June 13, 1961 W. H. KOLBE ET AL 2,988,345

AIR VALVE CARBURETOR

Filed Feb. 26, 1959 3 Sheets-Sheet 1

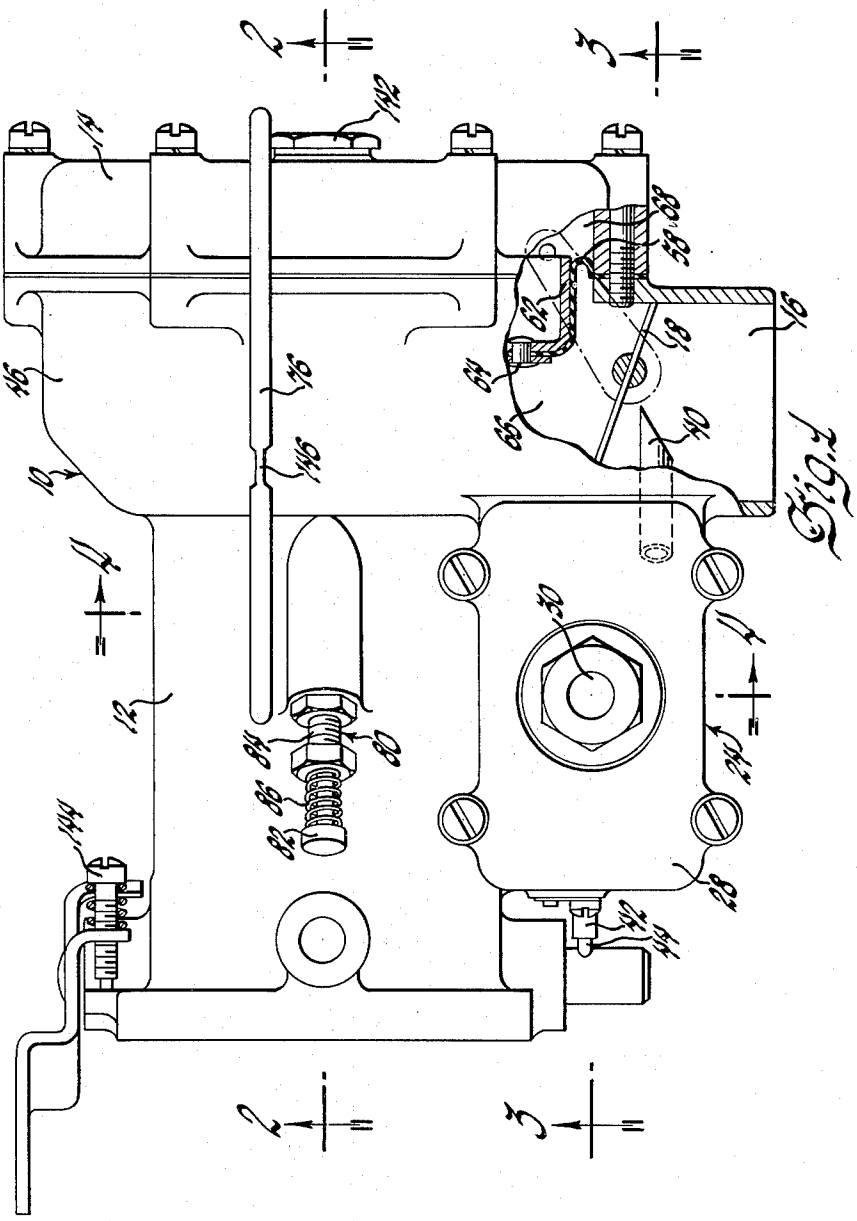


Fig. 1

INVENTORS
William H. Kolbe, Jr.
Alexander J. Sagady
BY R. T. Barnard
ATTORNEY

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AIR VALVE CARBURETOR

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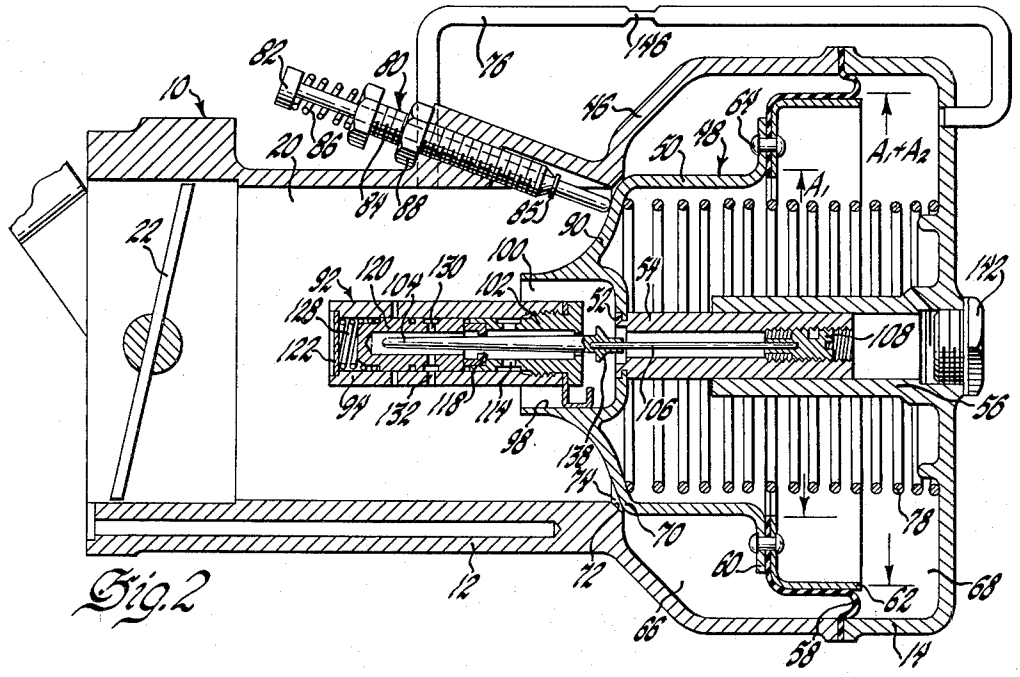


Fig. 2

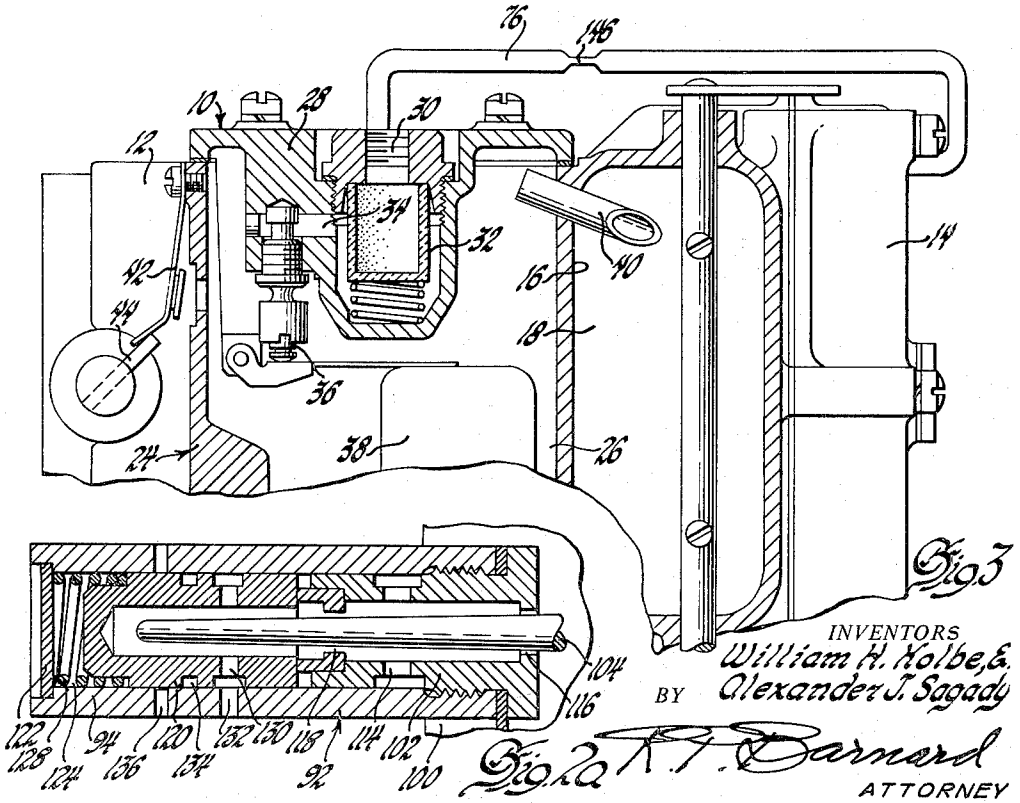


Fig. 3

INVENTORS
William H. Kolbe &
Alexander J. Sgoady

BY R. J. Barnard
ATTORNEY

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AIR VALVE CARBURETOR

Filed Feb. 26, 1959 3 Sheets-Sheet 3

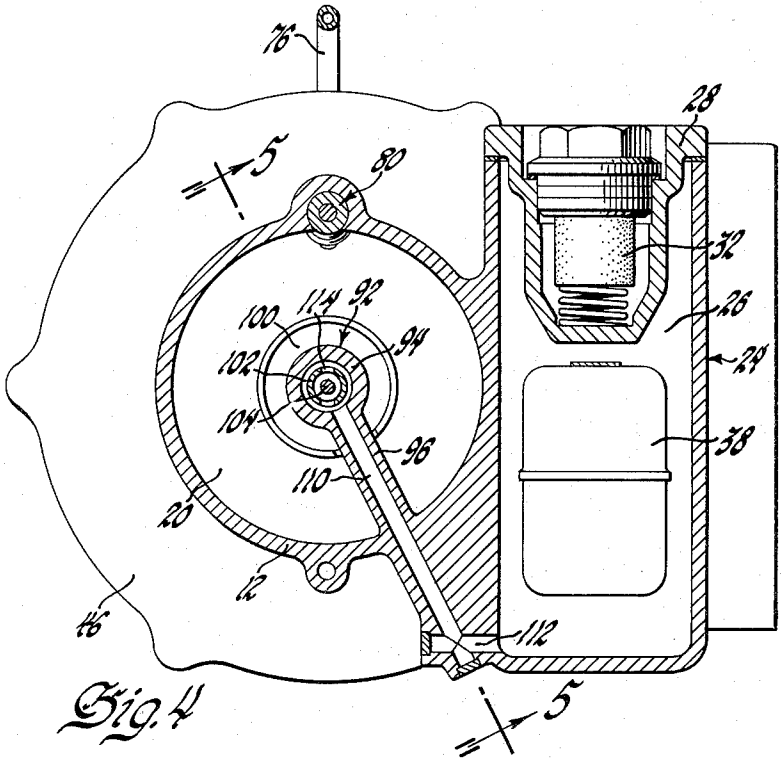


Fig. 4

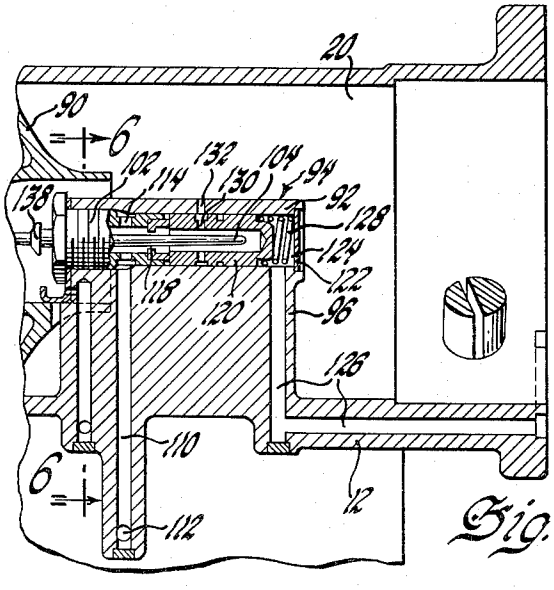


Fig. 5

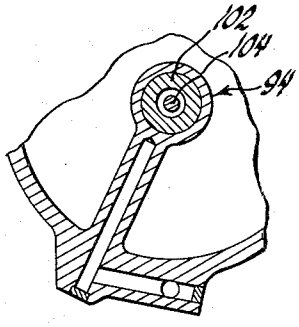


Fig. 6

INVENTORS
William H. Kolbe, &
Alexander J. Sagady
BY R. T. Barnard
ATTORNEY

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AIR VALVE CARBURETOR

William H. Kolbe, Birmingham, and Alexander J. Sagady, Centerline, Mich., assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

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9 Claims. (Cl. 261—50)

The present invention relates to a new and improved air valve carburetor in which the flow of fuel is controlled by maintaining a substantially constant pressure drop across a fuel metering valve device to maintain a substantially constant fuel-air ratio under normal operating conditions. The constant pressure drop is maintained by the provision of a unique air valve arrangement in which the quantity of air flow is varied in accordance with engine demand. In an air valve type carburetor the pressure drops across the air and fuel orifices are maintained substantially constant by varying the area of the orifices in accordance with engine demand.

It is one of the basic objects of the present invention to provide a carburetor of simple design utilizing fewer parts than a conventional carburetor and further in which calibration and servicing are also simplified because of the absence of air bleeds coupled with the ability to meter fuel by a single contoured needle.

It has been a basic defect with air valve type carburetors in the past that the actual air valve mechanism has been exposed to the air stream and the fuel in such a way as to be highly susceptible to sticking of the parts thereby upsetting the desired fuel metering function. In the present invention the air valve has been uniquely constructed so that it is mounted within a chamber free of air or fuel impurities thereby insuring accurate actuation of the valve in accordance with engine demand.

The present air valve has been uniquely combined with a fuel metering valve in such a way as to insure economical use of fuel under normal operating conditions and at the same time facilitating the flow of additional fuel under conditions of high power demand.

The details as well as other objects and advantages of the present invention will be apparent from a perusal of the detailed description which follows.

In the drawings:

FIGURE 1 is a partially sectioned elevational view of the subject carburetor;

FIGURE 2 is a view along line 2—2 of FIGURE 1;

FIGURE 2*a* is an enlargement of a portion of FIGURE 2;

FIGURE 3 is a view along line 3—3 of FIGURE 1;

FIGURE 4 is a view along line 4—4 of FIGURE 1;

FIGURE 5 is a view along line 5—5 of FIGURE 4; and

FIGURE 6 is a view along line 6—6 of FIGURE 5.

Referring first to FIGURES 1 through 3, a carburetor is indicated generally at **10** and includes casing members **12** and **14**. In order to facilitate lowering of the height of carburetor **10**, it is of the side opening type and includes an inlet passage **16** formed in casing **12**. A conventional choke valve **18** is mounted in air intake **16** and may either be of the manual or automatic types as preferred. Casing **12** includes an air induction passage **20** extending generally axially thereof and which includes a throttle valve **22** rotatably mounted therein to control the quantity of combustible mixture supplied to any suitable engine intake manifold.

A source of fuel or fuel reservoir is indicated generally at **24** and includes a fuel bowl **26** formed as a part of

casing **12**. A cover casing **28** is adapted to enclose fuel bowl **26** and includes a fuel inlet **30** formed therein which supplies fuel through a filtering element **32** to a passage **34** from whence the fuel will flow into bowl **26** in accordance with the position of a valve **36** controlled in the conventional manner by a float **38**.

A conventional vent tube **40** extends from the top of fuel bowl **26** and opens into air inlet passage **16** anteriorly of choke valve **18** to permit fuel vapors to be vented from the fuel reservoir. An additional vent valve **42** is mounted on fuel bowl **26** and is adapted to be opened by a lever **44** operatively connected with throttle valve **22** when the throttle is in its fully closed position. Thus when the engine is operative and air is being drawn in through air intake passage **16**, float bowl **26** will be internally vented through tube **40** whereas when the engine is inoperative the bowl will be externally vented through vent valve **42**.

Referring more particularly to FIGURE 2, it will be seen that the intake end of casing **12** is enlarged at **46** to provide a housing for an air valve member indicated generally at **48**. Air valve **48** includes a contoured diffuser or valve element **50** centrally apertured at **52** to support a hollow sleeve or stem member **54** slidably disposed within a corresponding cylinder **56** formed integrally on cover casing **14**. A flexible diaphragm **58** is clamped at its internal periphery to a radially extending flange **60** on valve element **50**. Diaphragm **58** is supported against flange **60** by a dish-shaped supporting member **62** secured thereto through a plurality of rivets **64**. The outer periphery of diaphragm **58** is clamped between casings **12** and **14** so as to respectively define therewith chambers **66** and **68**.

Air valve element **50** includes an annular shoulder portion **70** adapted to coact with an annular seat **72** on casing **12** to provide an annular air orifice or passage **74**, the cross sectional area of which is variable in accordance with the axial position of valve element **50**. As best seen in the sectioned portion of FIGURE 1, air inlet passage **16** openly communicates with chamber **66** defined by enlarged portion **46** of casing **12** and diaphragm **58**.

Chamber **68** defined by diaphragm **58** and cover casing **14** communicates through a conduit **76** with induction passage **20** intermediate throttle valve **22** and seat **72**. A spring element **78** is seated against casing **14** and is adapted to normally bias air valve element **50** in a direction so as to restrict the quantity of flow through annular air passage **74**.

An adjustable stop **80** is mounted in casing **12** and includes a plunger element **82** slidably mounted within threaded stud **84**. Plunger **82** is adapted to engage diffuser or valve element **50** to limit the latter's closing movement to insure adequate air flow under engine idling conditions. Plunger **82** includes a collar **85** to limit the plunger's outward movement by a spring **86**. The idle air adjustment is set by threading stud **84** within casing **12** and locking the same in position through nut **88**. The plunger may be depressed to open the air valve to check whether the idle mixture is satisfactory. To illustrate, if plunger **82** is depressed to open valve element **50** and an increase in engine speed follows, the idle mixture is too rich which can be corrected by reducing idle fuel flow, infra.

The actuation of air valve **48** is as follows: as already noted a constant pressure drop is maintained across annular air passage **74** by varying the cross sectional area of the passage through movement of the air valve. The

depression in induction passage **20** caused by the engine pumping air is imposed on portion **90** of valve element **50** designated at area A_1. This creates a force acting in the direction of throttle **22** tending to reduce the cross section of passage **74**. This same depression is transmitted through conduit **76** to chamber **68** and acts over an area A_1+A_2 to create a larger force tending to open valve element **50**. Area A_1 thus contains the same pressure on both sides and is balanced. However, area A_2 has induction passage depression on one side and intake air pressure on the other acting to open element **50**. This then is the pressure drop controlled by spring **78**. Since spring **78** wants to close the air valve and the depression over A_2 endeavors to open the valve, a balanced situation prevails. At each new position of throttle **22** a new balance obtains with a corresponding change in the cross sectional area of air passage **74**.

As best seen in FIGURES 2 and 4 through 6, a fuel metering mechanism is shown generally at **92**. Mechanism **92** includes a casing portion **94** disposed coaxially within induction passage **20** and supported upon a web section **96** extending from casing **12**. Air valve element **50** includes a recess **98** formed in portion **90** which recess is radially and longitudinally spaced from the upper end of valve casing **94**. Casing **94** and recess **98** define a downwardly opening chamber **100**. An orifice sleeve **102** is threadably mounted within the upper end of casing **94** and is adapted to slidably receive a tapered fuel metering needle **104**. Needle **104** is secured to air valve element **50** through a wire **106** the other end of which is adjustably secured within stem **54** through an adaptor **108**.

Casing **94** is communicated with fuel reservoir **24** through passages **110** and **112** whereby fuel is supplied through ports **114** in orifice sleeve **102** to the space between the latter sleeve and needle **104**. Sleeve **102** includes primary and secondary fuel orifices **116** and **118** with which metering needle **104** coacts to regulate fuel flow. Thus as air flows through induction passage **20** a depression occurs creating a pressure drop across primary fuel orifice **116** causing fuel to flow into the air stream. It is apparent that due to the tapered nature of needle **104**, as air valve element **50** moves axially with respect to casing **12** the quantity of fuel supplied to the induction passage will be varied. Thus as the air valve moves away from throttle **22** due to increased air flow, the opening between primary orifice **116** and needle **104** will be increased to increase the quantity of fuel supplied to the air stream.

As best seen in FIGURES 2 and 5, a piston **120** is slidably disposed in the end of casing **94** closed by a disc **122**. Piston **120** includes a hollow portion adapted to receive the lower end of metering needle **104**. The lower end of fuel valve mechanism **92** closed by a disc **122** and slidable piston **120** defines a chamber **124** which communicates through a passage **126** within casing **12** with the induction passage **20** posteriorly of throttle valve **22**. A spring member **128** is disposed within chamber **124** and endeavors to bias piston **120** into abutting relation with a secondary fuel orifice member **118**.

The purpose of piston **120** is to provide additional fuel under conditions of high power demand. Piston **120** includes a plurality of radially disposed ports **130** which are adapted, under certain conditions, to communicate with radial ports **132** formed in casing **94**. Under normal operating conditions, e.g., manifold depression above 5 inches Hg, the manifold vacuum in chamber **124** will overcome spring **128** and shift piston **120** to its lowermost position wherein ports **130** and **132** are out of registry. However, under conditions of high power demand manifold vacuum will decrease sufficiently to permit spring **128** to move piston **120** to its uppermost position in which ports **130** and **132** are in registry and which will permit fuel to be drawn through secondary fuel orifice **118** into the air stream. In this way the fuel from ports **132** supplement the regularly supplied fuel from the main metering orifice **116**.

In order to prevent manifold vacuum from sucking fuel around piston **120** under normal operating conditions and thus upsetting the normal fuel-air ratio, a suction breaking device is provided and comprises an annular groove **134** formed in piston **120** which is adapted to register with a plurality of radially disposed ports **136** formed in casing **94** when the piston is in its retracted or non-power position. In this way any manifold vacuum tending to draw such fuel past piston **120** is bled out by ports **136**.

As best seen in FIGURE 2, air valve element **50** terminates at its lower end in a tapered portion or shroud **90** which, as already noted, provides a recess **98** or shroud for the upper end of fuel metering valve mechanism **92**. This shroud arrangement protects the main fuel metering orifice **116** from the impact pressure of air entering induction passage **20** which might otherwise upset the quantity of fuel to be supplied in accordance with the volume or mass of air entering induction passage **20**.

The upper end of fuel metering needle **104** is formed with a baffle portion **138** which assists in deflecting the fuel being drawn through main metering orifice **116** downwardly into the air stream. Baffle **138** also assists in the atomization of the fuel by causing the same to be broken into smaller particles.

Wire **106** connecting fuel metering needle **104** with adaptor **108** serves two purposes, the first of which is to relieve critical alignment problems and, secondly, as a spring when bent or given a bias, holds needle **104** against the orifice openings relieving chatter and the resulting irregular flow caused thereby.

By removal of a casing plug **142**, idle fuel adjustment is achieved by threading adaptor **108** within stem **54** to vary the opening between metering needle **104** and primary fuel orifice **116**.

Idle mixture adjustment past throttle **22** is regulated by an idle stop screw **144** disposed on the throttle linkage and which stop is adapted to abut against casing **12** to vary the amount of throttle opening at idle.

Momentary enrichment of the fuel-air ratio is achieved for purposes of acceleration. As throttle **22** is rapidly opened, as occurs during acceleration, the engine's effort to draw more air into induction passage **20** results in increased depression in the passage. The full force of this increased depression is momentarily not transmitted to air valve chamber **68** due to a restriction **146** in conduit **76**. Thus the demand for more air is momentarily not reflected in an increased vacuum force on air valve area A_2 which would otherwise open annular air passage **74**. For this momentary period the full force of the increased depression in passage **20** acts only on fuel metering mechanism **92** increasing fuel flow through orifice **116** to provide temporary enrichment of the fuel-air ratio. While not shown, it is contemplated that restriction or orifice **146** may be made adjustable to vary the time interval over which enrichment would occur.

We claim:

1. A charge forming device for an internal combustion engine comprising an air intake casing, an induction passage in said casing having inlet and outlet portions, a seat formed in said passage intermediate the inlet and outlet portions, a member slidably mounted within said casing and adapted to coact with the seat to maintain a substantially constant pressure drop across said seat, a cover casing, a diaphragm peripherally clamped between said casings, said diaphragm and intake casing defining a first chamber communicating with the inlet portion of said passage, the diaphragm and cover casing defining a second chamber, a conduit communicating the intake passage posteriorly of said seat with the second chamber causing said slidable member to move away from said seat in proportion to the mass of air flow through said induction passage, spring means biasing said slidable

member toward said seat, adjustable means for limiting the closing movement of said slidable member, a fuel valve mechanism disposed within said induction passage posteriorly of said slidable member, said valve mechanism including an element operatively connected to and movable with said slidable member for controlling the fuel flow through said mechanism in accordance with air flow.

2. A charge forming device of the type including an induction passage, a throttle valve for controlling the flow of combustible mixture through said passage, air valve means actuated by the flow of air through said induction passage and across which a constant pressure drop is maintained, and a fuel metering mechanism operatively connected to said air valve adapted to supply fuel in proportion to the quantity of air flow through said air valve, in which said air valve means includes first and second casing members radially enlarged with respect to the induction passage, a valve element adapted to coact with one of said casing members to define an annular air passage the pressure drop across which is substantially constant, a flexible diaphragm fixed at its inner periphery to said valve element and the outer periphery of which is clamped between said casing members, said diaphragm and said first casing member defining a first chamber in communication with said induction passage, said diaphragm and said second casing member defining a second chamber, conduit means communicating said induction passage intermediate said throttle and said air valve with said second chamber, said valve element including a first portion exposed to the pressure in said induction passage posteriorly of said annular air passage, and a second portion extending radially outwardly of said first portion and fixed to the inner end of said diaphragm, said valve element adapted to be moved in an opening direction with a force proportional to the effective area differential between said first portion and the second portion plus said diaphragm, said second casing member including a hollow cylinder, a stem fixed to said valve element and slidably disposed within said casing cylinder, and spring means seated upon said second casing member and normally biasing said valve element in a direction tending to restrict flow to said annular air passage.

3. A charge forming device of the type including an induction passage, a throttle valve for controlling the flow of combustible mixture through said passage, air valve means actuated by the flow of air through said induction passage and across which a constant pressure drop is maintained, and a fuel metering mechanism operatively connected to said air valve adapted to supply fuel in proportion to the quantity of air flow through said air valve, in which said air valve means includes first and second casing members, a valve element adapted to coact with one of said casing members to define an annular air passage the pressure drop across which is substantially constant, a flexible diaphragm fixed at its inner periphery to said valve element and the outer periphery of which is clamped between said casing members, said diaphragm and said first casing member defining a first chamber in communication with said induction passage, said diaphragm and said second casing member defining a second chamber, conduit means communicating said induction passage intermediate said throttle and said air valve with said second chamber, an orifice disposed in said conduit means, sudden opening of said throttle momentarily increasing the pressure drop across the annular passage, said orifice momentarily delaying the transmission of the increased vacuum through the conduit means permitting said vacuum to increase fuel flow through the metering mechanism for acceleration purposes, said second casing member including a hollow cylinder, a stem fixed to said valve element and slidably disposed within said casing cylinder, and spring means seated upon said second casing member and normally biasing said valve element in a direction tending to restrict flow to said annular air passage.

4. A charge forming device of the type including an induction passage, a throttle valve for controlling the flow of combustible mixture through said passage, air valve means actuated by the flow of air through said induction passage and across which a constant pressure drop is maintained, and a fuel metering mechanism operatively connected to said air valve adapted to supply fuel in proportion to the quantity of air flow through said air valve, in which said air valve means includes first and second casing members, a valve element adapted to coact with one of said casing members to define an annular air passage the pressure drop across which is substantially constant, a flexible diaphragm fixed at its inner periphery to said valve element and the outer periphery of which is clamped between said casing members, said diaphragm and said first casing member defining a first chamber in communication with said induction passage, said diaphragm and said second casing member defining a second chamber, conduit means communicating said induction passage intermediate said throttle and said air valve with said second chamber, said second casing member including a hollow cylinder, a stem fixed to said valve element and slidably disposed within said casing cylinder, and spring means seated upon said second casing member and normally biasing said valve element in a direction tending to restrict flow to said annular air passage, said fuel metering mechanism comprising a cylindrical casing disposed in said induction passage intermediate the throttle and air valves, a fuel source, conduit means communicating the fuel source with the interior of the cylindrical casing, primary and secondary fuel metering orifices in said casing, a tapered metering needle extending through said orifices, means connecting one end of the metering needle to said air valve to increase fuel flow through the primary fuel orifice as air flow increases, and means normally blocking fuel flow from the secondary fuel orifice to the induction passage, said latter means permitting secondary orifice fuel flow when induction passage pressure exceeds a predetermined value.

5. A charge forming device as set forth in claim 4 in which the means for blocking secondary orifice fuel flow comprises a hollow piston slidably disposed in the cylindrical casing, said piston being closed at one end and open at the other end, said open end being disposed adjacent the secondary fuel orifice, radial ports in said piston and cylindrical casing, spring means biasing the piston to a position in which the piston and casing ports are in registry permitting fuel to flow from the secondary fuel orifice to the induction passage, conduit means communicating the space between the closed end of the piston and the cylindrical casing with the induction passage posteriorly of the throttle valve, the pressure differential across said piston being sufficient under normal operating conditions to shift the piston to a position moving the piston ports out of registry with the casing ports.

6. A charge forming device as set forth in claim 4 in which said primary fuel metering orifice opens upstream and is enshrouded by a portion of said air valve element the latter portion opening downstream whereby fuel flow between the primary fuel orifice and the metering needle is influenced solely by the pressure drop across the primary orifice.

7. A charge forming device as set forth in claim 4 in which said primary fuel metering orifice opens upstream and the metering needle includes a baffle element proximate said primary orifice for deflecting fuel flow downstream.

8. A charge forming device as set forth in claim 4 in which the means connecting the metering needle and the air valve comprises an axially adjustable plug disposed in said stem and a wire element connected intermediate the needle and the plug for moving the metering needle relative to the fuel orifices with movements of the air valve.

9. A charge forming device as set forth in claim 5 in which a second set of radial ports are formed in said cylindrical casing, an annular groove formed in the outer surface of said piston, said groove registering with said ports when the piston is in the position in which the piston ports are out of registry with the first set of casing ports.

References Cited in the file of this patent

UNITED STATES PATENTS

1,586,683	Mock	June 1, 1926
1,901,618	Waters et al.	Mar. 14, 1933
1,940,253	Hammond	Dec. 19, 1933
1,942,199	Bracke	Jan. 2, 1934
2,128,079	Dawes	Aug. 3, 1938