet fitting 68 past the valve portion 80 along the facets of the 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 needle valve 112 through the circular recess 166 and passages 168 into the central bore 152 past the ball check 156 and is delivered into the Venturi of the mixing passage 12 for high speed engine operation. Through the diaphragm control of the inlet valve, fuel flow past the inlet valve 80 is maintained 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 whereby, under the biasing 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 passages 111, 130 and restricted passage 132, passage 122 past the needle valve 136 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 open fuel may be delivered through both orifices 106 and 108. If the throttle is opened a greater distance the main orifice comes into operation and the secondary orifices gradually decrease fuel delivery into the mixing passage.

When one or both secondary orifices 106 and 108 are delivering fuel into the mixing passage and fuel ceases flowing into the mixing passage through the main orifice unit 102, 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 chamber 104 for delivery to the secondary orifices.

The passages 107 and 130, shown in FIGURE 7 may be cored or formed in the body 10 during the molding thereof and are utilized to accommodate adjustable fuel metering valves similar to the valves 116 and 138 where installation conditions render it desirable that access to the fuel metering adjusting means be provided at the air entrance end of the carburetor.

Several advantages are attained by molding the carburetor body 10, the inlet valve body 78, the closure plate 54, the lever 86, and the choke valve shaft 24 and its manipulating portion 27 from polyoxymethylene (Delrin). By fashioning the body 10 of this resin, the resin is endowed with heat insulating characteristics which prevent or deter the transmission of heat from the engine to the fuel in the carburetor body and hence the liability of "vapor lock" or premature volatilization of the liquid fuel in the carburetor is substantially eliminated. Several of the channels or passages in the carburetor body may be formed during the molding operation with a high degree of accuracy eliminating many machining or fabricating operations. Where machining is necessary, the resin may be readily machined or worked with a minimum of wear of the tools. The dies for molding the resin have much longer life than dies used for molding or casting carburetor bodies of metal or metal alloys. The inlet valve body 78 formed of resin is of light weight, which as hereinbefore explained provides for more accurate metering or regulation of fuel flow into the carburetor particularly at high engine speeds. The vent passages and openings for accommodating screws in the closure plate 54 may be formed during molding thus eliminating machine work on this component. The shaft 24 and the manipulating arm 27 molded as a unit eliminates machine and assembly operations heretofore necessary when the shaft and arm are fashioned of metal.

The metal inserts or fittings 110 and 123 are accurately positioned in the molding die and are embedded in the resin by the molding operation. The weight of the carburetor assembly with the body and above-mentioned components formed of molded resin is substantially less than a similar assembly where the body and components are made of metals such as aluminum, aluminum alloys, zinc or zinc alloys. Thus, in addition to a substantial reduction in weight, extensive savings in labor and machine operations are effected whereby the cost of producing the carburetor is greatly reduced.

FIGURE 8 illustrates a carburetor embodying a venting means for the air chamber adjacent the diaphragm. The carburetor body 10' shown in FIGURE 8 may be fashioned of resinous plastic material of a character commercially known as Delrin or the like, or the carburetor body may be fashioned of metal. The body 10' is formed with a mixing passage 12' which includes an air inlet region or air horn 14', a Venturi 16' having a choke band or zone of restriction 18' and a mixture outlet region 20'.

The body 10' adjacent the air inlet region is bored to receive a revoluble shaft 24' supporting a disc-type choke valve 26'. The body 10' at the mixture outlet region is bored to accommodate a revoluble shaft 30' supporting a disc-type throttle valve 32'. The carburetor body is fashioned with a mounting flange 38' for securing the carburetor to a crankcase of a two cycle engine or to an intake manifold of a four cycle engine. A flange 42' adjacent the air inlet region 14' is adapted to support an air filter or air cleaner so that air entering the inlet 14' is filtered.

The body 10' is fashioned with a shallow circular fuel chamber 46' adapted to contain liquid fuel. Extending across the fuel chamber 46' and forming a flexible wall of the chamber is a flexible diaphragm 48' an annular gasket 50' being disposed between the diaphragm and the carburetor body. A closure or cover plate 174 embraces the exterior major surface of the diaphragm and is secured to the carburetor body by screws in the manner illustrated in FIGURE 3. The central region of the cover or closure plate 174 is depressed or recessed providing a clearance space or air chamber 176 to accommodate flexing movements of the diaphragm.

The carburetor illustrated in FIGURE 8 embodies a fuel inlet valve arrangement of the character illustrated in FIGURE 5 wherein a member 65' carried by the diaphragm cooperates with a lever 86' whereby the aspiration in the fuel chamber 46' controls fuel flow from a supply into the fuel chamber. The carburetor shown in FIGURE 8 is inclusive of a main orifice construction fabricated as a unit 102' and a secondary fuel delivery system including an engine idling orifice 106' and a low speed orifice 108' to facilitate idling of the engine and for low speed engine operation.

The adjustable controlling or metering means for the main orifice and secondary orifice system are of the character illustrated in FIGURES 6 and 7.

The main orifice unit 102' is inclusive of a cylindrically-shaped fitting 150' having a main orifice or outlet 154' and a valve means such as a ball check valve 156' to prevent back bleeding of air through the main orifice when the secondary orifice system is delivering fuel into the mixing passage. The fuel conveying ducts for convey-

ing fuel from the fuel chamber **46'** to the main orifice construction unit **102'** are illustrated in FIGURES 6 and 7.

The diaphragm closure plate **174** may be fashioned of resinous plastic material or may be formed of metal. The walls **178**, defining a depressed region of the closure plate, are slanted downwardly or in converging relation as shown in FIGURE 8, and terminate in a central circular wall **180** which is slightly depressed to form a sink or recess **182** in which may accumulate any fuel which enters the air chamber **176**. The wall **180** is provided with a comparatively small size vent opening **184** which is vented to the atmosphere.

The plate **174** is fashioned with a depending skirt portion **186** defining a recess or chamber in which is disposed a filter **188**. The filter may be formed of felt or other suitable filter material so that air entering the vent **184** into the space **176** is filtered to avoid the entrance of dust or foreign matter into the chamber. The chamber **176** is also vented to the air inlet region **14'** of the carburetor through interconnecting ducts **190** and **192** formed respectively in the plate **174** and the carburetor body **10'** and a tubular member **194** in communication wtih the duct **192** which opens into the air inlet region **14'**. The interconnecting ducts **190**, **192** and the tubular member **194** forming an S-shaped passageway with the bottom and top portions of the S being upwardly inclined from the air chamber **176** and the central portion of the S being vertically inclined as best shown in FIGURE 8.

Under normal operating conditions with an air filter or air cleaner disposed at the entrance of the air inlet region **14'**, the tube **194** will be under slight subatmospheric pressure due to the resistance of air filter to the passage of air. It should be noted that the vent **184** is substantially smaller than the vent provided by the ducts **190**, **192** and the tube **194** so that while the tube **194** is under slight subatmospheric pressure, the vent **184** is at atmospheric pressure and hence, during engine operation, there will be a slight, though continuous, flow of air through the vent filter **188**, the vent **184** and through the connecting ducts **190**, **192** and the tube **194** into the mixing passage.

The venting arrangement shown in FIGURE 8 prevents the accumulation of liquid fuel which may enter the air chamber **176**. Sometimes under ram reaction in the mixing passage or possibly due to over-choking of the engine by manipulation of the choke valve **26'**, fuel from the mixing passage may enter the tube **194** and flow into the chamber **176'** and may accumulate to an extent that it would cause a "hydraulic lock" beneath the diaphragm. Through the provision of the venting arrangement shown in FIGURE 8, fuel which enters the chamber **176** through the vent tube **194** and the interconnecting ducts will flow into the sink or depression **182** and drain off through the vent opening **184**.

With the arrangement shown in FIGURE 8 under normal engine operation, a slight, but continuous air flow inwardly through the vent **184** into the air inlet region **14'** through the tube **194** occurs as above mentioned so that there will be no accumulation of fuel in the chamber **176**.

The use of the filter **188** is desirable as, during normal engine operation, air will enter the small vent **184** in the manner described and the filter **188** prevents the ingress of any foreign matter into the chamber **176**.

Due to the difference in size of the vent **184** and the vent arrangement through the tube **194**, a very slight subatmospheric pressure is existent in the air chamber **176** during normal engine operation, to obtain a better balance of pressures than in the arrangement shown in FIGURE 2 wherein a venting of the chamber **58** is solely through the tube **59** opening into the air inlet region **14**.

FIGURE 9 illustrates a modified form of closure plate for the diaphragm. In this form, the closure plate **198** is fashioned with downwardly coverging walls **200** and are joined with a central wall portion **202** providing a sink or recess **204**. In this form the vent opening **184'** is directly to the atmosphere without the use of a filter. The air chamber **176'** is also vented to the air inlet region of the mixing passage through a duct **190'** which interconnects with ducts **192** and **194** of the character shown in FIGURE 8.

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:

In combination, charge forming apparatus including a body member formed with a fuel and air mixing passage and a comparatively shallow fuel chamber, a choke valve in the inlet region of the mixing passage, a flexible impervious diaphragm forming a wall of the fuel chamber, a fuel inlet for the fuel chamber, a valve for said inlet, motion transmitting means between the diaphragm and the inlet valve whereby movement of said diaphragm controls said inlet valve to regulate flow of liquid fuel from a supply into the fuel chamber, resilient means normally biasing the inlet valve toward closed position, orifice means opening into the mixing passage arranged to deliver fuel from the fuel chamber into the mixing passage, a closure for said diaphragm having an air chamber formed therein accommodating movement of the diaphragm and wall regions opposite the diaphragm; said closure, said fuel chamber and said diaphragm being in stacked relation and secured directly below said air mixing passage; the wall regions opposite the diaphragm being in stacked relation and secured directly below said air mixing passage; the wall regions opposite the diaphragm defining the air chamber being downwardly covergent and terminating in a centrally disposed relatively shallow recess, a first vent opening centrally located in the wall region defining the recess, said closure being formed with a downwardly projecting skirt portion adjacent said first vent opening, a filter element disposed adjacent the first vent opening and within said skirt portion whereby air entering said first vent opening passes through said filter, a second vent opening between the air chamber and the air inlet region of said mixing passage, said first vent opening being of smaller cross-sectional area than the second vent opening, said second vent opening being connected to an S-shaped passageway, the bottom portion of said S-shaped passageway being inclined upwardly from said second vent opening, the central portion of said S-shaped passageway connecting said bottom portion and extending in a vertical direction, and the top portion of said S-shaped passageway inclined upwardly from said central portion and including a vent tube projecting at an angle into said mixing passage and in advance of said choke valve.

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