FUEL FEEDING AND CHARGE FORMING APPARATUS

Original Filed Jan. 14, 1965

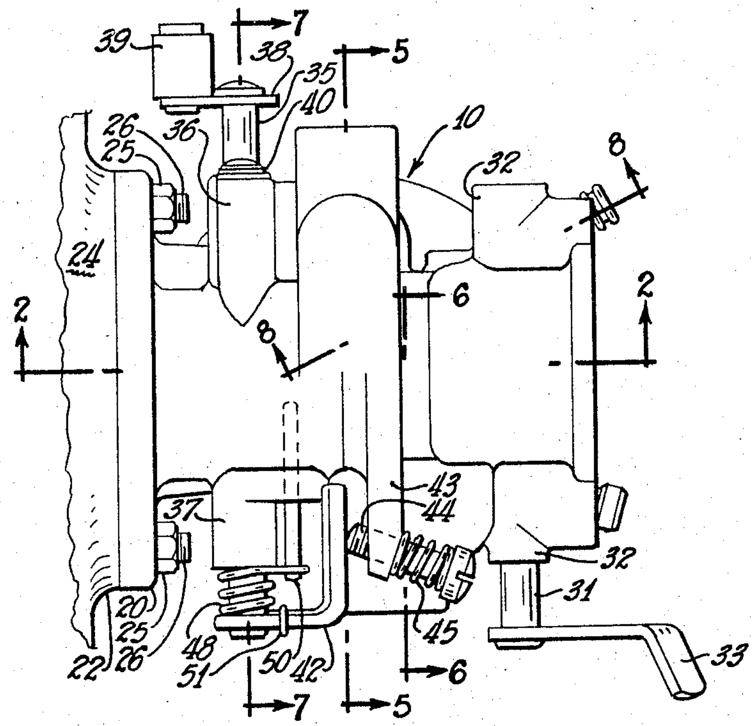

Fig. 1

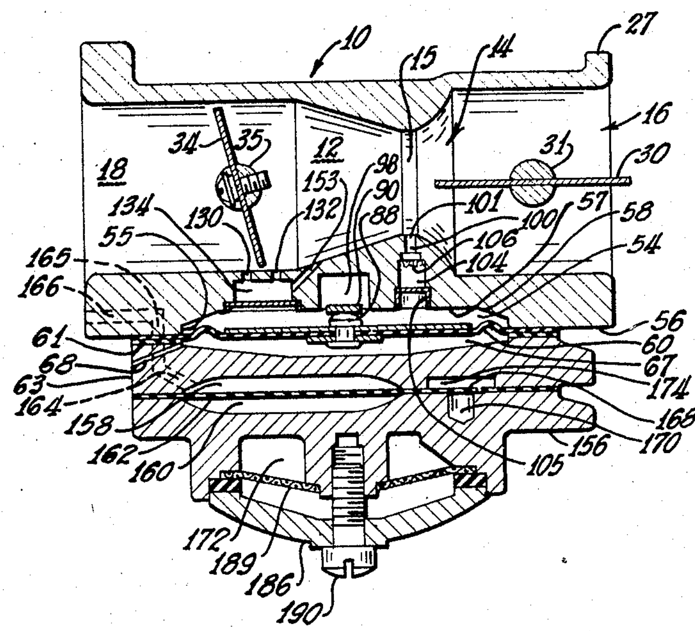

Fig. 2

INVENTOR.
BERNARD C. PHILLIPS
BY
Harry O. Ernsberger
ATTORNEY

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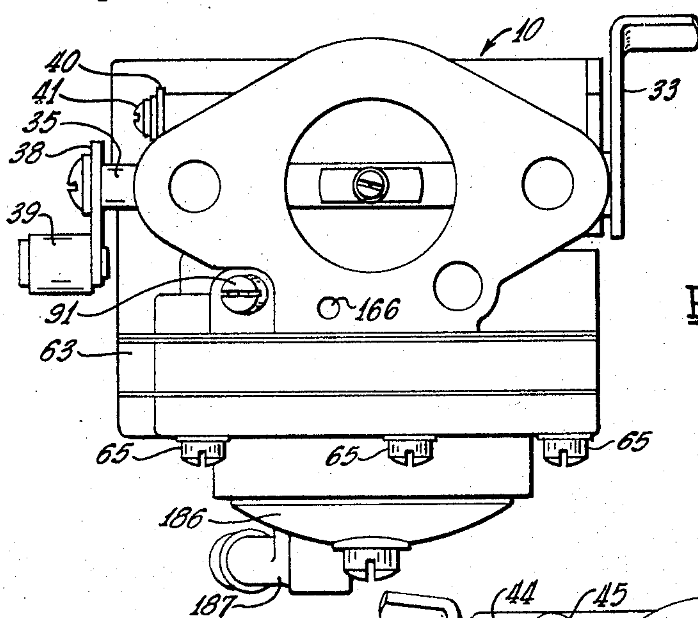

Fig. 3

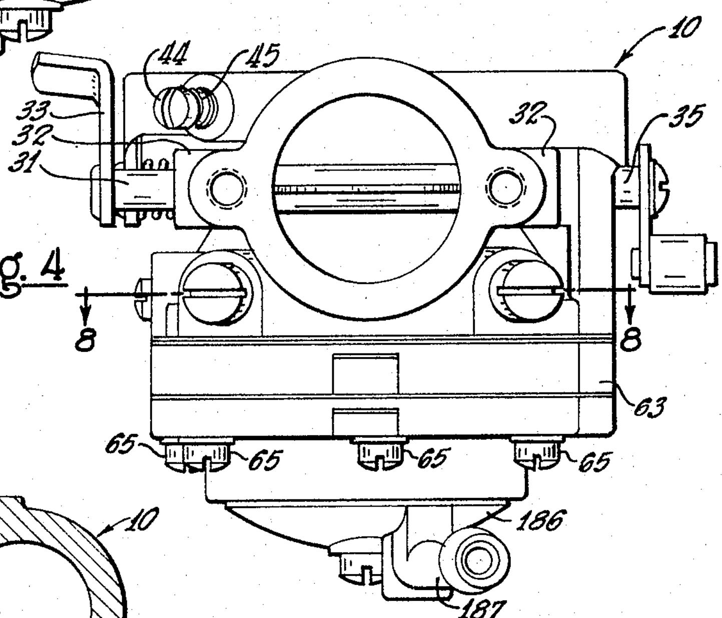

Fig. 4

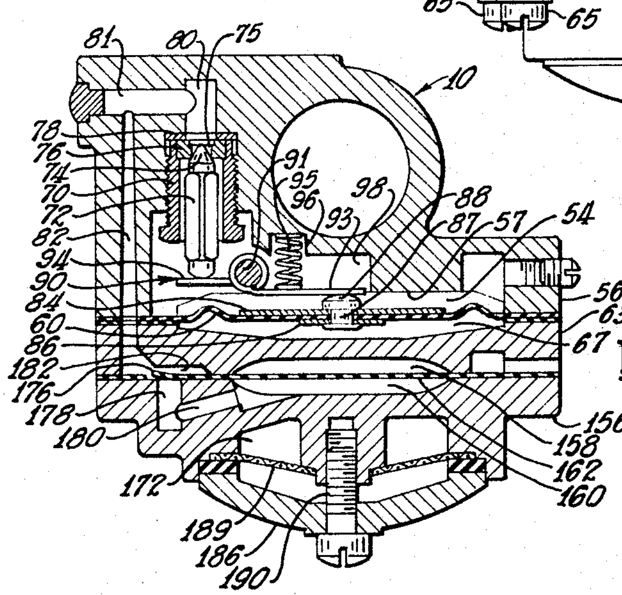

Fig. 5

INVENTOR.
BERNARD C. PHILLIPS
BY
Harry O. Ernsberger
ATTORNEY

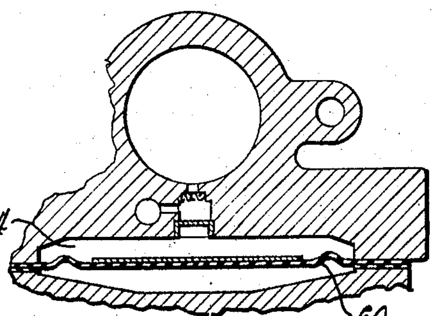

Fig. 6

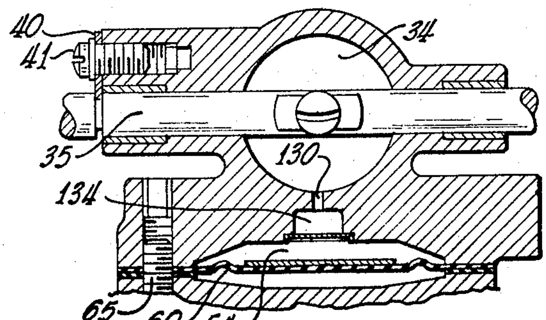

Fig. 7

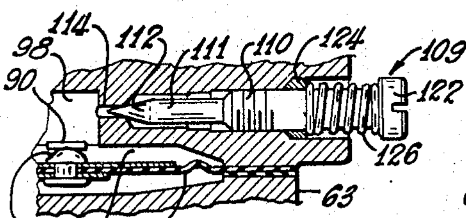

Fig. 9

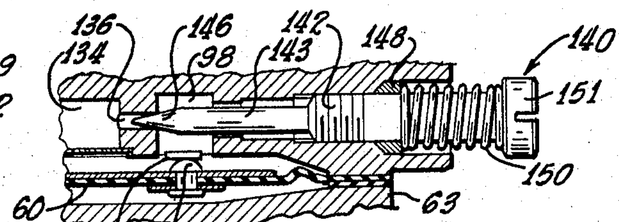

Fig. 10

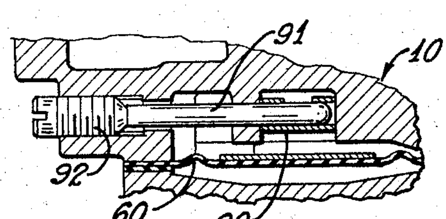

Fig. 11

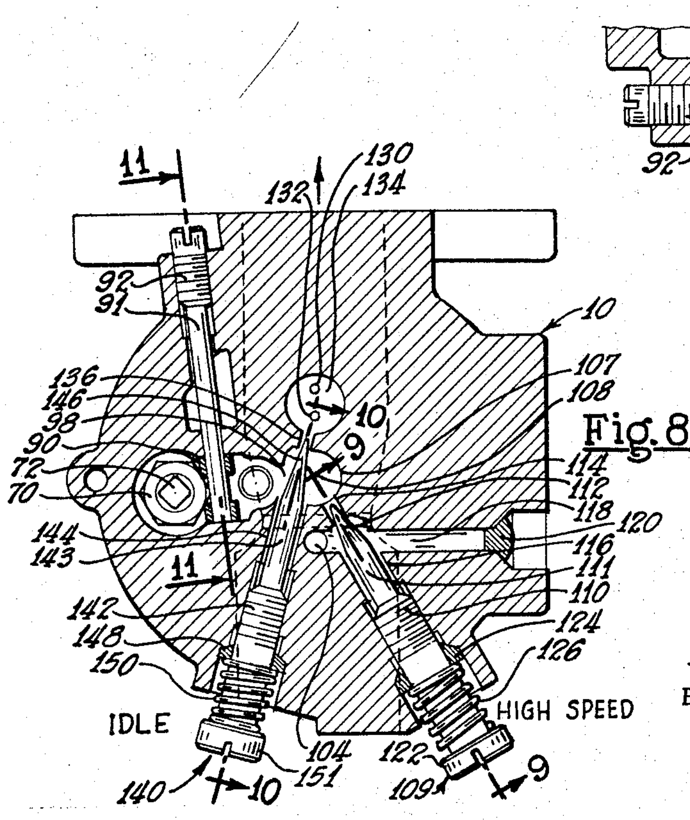

Fig. 8

INVENTOR.
BERNARD C. PHILLIPS
BY
Harry O. Ernsberger
ATTORNEY

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Patented July 8, 1969

3,454,265

FUEL FEEDING AND CHARGE FORMING APPARATUS

Bernard C. Phillips, Toledo, Ohio, assignor to The Tillotson Manufacturing Company, Toledo, Ohio, a corporation of Ohio

Continuation of application Ser. No. 425,540, Jan. 14, 1965. This application Jan. 13, 1967, Ser. No. 609,256
Int. Cl. F02m *11/00*
U.S. Cl. 261—41 1 Claim

ABSTRACT OF THE DISCLOSURE

A carburetor and fuel feeding arrangement for internal combustion engines which includes an elongated recess centrally located in a wall of a fuel chamber for conveying fuel to the main, idling and low speed orifices. The fuel chamber includes a diaphragm operated fuel inlet valve. The idle and low speed orifices open into the fuel chamber at a region as close as practicable to the central region or geometric center of the fuel chamber. A first adjustable valve for controlling the flow of fuel to the idle and low speed orifices extends through the elongated recess and into one end of a restricted passage. A second adjustable valve is received in a short restricted passage for regulating the flow of fuel to the main orifice. The valves are positioned in close angular proximity to each other and radially about the elongated recess.

This application is a continuation of my copending application Ser. No. 425,540, filed Jan. 14, 1965, and now abandoned.

This invention relates to fuel feeding and charge forming apparatus for internal combustion engines and more particularly to apparatus for supplying a fuel and air mixture to an internal combustion engine for idling or normal engine operation in all positions of the engine and the fuel feed and charge forming apparatus.

The invention pertains more especially to a diaphragm type carburetor or charge forming apparatus of the character especially for use with internal combustion engines of the two-cycle type usable for powering chain saws, lawn mowers, outboard marine engines and the like where the charge forming apparatus or carburetor is subjected to use in tilted or extreme angular positions, and where the engine is utilized for driving a chain saw, the carburetor or charge forming apparatus must be capable of operating in inverted positions as well as positions of extreme tilt.

Carburetors of this general character have come into extensive use with chain saw engines and embody a mixing passage having a Venturi or choke region, a main fuel nozzle or orifice for delivering fuel for high speed engine operation into the Venturi, and secondary orifices opening into the mixing passage downstream of the Venturi for delivering fuel into the mixing passage for engine idling and low speed operation. Fuel for the main orifice and the engine idling and low speed orifices is supplied through channel means connected with a fuel chamber in the carburetor, one wall of the chamber being a flexible diaphragm which, under the influence of aspiration or reduced pressure in the mixing passage, controls a fuel inlet valve for regulating the flow of liquid fuel from a supply into the fuel chamber. In carburetors of this character, the fuel for the engine idling and low speed orifices has been obtained through channel means connected with the fuel chamber at a region removed from the central region of the fuel chamber. In such arrangement the engine idling and low speed operation is directly affected under various positions of tilt or angular positions of the carburetor. For example, in certain positions of tilt, the head of fuel in the fuel chamber, affecting fuel flow to the engine idling and low speed orifices, may be greater than that when the carburetor is tilted in other positions where the fuel take-off channel is substantially spaced from the central region of the fuel chamber.

The present invention embraces a diaphragm type carburetor and fuel feeding arrangement wherein the fuel channel means, for conveying fuel to engine idling and low speed orifices, opens into the diaphragm fuel chamber at a region as close as practicable to the central region or geometric center of the diaphragm fuel chamber to obtain more uniform delivery of fuel to the engine idling and low speed orifices irrespective of the position of tilt or angular position of the carburetor.

Another object of the invention is to provide a manual adjustment of fuel flow to the engine idling and low speed orifice system wherein the adjusting restriction is disposed as near as practicable to the central region or geometric center of the diaphragm fuel chamber to obtain improved engine idling and low speed operation in extreme positions of tilt.

Another object of the invention is the provision of a diaphragm type carburetor embodying an engine idling and low speed orifice system connected with a fuel chamber by channel means which are fashioned as small and as short as practicable.

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 fuel feeding and charge forming apparatus or carburetor embodying the invention;

FIGURE 2 is a longitudinal sectional view taken substantially on the line **2—2** of FIGURE 1;

FIGURE 3 is a view of the mixture delivery end of the carburetor and fuel feed device;

FIGURE 4 is a view of the opposite end of the carburetor;

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

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

FIGURE 7 is a transverse sectional view taken substantially on the line **7—7** of FIGURE 1;

FIGURE 8 is a sectional view taken substantially on the line **8—8** of FIGURE 4;

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

FIGURE 10 is a fragmentary sectional view taken substantially on the line **10—10** of FIGURE 8; and

FIGURE 11 is a fragmentary sectional view taken substantially on the line **11—11** of FIGURE 8.

Referring to the drawings in detail and initially to FIGURES 1 through 5, there is illustrated a combined charge forming device or carburetor and a fuel feeding means or fuel pump fashioned as a unitary construction. While in the arrangement illustrated the fuel feeding means or fuel pump is mounted on the carburetor body, it is to be understood that the charge forming apparatus or carburetor may be supplied with fuel directly from a fuel tank by gravity, or by a fuel feed pump spaced from the charge forming apparatus or carburetor.

The charge forming apparatus or carburetor is inclusive of a metal body or body member **10** fashioned with a mixing passage 12, the passage including a Venturi 14 having a choke band or restricted region 15, the mixing passage provided with an air inlet region 16 and a mixture outlet region 18.

The carburetor body 10 is provided at one end with a mounting flange 20 which is adapted to be secured to a boss portion 22 formed on an engine crankcase 24 of an engine of the two-cycle type, the mounting flange 20 being secured to the boss 22 by means of securing nuts 25 threaded onto studs 26. The air inlet end of the carburetor body is fashioned with a flange 27 for mounting an air filter or air cleaner (not shown) for filtering air entering the inlet 16.

A choke valve for controlling the admission of air into the inlet end of the mixing passage for engine starting purposes is provided comprising a disc-like valve 30 mounted upon a transversely extending shaft 31 journaled in suitable bores formed in bosses 32 of the carburetor body. Mounted upon an end region of the shaft 31 exteriorly of the body 10 is an arm 33 for manipulating the choke valve 30. Disposed in the mixture outlet region 18 of the mixing passage is a throttle valve 34 of the disc-type mounted upon a shaft 35 journaled in bores formed in bosses 36 and 37 of the body 10.

An arm 38 is secured to one end of the throttle shaft 35 and is equipped with a roller 39 adapted to be engaged by a suitable throttle operating means (not shown). Lengthwise movement of the throttle shaft 35 is prevented by a U-shaped clip 40, secured to the body 10 by a screw 41, extending into a recess in the shaft, as shown in FIGURE 7.

Secured to the opposite end of the shaft 35 is an L-shaped member 42. The body 10 is provided with an integral projection 43 having a threaded opening to accommodate an adjusting screw 44, the extremity of the screw 44 providing a stop means engageable with a portion of the L-shaped arm 42 to limit the closing movement of the throttle valve, determining the engine idling position of the throttle valve. A coil spring 45 surrounds the screw 44 and engages the projection 42 and the head of the screw with sufficient friction to retain the screw 44 in adjusted position.

A coil spring 48 surrounds the portion of the shaft 35 mounting the bracket 42. One end of the coil spring 48 is anchored to a pin 50 mounted in a bore in the body 10, the other end 51 of the spring being hooked over a portion of the bracket 42, the coil spring 48 serving to normally bias the throttle valve 34 toward closed or engine idling position, shown in FIGURE 2.

The body 10 of the charge forming device is formed with a shallow fuel chamber 54 of circular configuration defined by a circular wall 55 of an annular boss portion 56, the upper wall 57 of the chamber being joined with the circular wall 55 by an annular chamfered surface 58. A flexible member or diaphragm 60 forms a wall of the shallow chamber 54 and extends across the face of the annular boss portion 56 of the body 10. An annular gasket 61 is disposed adjacent one face of the flexible diaphragm 60 as shown in FIGURE 2.

The diaphragm 60 and annular gasket 61 are secured in place by a plate-like member 63, the latter forming a component of a fuel feed means or pump hereinafter described. The plate 63 is secured in position by means of screws 65, shown in FIGURES 3 and 4, which extend through registering openings in the member 63, gasket 61 and the peripheral region of the diaphragm 60 into threaded openings in the body 10. The member 63 is fashioned with a concave portion providing a recess or chamber 67 to accommodate movements of the diaphragm 60. The space or chamber 67 at the dry side of the diaphragm is vented to the atmosphere by means of a vent passage 68, shown in FIGURE 2.

The diaphragm 60 is made of thin highly flexible cloth such as nylon fabric impregnated with a suitable resinous coating to render the diaphragm impervious. The diaphragm may be fashioned of flexible resinous plastic. The flexible diaphragm 60 is highly sensitive to minute variations or changes in pressure in the fuel chamber 54 to attain accurate control of the admission of fuel into the fuel chamber 54 for delivery into the mixing passage 12.

The charge forming apparatus is provided with valve means in a fluid inlet passage in the carburetor body and a motion transmitting means between the diaphragm 60 and the valve for regulating flow of fuel into the fuel chamber 54 solely under the influence of aspiration or reduced pressure in the mixing passage setup by engine operation.

Referring to FIGURE 5, the body 10 is provided with a threaded bore to receive a threaded valve cage, guide or fitting 70. Slidably disposed in a bore in the fitting 70 is a valve body or member 72 of polygonal cross section as, for example, of square cross section as shown in FIGURE 8.

The polygonal cross-sectional shape of the valve member 72 facilitates flow of liquid fuel along the facets of the valve body into the fuel chamber 54. The valve body 72 is provided with a cone-shaped valve portion 74 which extends into an inlet port 75 provided by an annular valve seat 76 disposed in the upper end of the fitting 70. A suitable gasket 78 is disposed between the bottom of the bore and the upper extremity of the fitting 70 to provide a seal. The valve seat member 76 is preferably formed of a resilient material such as neoprene or other material resistant to deterioration by hydrocarbon fuels.

The port 75 in the annular valve seat should be of comparatively small diameter so that fuel pressure acting against the cone-shaped valve 74 is reduced to a minimum. The port 75 is in communication with interconnecting ducts 80, 81 and 82, the ducts conveying liquid fuel from the pump construction to the port 75. The diaphragm 60 is provided with an upper reinforcing disc 84 of thin metal or plastic and a lower reinforcing disc 86, the discs being held in assembled relation to the diaphragm by a rivet 87 having a head portion 88.

The motion transmitting means between the diaphragm and the valve body 72 is inclusive of a lever 90 which is fulcrumed intermediate its ends on a fulcrum pin 91, the latter being shown in FIGURES 5 and 11. The pin 91 is provided with an enlarged threaded portion 92 threaded into a bore in the body 10 for securing the pin 91 in position. The long arm 93 of the lever 90 is adapted to be engaged by the head 88 of the rivet or other suitable means carried by the diaphragm 60. The short arm 94 of the lever is adapted for engagement with the valve member 72.

An expansive coil spring 95 disposed in a recess 96 is arranged to engage and bias the lever 90 in a direction to urge the valve 74 to close the port 75. The upper wall 57 of the fuel chamber 54 is fashioned with a narrow elongated recess 98 to accommodate movements of the motion transmitting lever 90. From FIGURE 5 it will be apparent that upward movement of the diaphragm 60 effects swinging movement of the lever 90 in a counterclockwise direction about its fulcrum pin 91, lowering the short arm 94 of the lever to facilitate movement of the valve body and valve portion 74 away from the port 75 to admit fuel past the valve into the fuel chamber 54.

The carburetor or charge forming apparatus of the invention is inclusive of a main or primary fuel delivery system and a secondary or engine idling and low speed delivery system conveying fuel from the fuel chamber 54 into the mixing passage.

The main fuel delivery system, for normal or high speed engine operation, is inclusive of a channel 100, the outlet or orifice 101 of channel 100 opening into the choke band or restricted region 15 of the Venturi delivering fuel for normal or high speed engine operation.

The channel 100 is in communication with a bore 104, the lower end of the bore being closed by a plug 105. Disposed in the upper end of the bore **104** is a fine mesh screen **106** which provides a restriction or means for establishing a liquid fuel capillary seal in the main fuel delivery system to prevent bleeding of air into the secondary or idling and low speed system when the latter system is delivering fuel. The capillary seal principle of anti-back bleeding in diaphragm carburetor constructions is described in my Patent 2,841,372.

The high speed fuel channel system and fuel metering adjustment are particularly illustrated in FIGURES 8 and 9. It will be noted from FIGURE 8 that the end region of the elongated space or recess **98** is of generally semicircular curvature indicated at **107**, the center **108** of the curvature **107** being at the geometric center or axis of the circular fuel chamber **54**. As shown in FIGURE 9, the body **10** has a threaded bore to accommodate a threaded portion **110** of a high speed adjusting valve member **109**, the latter having a shank portion **111** terminating in a needle valve **112** for metering fuel for normal and high speed engine operation.

The needle valve **112** extends into a restricted passage **114** which is in direct communication with the semicircular end region of the elongated passage **98** and receives fuel therefrom for delivery through the main orifice **101**, shown in FIGURE 2. The shank **111** of the manually adjustable valve member **109** is disposed in a channel **116** which intersects a channel **118** for conveying fuel flowing past the needle valve **112** to the bore **104** beneath the main orifice **101**. The outer end of the channel **118** is closed by a plug **120**, as shown in FIGURE. 8.

The high speed adjusting valve member **109** is provided with a head **122**. A sealing ring or gasket **124** surrounds an unthreaded portion of the valve member **109** and a coil spring **126** disposed between the head **122** and the sealing gasket **124** biases the sealing gasket toward sealing position, and further provides sufficient friction for retaining the valve member **109** in manually adjusted position. By adjusting the relative position of the valve member **109**, the extent of projection of the needle valve **112** into the restriction **114** meters the fuel for delivery through the main orifice **101**, shown in FIGURE 2.

The engine idling and low speed fuel delivery system is inclusive of an engine idling orifice **130** and a low speed orifice **132** opening into the mixing passage as shown in FIGURES 2 and 8.

As shown in FIGURE 2, the throttle valve **34** is in nearly closed position, in which position fuel is delivered through the orifice **130** for engine idling operaton. When the throttle **34** is partially opened, the low speed orifice **132** delivers fuel into the mixing passage in addition to the fuel delivered through the orifice **130**. The orifices are in communication with a supplemental chamber **134** provided in the body **10**.

The supplemental chamber **134** is in communication with the recess **98** at a region as close to the geometric center or axis of the circular fuel chamber **54** as is practicable, as shown in FIGURE 8. A comparatively short restricted passage **136** provides for fuel flow from the elongated recess **98** into the supplemental chamber **134**. A valve member **140** is provided for adjustably metering the fuel delivered to the supplemental chamber from the fuel chamber **54** for metering or regulating fuel for engine idling and low speed purposes. A threaded portion **142** of the valve member **140** extends into a threaded portion of a bore in the body **10**, a tenon portion **143** of the valve member **140** being disposed in a bore **144** in the body **10**.

The manually adjustable valve member **140** is provided with a needle valve portion **146** which extends into and cooperates with the restricted passage **136** for metering fuel flow through the restricted passage or channel **136**. Surrounding the valve body **140** in a recess in the body **10** is a sealing gasket **148**.

Surrounding the body of the valve member **140** is an expansive coil spring **150** disposed between the head **151** of the valve member and the sealing gasket **148** for biasing the gasket to sealing position, the spring providing friction for retaining the valve **140** in adjusted position.

As shown in FIGURE 2, an extremely small air bleed passage **153** may be employed opening into the mixing passage **12** from the supplemental chamber **134** to provide for the admixture of a small amount of air with the liquid fuel delivered through the engine idling and low speed orifices **130** and **132** whereby an emulsion of fuel and air is delivered through these orifices.

In the embodiment illustrated in FIGURES 1 through 5, a pulse operated fuel feeding arrangement or fuel pump construction is combined with the charge forming device or carburetor, and is of the general character shown in my Patent 2,796,838. The pump construction is inclusive of the plate-like member **63** to which is secured a pump body **156** by the screws **65**. The plate-like member **63** is fashioned with a cavity **158** and the body **156** provided with a similar cavity **160**. A pumping diaphragm **162** of flexible impervious material is disposed between the plate **63** and the body **156**.

The cavity **158** with the diaphragm **162** provides a pumping or pulse chamber, and the cavity **160**, provides with the diaphragm **162**, a fuel chamber.

The pumping chamber **158** is in communication, through connecting ducts **164**, **165** and **166**, with an opening in the engine crankcase wall registering with the duct **166** for communicating varying fluid pressure in the engine crankcase to the pumping chamber **158**, the varying fluid pressures or pulsations acting on the diaphragm **162** to actuate or vibrate the diaphragm and effect pumping action in the fuel chamber **160**.

The pumping diaphragm **162** is provided with an inlet flap valve **168** integral with the diaphragm which cooperates with a fuel inlet port **170**, the latter being connected by a passage or duct (not shown) with a supplemental fuel chamber **172** in the body **156**. The space or region **174** above the flap valve is in communication with the fuel chamber **160** by a passage means (not shown). As shown in FIGURE 5, the pumping diaphragm **162** is formed with an outlet flap valve **176** which cooperates with a port **178** connected with the fuel chamber **160** by a passage or duct **180**.

The space **182** above the outlet flap valve **176** is in communication with the duct **82** which, in conjunction with the interconnecting ducts **80** and **81**, conveys fuel to the region of the inlet valve port **75** which is controlled by the fuel inlet valve **74**. Secured to the pump body **156** is a closure member **186** provided with a nipple portion **187** adapted to be connected by a tubular means (not shown) with a fuel supply tank (not shown). A filter screen **189** extends across the supplemental fuel chamber **172** to filter incoming fuel. The closure member **186** is secured in position by means of a screw **190** extending into a threaded bore in a central boss provided on the pump body **156**.

The pumping diaphragm **162**, during engine operation, is vibrated or actuated by varying fluid pressures in the engine crankcase transmitted to the pumping chamber **158**. The vibrations of the pumping diaphragm **162**, through the cooperation of the flap valves **168** and **176**, pump fuel from the fuel supply tank through the screen **189** and through the port **170**, space **174** into the fuel chamber **160**, thence through the duct **180**, outlet port **178** and ducts **82**, **81** and **80** to the region of the fuel inlet control valve **74** normally closing the port **75**.

The fuel pressure developed by the pumping action of the diaphragm **162** is insufficient to overcome the biasing force of the spring **95** acting on the lever **90** and, hence, fuel is not admitted through the port **75** into the fuel chamber **54** except under the influence of reduced pressure or aspiration developed in the mixing passage **12** by engine operation, the reduced pressure or aspiration being communicated to the fuel chamber **54** through either the primary fuel delivery system or the secondary fuel delivery system.

The operation of the carburetor or charge forming apparatus illustrated in FIGURES 1 through 11 is as follows: The internal combustion engine with which the carburetor may be used is started with the choke valve **30** manually moved to closed position to provide high suction or reduced pressure in the mixing passage to effect fuel flow from the fuel chamber **54** into the mixing passage **12.**

When the engine is operating at normal or high speeds, reduced pressure in the mixing passage at the restricted region **15** of the Venturi is communicated through the main orifice **101**, passage **100**, bore **104**, channel **118** and the restricted channel or passage **114** to the fuel chamber **54**.

The reduced pressure impressed in the fuel chamber **54** causes the diaphragm **60** to flex or move upwardly by differential pressure at the dry side of the diaphragm as viewed in FIGURES 2 and 5. The rivet head **88**, carried by the diaphragm **60**, causes the lever **90** to be moved in a counterclockwise direction as viewed in FIGURE 5 against the expansive pressure of the spring **95** whereby the short arm **94** of the lever moves downwardly, permitting the valve **74** to move away from the port **75** whereby fuel flows into the chamber **54** at a rate dependent upon the relative position of the diaphragm **60**.

The high speed adjusting valve **109** is manually adjusted to meter fuel flow from the chamber **54** to the main discharge orifice **101** into the Venturi of the mixing passage, the fuel being there mixed with air entering the inlet region **16** to provide a fuel and air mixture which flows into the crankcase of the engine through the mixture outlet region **18**. The relative position of the throttle valve **34** controls the speed of the engine in a conventional manner.

When the throttle valve **34** is moved to near closed or engine idling position, fuel is delivered into the mixing passage at the downstream side of the throttle in the following manner. Fuel at the geometric center of the fuel chamber **54** in the region of the end of the elongated recess **98** accommodating the lever **90** flows through the short restricted passage **136**, shown in FIGURE 8, past the metering needle valve **146** into the supplemental chamber **134**, thence through the engine idling orifice **130** into the mixture outlet passage **18**.

A small amount of air is mixed with the fuel in the chamber **134** for engine idling operations through the restricted air bleed **153**, shown in FIGURE 2, which admits a restricted amount of air from the Venturi region of the mixing passage into the supplemental chamber **134**. In this manner an emulsion or mixture of liquid fuel and air is delivered through the engine idling orifice. In order to avoid back bleeding of air in a reverse direction through the main orifice **101** and into the engine idling or secondary fuel system, the fine mesh screen **106** holds or retains fuel in the bore **104** thereby forming a capillary seal or liquid fuel block impeding air flow from the mixing passage through the main orifice into the secondary fuel delivery system.

When the throttle **34** is partially opened from engine idling position, the low speed orifice **132** begins to deliver fuel from the supplemental chamber **134** into the mixing passage in addition to the fuel delivered through the engine idling orifice **130**.

When the throttle valve **34** is substantially opened, fuel is delivered through the main orifice **101** into the mixing passage by reason of the increase in reduced pressure in the restricted zone **15** of the Venturi, and the secondary orifices **130** and **132** substantially cease delivering fuel into the mixing passage at increased engine speeds.

As the fuel take-off from the fuel chamber **54** for engine idling is at or substantially at the region of the geometric center of the fuel chamber **54**, fuel flows through the comparatively short restricted passage **136** into the supplemental chamber **134** for delivery through the orifices **130** and **132**, improved engine idling is attained in all angular positions of the carburetor as the carburetor may be moved to any position of tilt without appreciably effecting the head of fuel at the centrally positioned fuel take-off passage **136**. Thus improved engine idling operation is attained irrespective of the position of the carburetor.

An important factor promoting the attainment of improved idling operation resides in positioning the fuel take-off or supply port **136** as near the center of the annular fuel chamber **54** as possible. Another factor is that the annular fuel restriction provided by the needle valve **146** should be disposed as near as possible to the geometric center of the fuel chamber **54**. A third factor promoting efficient engine idling operation is the fashioning of the take-off port or restriction **136** as short as practicable.

I claim:

1. In combination, charge forming apparatus including a body having a mixing passage, a substantially circular fuel chamber in said body including an upper wall, said upper wall having a narrow elongated recess centrally located therein, a flexible diaphragm forming a lower wall of said fuel chamber, main and secondary orifices opening into said mixing passage, a fuel inlet for said fuel chamber, a valve in said fuel inlet, motion transmitting means disposed in said fuel chamber for transmitting movement of said diaphragm to said inlet valve for controlling fuel flow from a supply into the fuel chamber, means normally biasing said fuel inlet valve to closed position, said diaphragm being actuated solely by aspiration in said mixing passage, fuel channel means in said body in communication with said elongated recess in said fuel body and said main orifice and including a first short restricted passage having one end opening into said elongated recess, a first manually adjustable valve means in said fuel channel means extending in a direction toward said elongated recess, the other end of said first short restricted passage receiving said valve means for controlling fuel flow to said main orifice, a second short restricted passage in said body in communication with said secondary orifice and having one end opening into said elongated recess, a second manually adjustable valve means extending through said elongated recess and into the said one end of said second restricted passage for regulating fuel flow to said secondary orifice, and said first and second adjustable valve means being positioned in close angular proximity to each other and radially about said elongated recess.

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RONALD R. WEAVER, *Primary Examiner.*

U. S. Cl. X.R.

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