United States Patent [19]

High

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[54] **PRESSURE CARBURETOR SYSTEM FOR MANIFOLD DISTRIBUTION**

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[22] Filed: **June 14, 1973**

[21] Appl. No.: **363,946**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 119,591, March 1, 1971, abandoned, which is a continuation-in-part of Ser. No. 11,572, Feb. 16, 1970, abandoned.

[52] **U.S. Cl.** ..... **123/119 R;** 261/79; 123/131; 123/141; 123/136; 123/119 B

[51] **Int. Cl.** **F02b 33/00;** F02m 7/00

[58] **Field of Search** ..... 123/119 R, 131, 136, 141; 261/79

[56] **References Cited**

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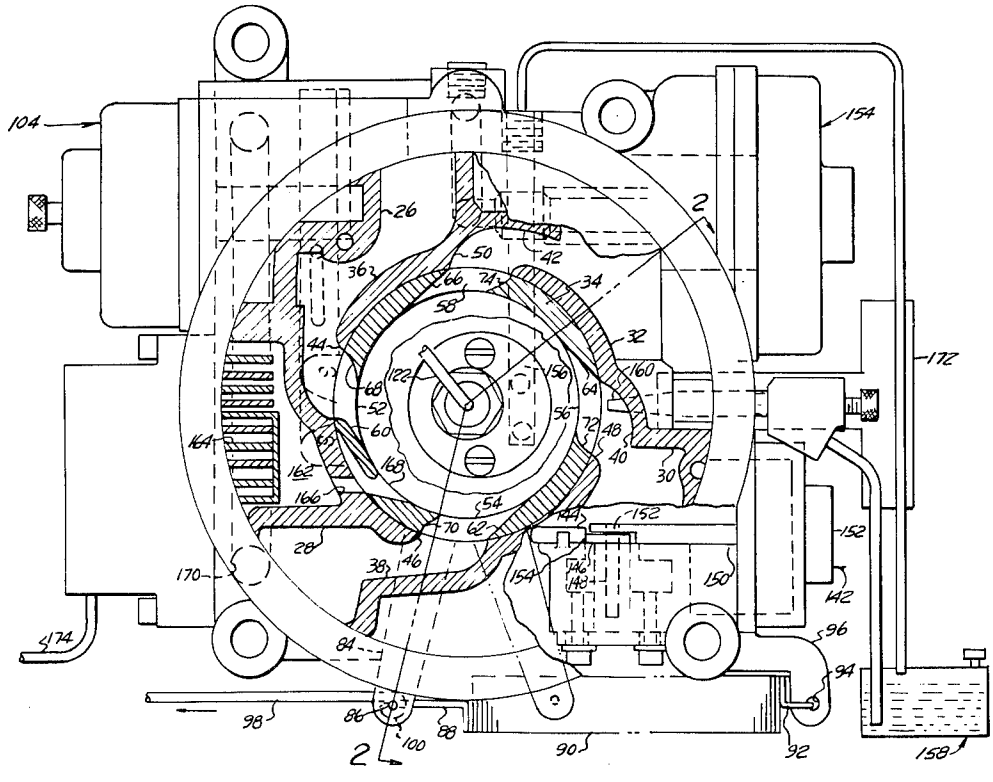
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[57] **ABSTRACT**

A charge forming system for an internal combustion engine in which a pressure carburetor incorporates a centrally located vertically disposed cylindrical mixing chamber, disposed immediately upstream of the intake manifold inlet and opening directly thereto. The chamber is defined by a cylindrical air valve which has a plurality of annularly spaced air inlet ports formed in the cylinder wall registering with corresponding tangential air inlet ducts formed in the carburetor housing for tangentially introducing air into the air valve. The air valve may be rotated about a vertical axis to vary the amount of registration between the inlet ports formed in the valve and the inlet ducts, thereby varying the amount of air introduced into the mixing chamber or, as shown in another modification, the air valve consisting of a simple cylinder may be vertically shifted within the peripheral housing to vary the opening of the inlet ducts over the upper end of the valve. In a third preferred embodiment, the cylindrical air valve is replaced by one or more butterfly valves situated in one or more air inlet passages, which are formed to tangentially introduce air into the mixing chamber. A downwardly directed fuel nozzle is disposed at the top or closed end of the mixing chamber for spraying a metered supply of atomized fuel axially therein, whereby the spray is mixed with the air before it is inducted into the intake manifold.

14 Claims, 9 Drawing Figures



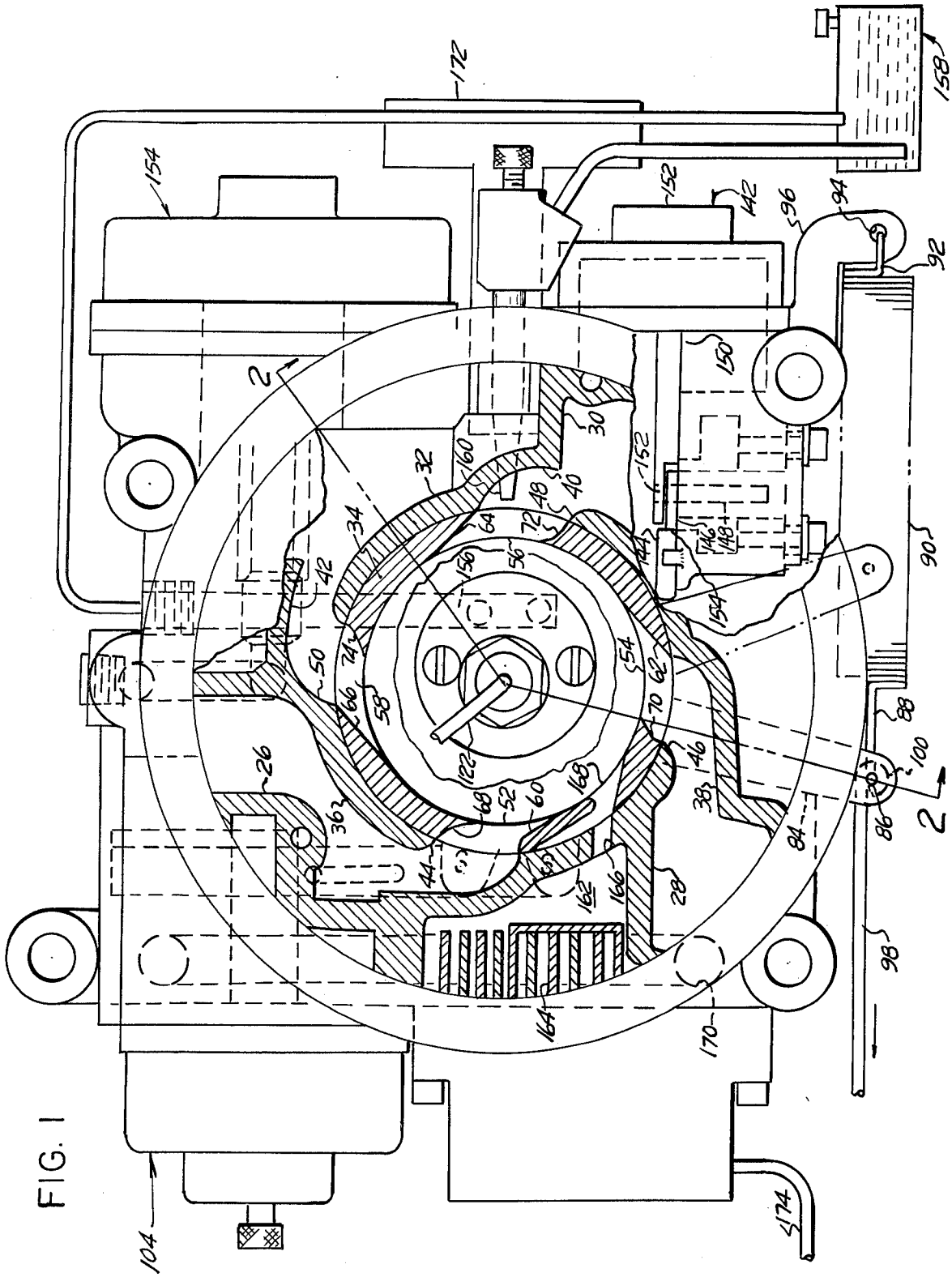


FIG. 1

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FIG. 2

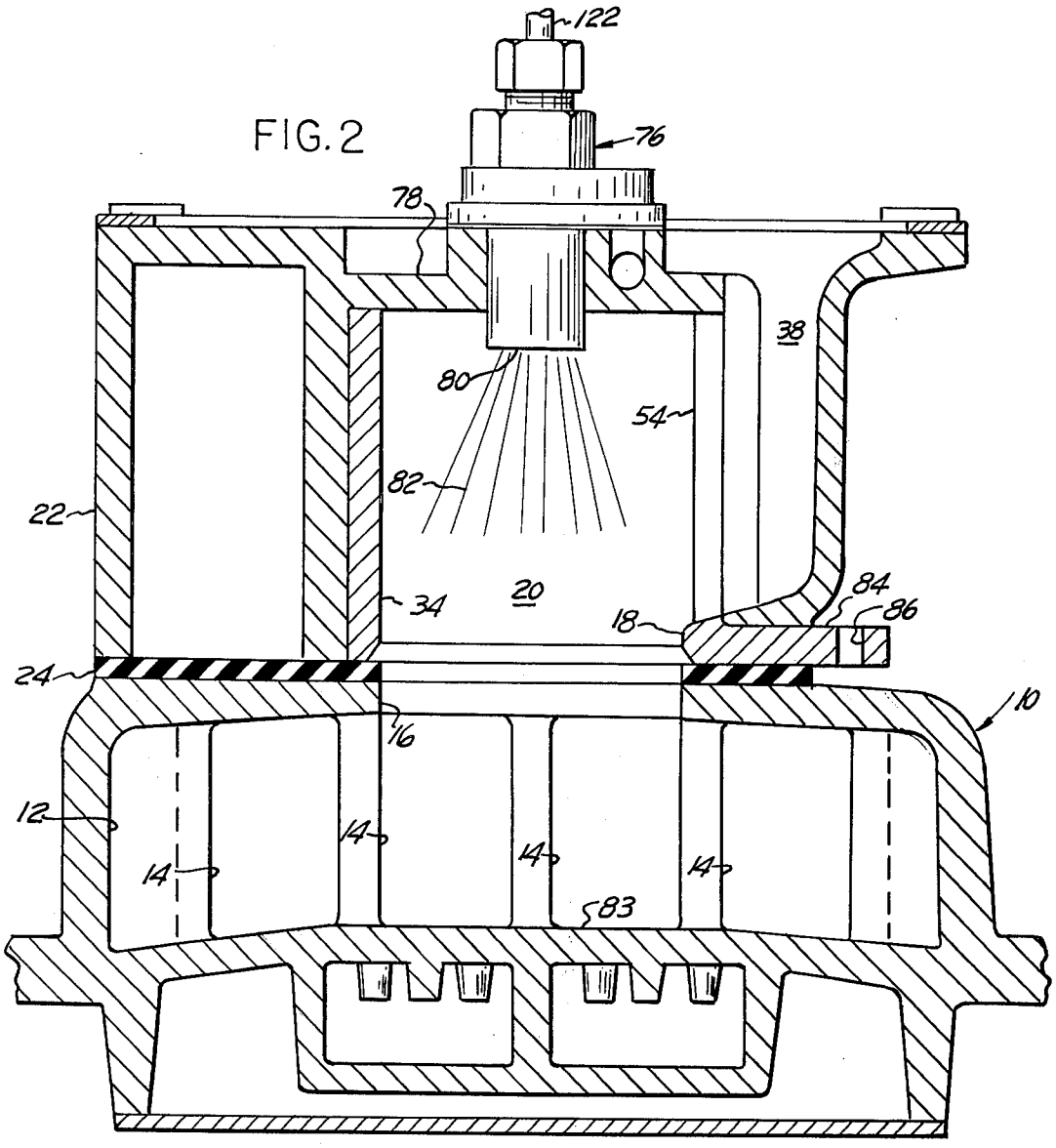
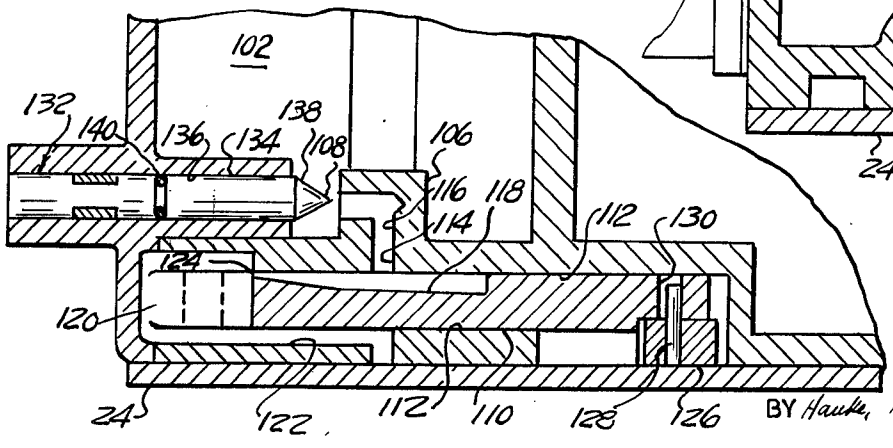


FIG. 3



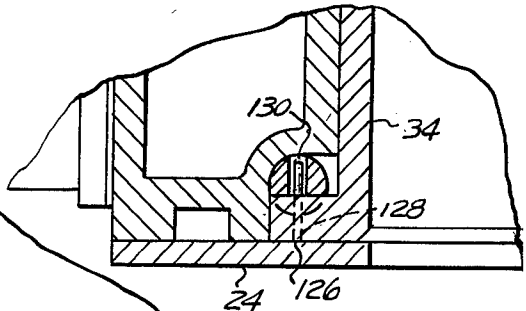


FIG. 4

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FIG. 5

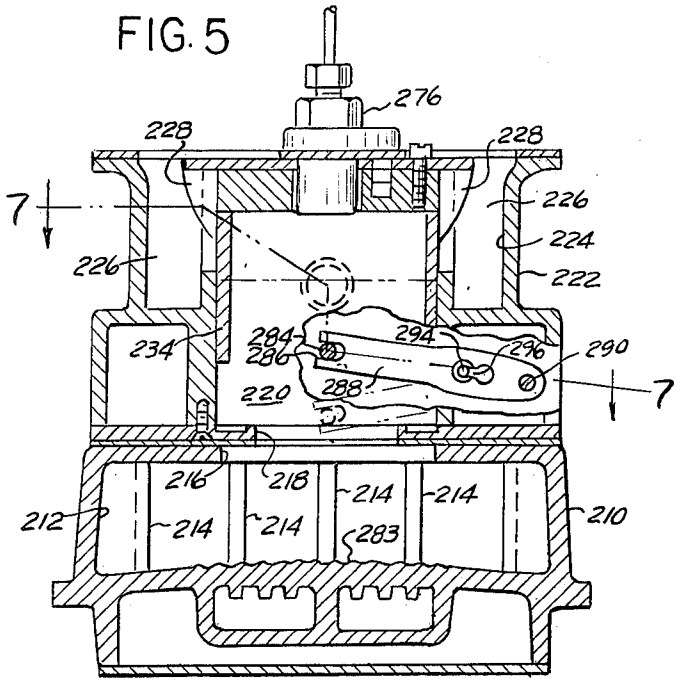


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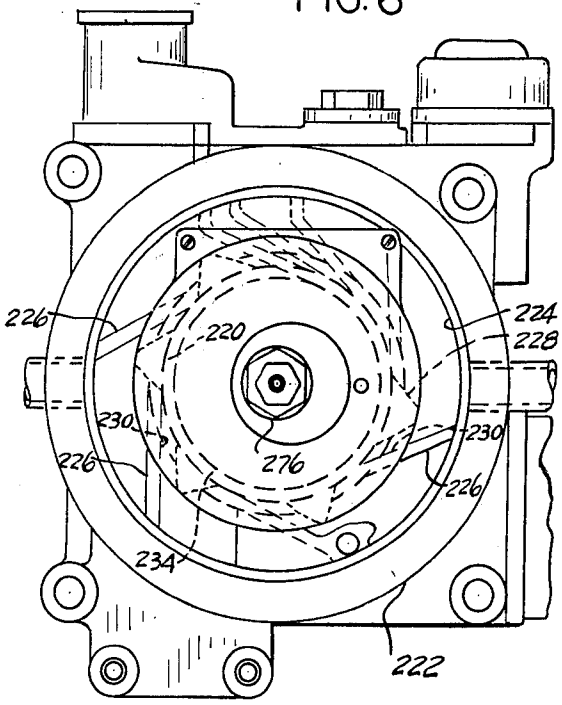
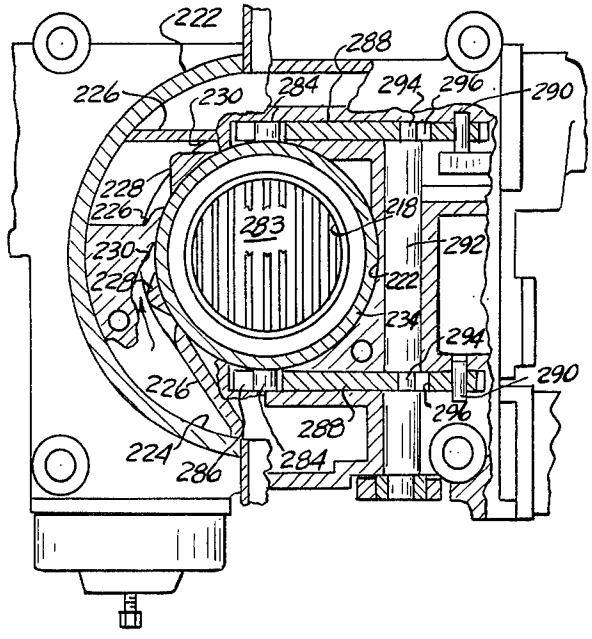


FIG. 7



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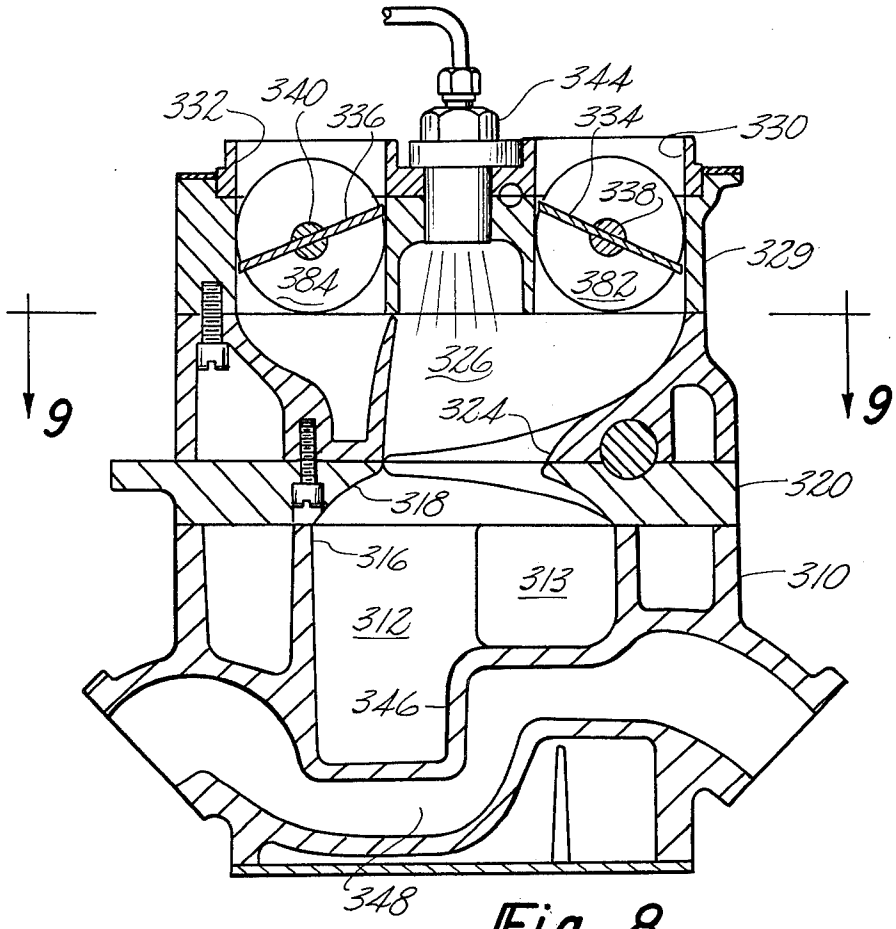

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Fig - 8

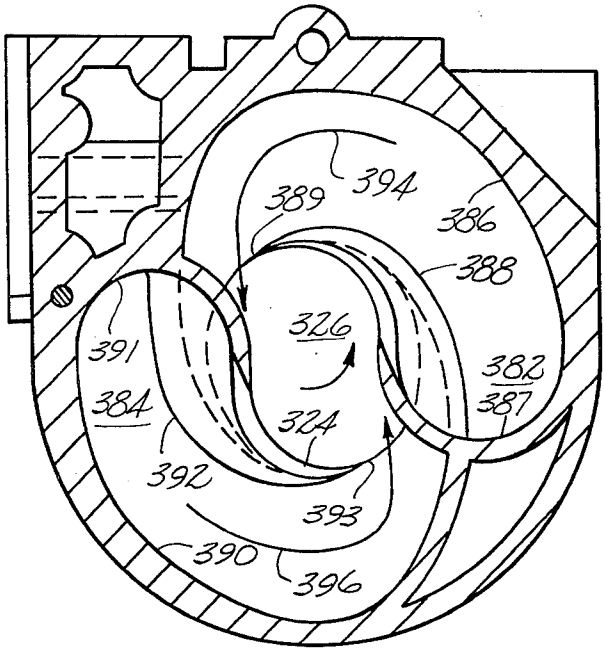

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Fig - 9

PRESSURE CARBURETOR SYSTEM FOR MANIFOLD DISTRIBUTION

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of my application Ser. No. 119,591 filed Mar. 1, 1971, now abandoned, which was a continuation-in-part of my application Ser. No. 11,572 filed Feb. 16, 1970 and now abandoned, and represents an improvement over my U.S. Pat. No. 3,635,201 issued Jan. 18, 1972 on an application co-pending with the applications from which the present application derived.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to internal combustion engine charge forming control systems for pressure carburetion with manifold distribution of the charge.

2. Description of the Prior Art

Reduction of discharge residue and resultant toxic gases emitted by internal combustion engines, particularly in automobiles and large commercial vehicles such as trucks and buses, has received substantial attention in recent years. The reason for this attention has been part of a total effort aimed at reducing smog or polluted air concentrations in the larger cities.

Efforts toward reducing the discharge residue from internal combustion engines has been directed toward the improvement of the engine combustion characteristics, since by optimizing the combustion process fewer unburned and partially burned components are available for discharge to the atmosphere. These efforts have so far been only sporadically successful.

SUMMARY OF THE INVENTION

The present invention illustrates a pressure carburetion-manifold distribution system provided with the features deemed important for the solution of the problem of engine generated air pollution. The system improves engine combustion characteristics by thoroughly diffusing and mixing the fuel and air and by completely vaporizing the atomized fuel in the fuel-air charge, thereby reducing the quantity of unburned hydrocarbons and carbonmonoxide. The system substantially simulates the performance of liquid petroleum gas or propane, which burns clean in the combustion chamber with the exhaust gases substantially free of emissions. Formation in the combustion process of nitric oxide, which becomes toxic nitrogen dioxide upon its introduction into the atmosphere, is prevented by the introduction into the fuel-air mixture, during the upper ranges of the engine operation, of a difinite quantity of engine exhaust gases and a fog of water raising the humidity of the inducted mixture. The introduction of exhaust gases and the water fog cools the combustion processes, thereby avoiding the heat plus pressure combination which otherwise causes the formation of nitric oxide.

The preferred embodiment of the invention comprises a carburetor housing having a swirl-type mixing chamber disposed immediately up-stream of the engine intake manifold. The chamber in some modifications is formed within a centrally located cylindrical air valve mounted in the carburetor housing and rotatable about a central vertical axis or axially movable within the housing chamber. The carburetor housing includes a

plurality of tangential air inlet ducts, or a peripheral air inlet chamber provided with swirl-producing vanes, the ducts or spaces between the vanes arranged either to register with a plurality of air valve inlet ports tangentially formed in the side walls of the rotatable air valve or to introduce air over the top edge of the cylindrical valve. Rotation of the rotatable air valve or axial movement of the valve varies the registration of the ports and ducts or the degree of opening of the ducts to thereby vary the amount of air introduced into the mixing chamber formed in the center of the air valve. The tangential admission of air into the mixing chamber causes the air to swirl at a substantially high velocity in the mixing chamber before it is inducted into the engine intake manifold.

A fuel nozzle assembly is disposed immediately about or at the closed end of the mixing chamber and has its fuel outlet nozzle extending axially downwardly into or toward the mixing chamber and in line with the outlet from the mixing chamber for discharging a metered quantity of atomized fuel towards the mixing chamber outlet into the swirling air within the air valve. Thus, the tangentially entering air swirls inwardly around the mixing chamber, thoroughly mixing with the fuel spray before the mixture is inducted into the intake manifold. A surface heated by the engine's exhaust gases is disposed within the intake manifold immediately downstream from the mixing chamber outlet, aiding in the vaporation of the fuel. The chamber opening to the manifold may be of reduced diameter to form an orifice which enhances the mixing of the fuel spray throughout the swirling air and directs the mixture in a definite pattern against the exhaust heated surface of the manifold. The swirling fuel-air charge is then relatively uniformly distributed to the cylinder intake port runners opening from the intake manifold.

In an improved modification, an adapter plate is mounted between the carburetor and manifold structures and has an opening communicating same which is formed to initiate directional flow of the mixture toward the port runners leading from the manifold.

DESCRIPTION OF THE DRAWINGS

The description refers to the accompanying drawings wherein like reference characters refer to like parts throughout the several views, and in which:

FIG. 1 is a top plan view of a preferred embodiment of the pressure carburetion-manifold distribution system with the air cleaner removed for clarity and partially broken away to illustrate some components in cross-section;

FIG. 2 is a cross-sectional view of the system taken substantially on line 2—2 of FIG. 1;

FIG. 3 is a fragmentary cross-sectional view of the system of FIG. 1 showing the construction of a preferred metering valve;

FIG. 4 is a fragmentary cross-sectional view of the system shown in FIG. 1 showing detailed construction of the connection between the air valve and the fuel metering piston;

FIG. 5 is a vertical cross-sectional view of another preferred embodiment of the invention;

FIG. 6 is a top plan view of the system of FIG. 5;

FIG. 7 is a fragmentary cross-sectional view taken pn the line 7—7 of FIG. 5;

FIG. 8 is a vertical cross-sectional view of a third preferred embodiment of the invention; and

FIG. 9 is a fragmentary cross-sectional view taken on line 9—9 of FIG. 8.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2, a preferred pressure carburetion manifold distribution fuel-air mixture induction system comprises a preferred intake manifold, generally indicated at **10**, for an eight cylinder V-type engine. The manifold includes a central chamber **12** connected with a plurality of annularly spaced intake port runners **14** leading to each of the engine's cylinders (not shown). The chamber **12** is provided with a central fuel-air mixture intake port **16** that registers with a fuel-air mixture outlet **18** of a mixing chamber **20**, which is centrally located in a carburetor housing **22**. The housing **22** is secured to the intake manifold **10** by any convenient means and has a gasket plate **24** disposed therebetween to retain a hereafter described valve **34** and to prevent leakage.

The present system is designed for use primarily with the manifold shown, but may be adapted to other manifolds as is or with some modifications, but the principles herein described are the same.

Referring to FIG. 1, the housing **22** is formed preferably with four vertically disposed air inlet channels **26**, 28, 30 and **32** positioned around a centrally located rotatably mounted cylindrical air valve **34**. Each of the air inlet channels includes a duct, indicated at **36, 38, 40** and **42**, respectively, extending in a counter-clockwise direction from the respective inlet channel around the air valve **34** to the outlet ports **44, 46, 48** and **50**, respectively, with which are engaged the outer surface of the cylindrical wall of the air valve **34**. As shown in FIGS. 1 and 2, the air valve **34** has four vertically extending annularly spaced air inlet ports **52, 54, 56** and **58**, which register with the air outlet ports **44, 46, 48** and **50**, respectively, for receiving air therefrom into the mixing chamber **20** formed within the air valve **34**. Thus, air for engine operation is inducted into the air inlet channels **26, 28, 30** and **32**, and through the connecting ducts **36, 38, 40** and **42** to the air outlet ports **44, 46, 48** and **50**. When the incoming air reaches the air outlet ports, it is moving counter-clockwise, as viewed in FIG. 1. This counter-clockwise movement is continued as the air passes from the air outlet ports through the air inlet ports **52, 54, 56** and **58** and into the mixing chamber **20**. Thus, air entering the mixing chamber **20** swirls counterclockwise around the mixing chamber before it is inducted through the fuel-air mixture oulet **18** formed in the valve **34** and into the central chamber **12** of the intake manifold.

It will be noted that the vertically disposed edge surfaces of the air inlet ports **52, 54, 56** and **58** are formed so as to aid in directing the incoming air tangentially into the mixing chamber **20** along the inner wall of the air valve **34**. Specifically, vertical edge surfaces, **60, 62,** 64 and **66** of the air inlet ports **52, 54, 56** and **58**, respectively, are slanted clockwise from a radial line through their respective point of intersection with the outer wall of the valve **34** so as to be substantially tangential to the inner wall surface of the valve **34** and, thus, not hinder the incoming air from tangentially entering the chamber **20**. Each of the opposite vertical edge surfaces **68, 70, 72** and **74** of the air inlet ports are curved toward the edge surfaces **60, 62, 64** and **66**, respectively, in extending from their intersection with the outer wall of the valve **34** to their intersection with the inner wall of the valve. Thus, the edge surfaces **68, 70,** 72 and **74** also aid in directing incoming air counterclockwise around the mixing chamber **20.**

Referring to FIG. 2, it will be noted that the inlet port **54** extends (as do the inlet ports **52, 56** and **58**) almost the entire vertical length of the air valve **34.** If it is desired to use the system on smaller sized engines, the ports **52, 54, 56** and **58** may be formed in the air valve **34** so as to extend a lesser vertical distance.

Referring to FIGS. 1 and 2, a fuel nozzle assembly **76** is mounted on a supporting structure **78** which is a part of the housing **22** and extends over the top opening of the cylindrical air valve **34,** preventing air from entering therethrough. The fuel nozzle assembly **76,** the detailed construction and operation of which is shown and described in my U.S. Pat. No. 3,635,201, issued Jan. 18, 1972, includes a downwardly directed fuel outlet **80** disposed within the upper portion of the mixing chamber **20** for spraying a finely atomized spray of metered fuel into the mixing chamber, as indicated by the lines **82.** Thus, the spray of fuel from the outlet **80** is swirled counterclockwise around the mixing chamber **20** by the counterclockwise swirling air, thoroughly mixing the fuel spray with the air before the mixture is inducted into the intake manifold, thereby forming a better burning mixture that results in the formation of less pollution. From the mixing chamber **20,** the mixture passes through the outlet **18** into the intake manifold, thereby forming a better burning mixture that results in the formation of less pollution. From the mixing chamber **20,** the mixture passes through the outlet **18** into the central chamber **12** where it engages a surface **83** which is heated by hot engine exhaust gases as previously described in my U.S. Pat. No. 3,635,201. The heating of the fuel-air mixture from its contact with the heated surface **83** aids in the substantially complete vaporization of the fuel. The central location of the chamber **12,** the annular arrangement of the port runners **14,** and the swirling of the fuel-air charge ensure an even distribution of the charge to the individual cylinders.

As previously described, the air valve **34** is rotatably mounted about its central vertical within the housing **22** for varying the quantity of air entering the mixing chamber **20** by varying the size of the openings into the chamber **20** formed by the air outlet ports **44, 46, 48** and **50** and the air inlet ports **52, 54, 56** and **58.** Referring to FIG. **1,** as the air valve **34,** which is shown in the full open position, is rotated counter-clockwise about its central axis, the registration between the outlet ports and the inlet ports decreases, decreasing the quantity of air entering the mixing chamber **20.**

As seen in FIGS. **1** and **2,** the valve **34** has a horizontally disposed elongated lever **84** extending radially outward from its lower portion between the housing **22** and the gasket plate **24** for rotating the valve about its central axis. The lever **84** has an aperture **86** formed adjacent its free end for receiving a loop **88** formed on one end of a coil spring **90.** The spring **90** has a second loop **92** formed on its other end extending into an aperture **94** formed in a fixed support **96** secured to the housing **22,** thereby stretching the spring **90** between the support **96** and the lever **84.** Thus, the spring **90** urges the valve **34** counter-clockwise toward a position closing the air inlet ports formed in the valve.

A lever **98,** having one end **100** hooked around the loop **88** of the spring **90** immediately beneath the lever

84, has its other end attached to a conventional foot-operated acceleration pedal (not shown). As the foot pedal is pushed downward, the lever 98 is pulled toward the left, as viewed in FIG. 1, rotating the valve 34 clockwise against the force of the spring 90, increasing the quantity of air flowing into the mixing chamber 20 by increasing the open area between the air inlet ports and the air outlet ports.

Fuel to the fuel nozzle assembly 76 is metered through a pair of variable orifice valves shown in FIGS. 1, 3 and 4. Fuel from a main fuel tank (not shown) is delivered by the action of a fuel pump (not shown) into a fuel chamber 102. The flow of fuel from the main fuel tank into the fuel chamber 102 is controlled by a variable orifice valve assembly 104 which is responsive to intake manifold pressure to increase fuel flow into the chamber 102 as the intake manifold pressure increases. The detailed construction and operation of the valve assembly 104 is more fully shown and described in my co-pending application Ser. No. 857,415, now U.S. Pat. No. 3,635,201.

Referring to FIGS. 3 and 4, the fuel chamber 102 is formed with a boss 106 having a fuel outlet orifice 108. A variable orifice piston 110 is closely fitted in and axially movable in a chamber 112. The chamber 112 has an outlet orifice 114 connected by conduit 116 with the outlet orifice 108. The piston 110 is formed with a tapered groove 118, which intersects the orifice 114 for metering fuel from the fuel chamber 102 into an accumulator chamber 120 which forms a part of the chamber 112. A conduit (not shown) leads from the accumulator chamber 120 and connects to a conduit 122, as shown in FIGS. 1 and 2, which leads to the fuel nozzle assembly 76 for delivering liquid fuel thereto. The piston 110 forms a variable orifice 124 between the left end of the close fitting portion of the chamber 112 and the tapered groove 118 for metering the fuel. As the piston moves to the left, as viewed in FIG. 3, the effective cross-section of the metering orifice 124 increases due to the taper of the groove 118, thereby increasing fuel flow from the fuel chamber 102 into the conduit 122 and to the fuel nozzle assembly 76. The piston 110 has its end opposite the accumulator chamber 120 pivotally connected to a flange 126 by means of a pin 128. The flange 126 is integrally formed with and extends radially outward from the lower portion of the valve 34 and has the vertically disposed pin 128 threaded therein. The upper portion of the pin 128 extends into an elongated aperture 130 formed in the piston 110. Thus, as the valve 34 is rotated clockwise as shown in FIG. 1, the stud 126 is pushed to the left, as shown in FIG. 3, thereby pushing the piston 110 to the left and increasing the opening of the orifice 124, delivering more fuel from the chamber 102 to the fuel nozzle assembly 76. Thus, as the valve 34 is rotated to allow more air to flow into the mixing chamber 20, the orifice 124 is simultaneously opened to increase fuel delivery.

It is noted that when the valve 34 is quickly rotated clockwise allowing air to rush into the intake manifold for quick acceleration, the piston 110 is quickly moved to the left, as viewed in FIG. 3, forcing the free end of the piston into the accumulator chamber 120, and immediately displacing a portion of the fuel therein to provide the greater quantity of fuel needed to mix with the sudden rush of air.

A fuel shut-off valve 132, as illustrated in FIG. 3, may be provided for manually shutting off the fuel to prevent a gravity fuel flow from an elevated fuel tank into the carburetor. The valve 132 includes an elongated needle valve 134 slidably mounted in a cylinder 136 formed in the housing 22. The valve 134 includes a conical tip 138 disposed in the fuel chamber 102 for insertion into the outlet orifice 108 for stopping the flow of fuel from the fuel chamber 102. The valve 134 includes an O-ring 140 positioned therearound to prevent leakage of fuel from the chamber 102. Appropriate linkage may be secured to the valve 134 to actuate it.

Referring to FIG. 1, a variable idler stop system 142 is provided to give a higher idling speed during engine warm-up. The system 142 includes an elongated horizontally disposed member 144 slidably mounted on the housing 22 and having one end engaging the lever 84 when the valve 34 is positioned in the idle position. The lever 144 is actuated by an elongated vertically disposed member 146 pivotally mounted at its lower end on a pin 148. The upper end of the member member 146 is pivotally secured to a lever 150 by means of a pin 152. A cam 154 is formed on the lower edge of the member 146 to actuate the lever 144 as the member 146 is pivoted about the pin 148 by the lever 150, thus varying the idle stop position of the air valve 34 and simultaneously the fuel metering piston 110. The lever 150 is connected to a diaphragm assembly 153, as shown and described in my U.S. Pat. No. 3,635,201, responsive to intake manifold pressure for varying the idle stop position.

As described in my aforementioned U.S. Pat. No. 3,635,201, the nozzle assembly 76 may be selectively alternatively vented to atmospheric air and hot engine exhaust gases. Referring to FIG. 1, a conventional diaphragm snap-acting valve assembly 155 is shown for selectively alternatively directing air and hot engine exhaust gases to the nozzle assembly 76 through conduit 156. Although the specific construction of the valve 154 may be of any convenient design, its operation and purpose may be as previously described in my U.S. Pat. No. 3,635,201.

Referring to FIG. 1, a water spray system 158 is shown, its operation and construction previously shown and described in my U.S. Pat. No. 3,635,201. It will be noted that the water spray system 158 includes a nozzle 160 for spraying water through the inlet port 56 into the mixing chamber 20.

Referring to FIG. 1, a chamber 162 for venting the crankcase fumes is formed in the housing 22 for the reception of adhesion plates 164. The chamber 162 is communicated with the engine crankcase, as by passage 170, for receiving engine crankcase fumes therefrom. The crankcase receives ram-air via the rocker-box covers (not shown) from the T-pipe 172. The crankcase fumes are inducted into one end of the chamber 162 and weave back and forth between the plates 164 before exiting through an aperture 166 formed in the chamber 162. Simultaneously with the fumes from the crankcase, evaporative losses of fuel from the condensing chamber of the sealed fuel tank, as shown in my U.S. Pat. No. 3,635,201, are transferred to the inlet of the chamber 162 through the tube 174. The aperture 166 communicates with a port 168 formed in the air valve 34 for drawing the crankcase fumes and evaporative losses into the mixing chamber 20. It will be noted that the port 168 is formed with a wide opening on the outer surface of the valve 34 so

that the chamber **162** communicates with the mixing chamber **20** irrespective of the angular position of the air valve **34.**

FIGS. **5, 6** and **7** illustrate another preferred embodiment of the invention in which an intake manifold **210** has a central chamber **212** connected with a plurality of annularly spaced intake port runners **214** leading to each of the engine's cylinders (not shown). The chamber **212** is provided with a central fuel-air mixture intake port **216** which registers with a reduced orifice fuel-air mixture outlet **218** of a mixing chamber **220** located in the carburetor housing **222.**

The housing **222** is formed with an annular outer air intake chamber **224** provided with vertical vanes **226** extending from the outer peripheral wall of the chamber **224** tangentially to the inner peripheral wall of the chamber **224,** and inner vane elements **228** located in annularly spaced positions around the inner peripheral wall of the chamber **224** and formed to cooperate with the vanes **226** to form channels **230** leading tangentially into the mixing chamber **220.** Air enters the upper end of the chamber **224** from a conventional air intake filter (not shown).

A cylindrical air valve **234** is disposed within the mixing chamber **220** for vertical movement therein so that its upper edge will selectively variably open the channels **230** into the mixing chamber **220,** so that air for engine operation is inducted into the intake chamber **224,** through the channels **230,** and tangentially into the mixing chamber **220** to produce a substantially high velocity air swirl therein.

A fuel nozzle assembly **276** is mounted on the top of the housing **222,** its detailed construction and operation being shown and described in my U.S. Pat. No. 3,635,201 and operates to inject a finely atomized spray of metered fuel axially downwardly into the mixing chamber **220.** The fuel spray is swirled around the mixing chamber **220** by the swirling air, thoroughly mixing the fuel spray with the air before the mixture is inducted into the intake manifold, as previously described for the embodiment of FIGS. **1–4.** From the mixing chamber **220,** the mixture passes through the smaller diameter outlet orifice **218** which operates to more thoroughly mix the fuel spray with the swirling air and to direct it in a definite pattern into the intake manifold **210** and aganist a preferably ribbed surface **283** which is heated by hot engine exhaust gases as described in the aforesaid patent, for the previously described purposes.

The valve **234** is provided near its lower end with outwardly extending pins **284** which are engaged in slots **286** provided in the ends of the lever arms **288.** The arms **288** are fulcrummed at their other ends on pins **290** mounted in the carburetor housing **222.** A rotatable shaft **292** extends through the housing **222** and has eccentric portions **294** which engage in slots **296** provided in the lever arms **288** intermediate the pins **284** and **290,** so that rotation of the shaft **292** can lower and raise the air valve **234** between the upper position shown and a lower position as indicated in phantom lines to variably open and close communication between the channels **340** leading from the outer air intake chamber **224** into the mixing chamber **220.** The shaft **292** may be rotated by any preferred mechanism in relation to the injection of fuel into the mixing chamber to thereby provide the desired fuel-air mixture for optimum operation of the engine.

FIGS. **8** and **9** illustrate a third preferred embodiment of the invention in which the intake manifold **310** has a distribution chamber **312** connected with a plurality of port runners **313** (one only being shown), leading to each of the engine's cylinders (not shown). The chamber **312** has an upper fuel-air mixture inlet opening **316** which registers with one end of a contoured passage **318** extending through a mounting plate **320.** The other end of the mounting plate passage **318** registers with a fuel air mixture outlet **324** of a mixing chamber **326** located in a carburetor housing **328.**

The passage **318** in the mounting plate **320** is formed so as to initate directional flow of the fuel-air mixture to each of the port runners **313,** but such contouring will in the intake manifold be individually designed for each different type of engine with which the present invention is to be used, and the shape of the mounting passage **318** in FIG. **8** is merely illustrative.

A housing **329** includes a pair of cylindrical air inlets **330** and **332** arranged in parallel and having throttle valves **334** and **336,** respectively. The throttle valves **334** and **336** are secured to rotatably mounted shafts **338** and **340** that are mechanically linked together (not shown) and connected to a foot operated accelerator pedel (not shown) by any conventional means. As the foot pedal is pushed downward, shaft **340** is rotated in a counterclockwise direction and shaft **338** is rotated in a clockwise direction thereby opening the throttle valves **334** and **336** to induct a variable air flow into air inlets **330** and **332,** depending on the degree of depression of the accelerator pedal.

As the throttle valves **334** and **336** are opened, air from the air inlets **330** and **332** is inducted by the suction pressure of the intake manifold **310** into air channels **382** and **384,** respectively, of the mixing chamber **326.** The beginning of the channel **382** is formed by an outer wall **386,** a backwall **387** and an inner wall **388.** The inner wall **388** extends upward from the outer periphery of the outlet **324** of the mixing chamber **326** and slopes downward afterwards the outlet **324** ad the channel **382** curves counterclockwise around the outlet **324** to the channel outlet **389,** where the wall **388** terminates. The beginning of of the channel **384** is formed by the outer wall **390,** a backwall **391** and an inner wall **392.** The inner wall **392** extends upwardly from the outer periphery of the outlet **324** and slopes downward towards the outlet **324** and the channel **382** curves counterclockwise around the outlet **324** to the channel outlet **389,** where the wall **388** terminates. The beginning of the channel **384** is formed by the outer wall **390,** a backwall **391** and an inner wall **392.** The inner wall **392** extends upwardly from the outer periphery of the outlet **324** and slopes downward toward the outlet **324** as the channel **384** curves counterclockwise around the outlet **324** to the channel outlet **393,** where the wall **392** terminates.

The suction pressure of the intake manifold **310** inducts the air in the channels **382** and **384** in a counterclockwise direction, as illustrated in FIG. **9** by arrows **394** and **396,** toward the central outlet **324** of the mixing chamber **326.** The air tangentially enters the central outlet **324** where it swirls the fuel sprayed from nozzle **344,** as previously described in the first embodiment and in my U.S. Pat. No. 3,635,201, so as to diffuse the sprayed fuel and mix it evenly with the air. The mixture then swirls axially through the outlet **324** and the opening **318** in the mounting plate **320,** and into the central

chamber 312 of the intake manifold 310. As the fuel-air mixture moves into the intake manifold 310, it sweeps across a heated surface 346 of an exhaust cross-over passage 348 which further aids in the vaporization of the fuel.

Although I have described but three preferred embodiments of my invention, it is to be understood that various changes and revisions can be made therein without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. In an internal combustion engine having an intake manifold adapted to distribute a fuel-air mixture to engine cylinders, a fuel-air charge forming system comprising:

a carburetor housing having a mixing chamber defined by a cylindrical recess open at one end for communication at all times openly and directly with said intake manifold and closed at the opposite end, a liquid fuel nozzle carried at said closed end substantially at the chamber axis and adapted to inject an atomized fuel spray substantially axially into said chamber toward said open end,

means for regulating fuel flow to said nozzle,

at least one air intake passage in said housing directing air to an intake port opening into the side of said mixing chamber,

valve means disposed within said housing adjacent said mixing chamber and operable upon actuation to regulate air flow into said mixing chamber,

means connecting said fuel flow regulating means and said valve means to increase air flow into said chamber as fuel flow increases and to decrease the air flow into said chamber as fuel flow decreases; and

said intake passage and said valve means being formed to direct air tangentially to said intake port to swirl air inwardly into said mixing chamber for mixing with the liquid fuel spray from said fuel nozzle prior to discharge into said manifold.

2. The system of claim 1 wherein said valve means is associated with said intake port opening for selectively varying the cross-sectional area thereof.

3. The system of claim 1 wherein said valve comprises a tubular member fitting within the side wall of said chamber.

4. The system of claim 1 wherein said valve is rotatable in said chamber and has at least one port variably registerable with said intake port on rotation of said valve.

5. The system of claim 4 wherein said intake port and said valve port extend longitudinally parallel to said chamber axis.

6. The system of claim 4 wherein said valve port has bevelled edges to augment tangential entry of air into said chamber.

7. The system of claim 3 wherein said valve is axially movable in said chamber with one end variably opening said air intake port to said chamber.

8. The system of claim 7 wherein said air intake port is disposed adjacent the fuel nozzle end of said chamber.

9. The system of claim 7 wherein said intake port extends longitudinally parallel to said chamber axis.

10. The system of claim 1 including an adapter plate mounted intermediate said carburetor housing and said intake manifold, said intake manifold having two or more port runners, said plate having an opening therethrough with one end thereof registering with said chamber open end and side walls thereof formed selectively to initiate directional distribution of said mixture from said chamber toward the port runners of said manifold with respect to the engine with which the system is used.

11. The system of claim 1 and including a surface heated by the exhaust gases of said internal combustion engine disposed down-stream of said mixing chamber for aiding in the vaporizing of the atomized fuel discharged from said mixing chamber.

12. The system of claim 1 and including an idle stop mechanism responsive to engine manifold pressure associated with said valve means for varying the engine idle setting of said valve.

13. The system of claim 1 and including means for venting fumes from the engine crankcase into said mixing chamber.

14. The system of claim 1 and including means for venting evaporative losses from the fuel system into said mixing chamber.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,877,449

DATED : April 15, 1975

INVENTOR(S) : Carl F. High

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 2, line 64, delete "pn" and insert --on--

Col. 3, line 51, delete "oulet" and insert --outlet--

Col. 4, line 43, after "vertical" insert --axis--

Col. 5, line 26, delete "outlet" and insert --inlet--

Signed and sealed this 15th day of July 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks