

Nov. 7, 1961

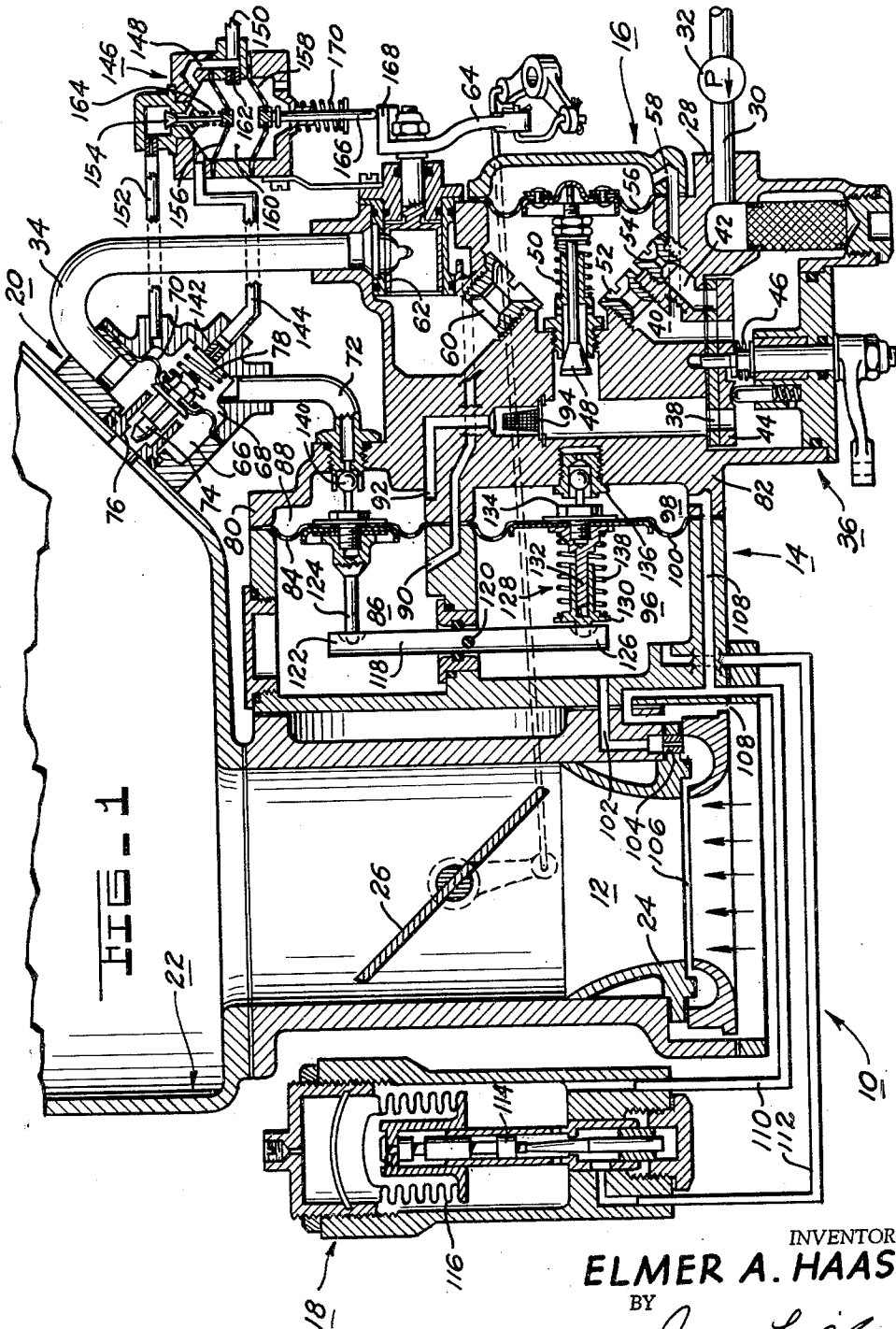
E. A. HAASE

3,007,684

CHARGE FORMING DEVICE

Filed Sept. 11, 1958

3 Sheets-Sheet 1



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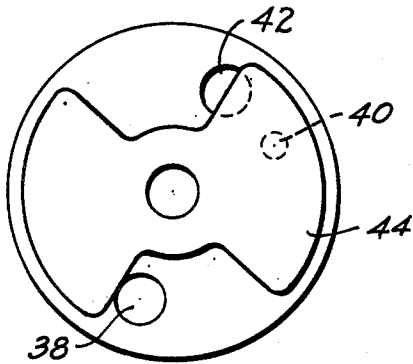
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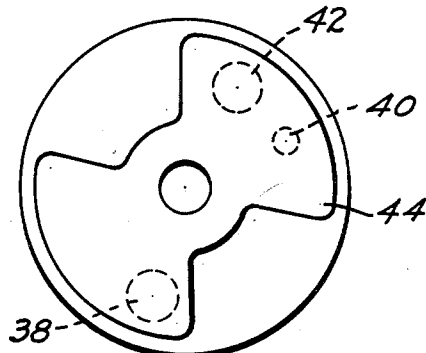
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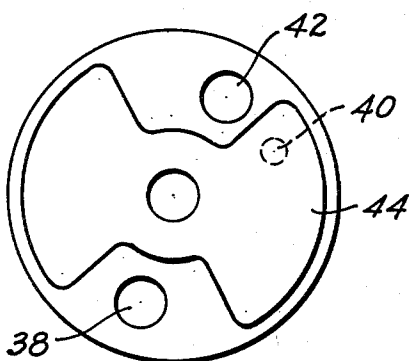
MANUAL LEANING

FIG. 2



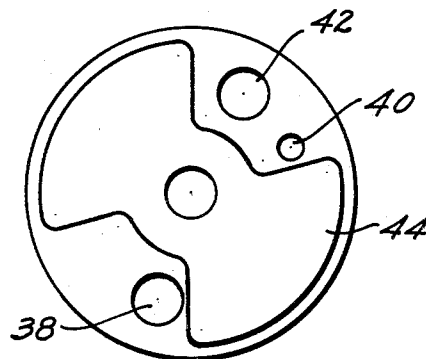
CUT-OFF

FIG. 3



NORMAL

FIG. 4



RICH

FIG. 5

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3 Sheets-Sheet 3

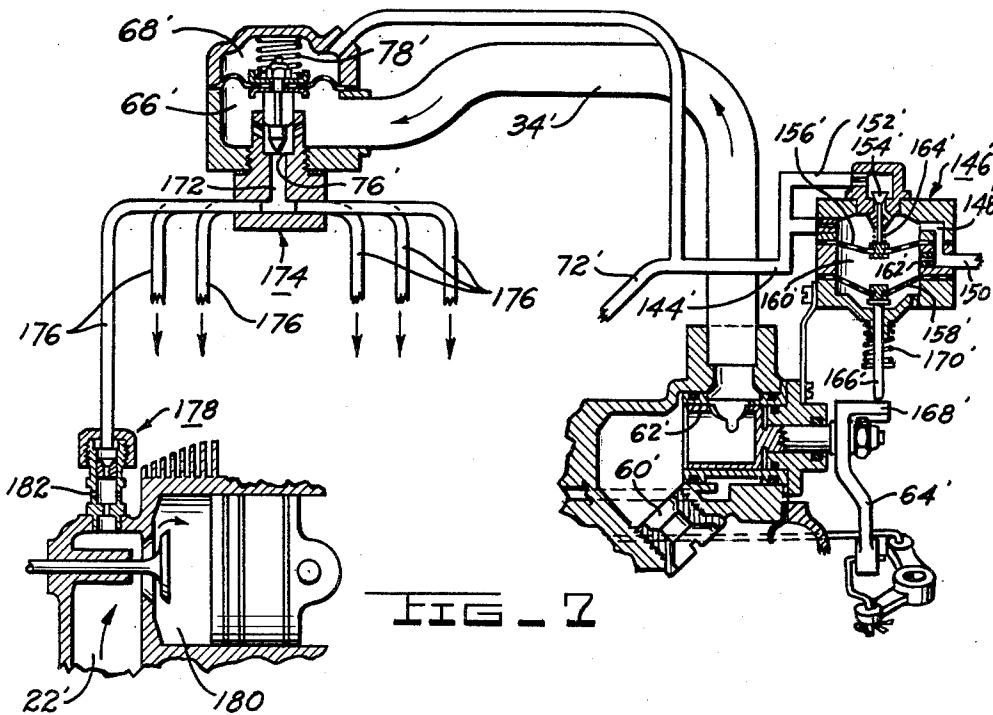
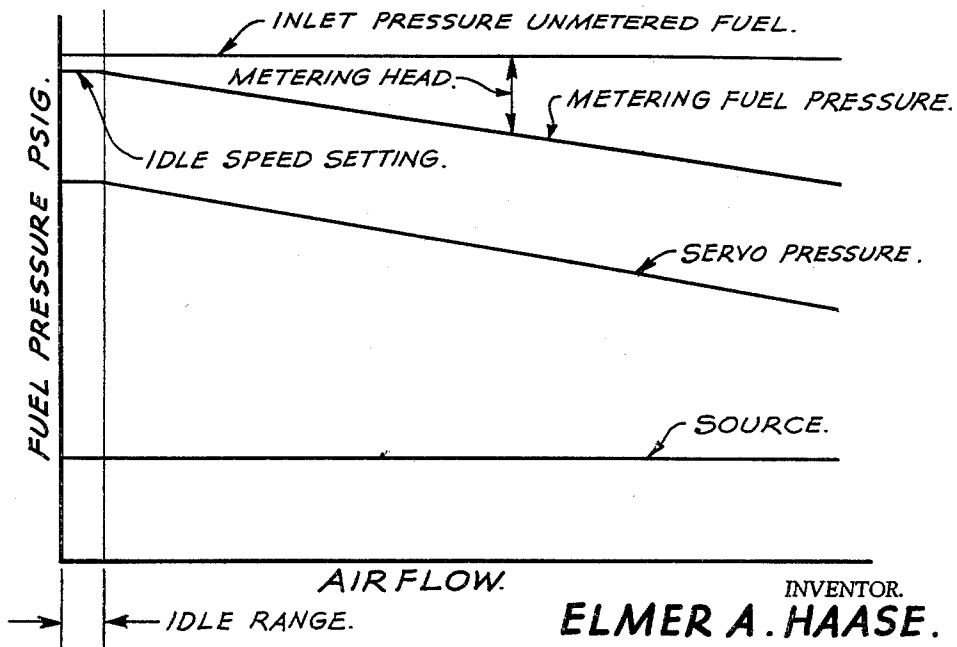


FIG. 6

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3,007,684

CHARGE FORMING DEVICE

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Filed Sept. 11, 1958, Ser. No. 760,326
13 Claims. (Cl. 261-69)

The present invention relates generally to charge forming devices for internal combustion engines and more particularly to charge forming devices of the pressure feed type such as the Stromberg Injection Carburetor disclosed in U.S. Patent 2,361,227.

An object of the present invention is to provide in a charge forming device metering means which will compensate for changes in inlet fuel pressure.

Another object of the invention is to provide in a charge forming device a fuel supply regulator responsive to certain engine operating parameters which has low hysteresis, good repeatability and accuracy.

Another object of the invention is to provide in a charge forming device a servo fuel regulator which is responsive to small pressure changes in the air induction passage.

Another object of the invention is to provide a charge forming device having means disposed to reduce the formation of fuel vapor therein.

Another object of the invention is to provide improved means for supplying increased fuel supply to the engine during acceleration.

Another object of the invention is to provide improved means for controlling the idling fuel supply to the engine.

A further object of the invention is to provide improved means for cutting off all fuel flow to the engine when it is to be stopped.

A still further object of the invention is to provide in a charge forming device a servo regulator sub-assembly which may be used in various charge forming devices of widely varying fuel flow capacities.

A still further object of the invention is to provide a charge forming device having relatively few parts and being relatively inexpensive to manufacture and which is reliable in operation with relatively little maintenance.

Other objects and advantages will be apparent to one skilled in the art from the following detailed description taken in connection with the appended drawings in which:

FIGURE 1 is a diagrammatic view of a charge forming device embodying the present invention;

FIGURES 2, 3, 4 and 5 are elevation views of the mixture control valve in its manual leaning, cut-off, normal and rich positions respectively;

FIGURE 6 is a graph illustrating certain operating characteristics of the charge forming device; and

FIGURE 7 is a partially diagrammatic view of a charge forming device illustrating another embodiment of the invention.

Referring now to the drawings, numeral 10 designates a charge forming device having an air duct or passage 12, a servo regulator 14, metering section 16, automatic mixture control 18 and a discharge nozzle 20. The air duct 12 forms a part of the induction passage 22 of an internal combustion engine (not shown) and is provided with a venturi 24 and a throttle 26.

The metering section 16 is provided with an inlet 28 which is connected to a source of fuel (not shown) by a conduit 30 in which is disposed a pump 32. The discharge nozzle 20 is connected to the metering section 16 by means of a conduit 34. Inlet 28 is selectively connected to the discharge conduit 34 by means of a manual mixture control 36 which is provided with economizer, auto-lean and auto-rich passages respectively designated 38, 40 and 42. The passages 38, 40 and 42 are selectively opened by a manually actuatable disk 44, the positions of which are best

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illustrated in FIGURES 2 through 5. Disk 44 is urged into sealing engagement with the entrances to passages 38-42 by means of spring 46 and the force of inlet fuel pressure acting thereon.

Economizer passage 38 is controlled by a fuel head enrichment valve 48 which is urged toward closed position by a spring 50. The auto-lean and auto-rich passages 40 and 42 respectively are provided with metering restrictions 52 and 54 respectively. A diaphragm 56 marginally clamped in the metering section 16 is subjected on one side to the pressures downstream of the metering restriction and on the other side to fuel pressures upstream of the metering restriction by means of conduit 58. The differential in fuel pressure acting on diaphragm 56 urges the fuel head enrichment valve toward open position to provide increased fuel flow to the engine during high power requirements. The total fuel flow through the metering restrictions 40 and 42 and the fuel head enrichment valve 48 passes through a power jet 60 which regulates the maximum fuel flow to the engine. Downstream of power jet 60 is located a cylindrical valve 62 which is connected to the throttle lever 64 for actuation thereby to control the idle flow through the conduit 34.

The discharge nozzle 20 is divided into a metered fuel chamber 66 and a servo fuel chamber 68 by a diaphragm 70. Conduit 34 connects the metered fuel chamber 66 with the metering section 16. The servo fuel chamber 68 is connected to the servo regulator 14 by means of passage 72. A discharge valve 74 is secured to the central portion of diaphragm 70 and is disposed to control the discharge through port 76 which opens into the induction passage 22. A spring 78 located in the servo fuel chamber urges the discharge valve 74 towards closed position. The discharge valve 74 is urged toward open position by the differential pressure between the pressure in the metered fuel chamber 66 and the pressure in servo fuel chamber 68 acting on the diaphragm 70.

The servo regulator 14 includes a fuel section 80 and an air section 82. A diaphragm 84 divides the fuel section into a metered fuel chamber 86 and an unmetered fuel chamber 88. Metered fuel chamber 86 is connected to conduit 34 downstream of the metering restrictions by means of a passage 90. The unmetered fuel chamber 88 is connected to the economizer passage 38 by means of a passage 92 which contains a filter 94. The air section 82 is divided into a pair of air chambers 96 and 98 by means of diaphragm 100. Chamber 96 is connected to venturi 24 by means of passage 102, restriction 104 and annular passage 106. Chamber 98 is connected to the air duct 12 anterior throttle 26 by means of passage 108. Control of the differential pressure across the air diaphragm 96 is obtained by establishing a flow of air through passage 108, 110, automatic mixture control 18, passages 112, 102, restriction 104, annular passage 106 to the venturi 24. The flow through the automatic mixture control 18 is regulated by means of a valve 114 which is operatively connected to a bellows 116 which is filled with a gas so as to be responsive to changes in air density.

The servo regulator 14 is provided with a lever 118 which is pivoted at 120. Lever 118 is connected at one end 122 to the fuel diaphragm 84 by means of a rod 124 which is centrally clamped to the fuel diaphragm. The other end 126 of lever 118 is operatively connected to the air diaphragm 100 by means of a one-way connection 128 comprising a cylinder 130 which is adapted to receive a rod 132 which is centrally clamped to the diaphragm 100. An abutment 134 is secured to the central portion of air diaphragm 100 and is reciprocally mounted in a guide member 136 for limited movement therein. A spring 138 encircles the one-way connection 128 and urges diaphragm 100 and abutment 136 toward a limit position to the right as viewed in FIGURE 1 and also

urges lever 118 in a clockwise direction about its pivot 120. It is to be noted that when diaphragm 100 and the end point 126 of lever 118 are a predetermined distance apart, cylinder 130 and rod 132 of the one-way connection 128 are in abutting engagement whereby the spring 138 is rendered ineffective. A spherical servo valve 140 is connected to the central portion of the fuel diaphragm 84 to control the flow of fuel from unmetered fuel chamber 88 to passage 72.

The servo fuel chamber 68 is connected to the low pressure source via restriction 142, conduit 144, acceleration device 146, conduits 148 and 150. A by-pass conduit 152 is provided to connect servo fuel chamber 68 with the low pressure source in parallel with the conduit 144. By-pass conduit 152 is controlled by an acceleration valve 154. Acceleration device 146 contains a pair of diaphragms 156 and 158 which define therebetween a fluid chamber 160 which is connected to conduit 150 by means of restriction 162. Diaphragm 156 is connected to acceleration valve 154. A spring 164 urges diaphragm 156 in a direction to close the acceleration valve 154. Diaphragm 158 carries a rod 166 which is urged into engagement with a cam 168 on the throttle lever 64 by means of a spring 170. When the throttle lever 64 is moved in a throttle opening direction, diaphragm 158 is moved upwardly causing diaphragm 156 to temporarily move upwardly to open valve 154 thereby permitting fuel to flow from the servo fuel chamber 68 through the by-pass conduit 152.

In operation pump 32 delivers fuel to the inlet of the metering section 16 at substantially constant pressure. Fuel from the inlet 28 passes through the manual mixture control 36 and is metered by the selected metering means 52, 54 and 48. During conditions of high power output such as at take-off the power jet 60 controls the metered fuel flow. The metered fuel pressure is controlled as a direct function of the servo fuel pressure in servo chamber 68. The relationship between metered fuel pressure and servo fuel pressure is shown graphically in FIGURE 6; and as is shown therein, metered fuel pressure differs from servo fuel pressure by an amount equal to the force of spring 78 times the area of diaphragm 70. It is to be noted that the metering restrictions receive fuel at the highest pressure in the system, inlet fuel pressure. The first fuel pressure drop in the metering section 16 occurs at the metering restrictions. This arrangement reduces the tendency of the fuel to vaporize such as is the case when a control valve is placed upstream of the metering restriction.

The servo fuel pressure in chamber 68 is regulated by the servo regulator section 14. Inlet or unmetered fuel pressure is conducted to chamber 88 to act on the diaphragm 84 in a direction to open the servo fuel valve 140 and thereby increase the servo fuel pressure. Metered fuel pressure is conducted to chamber 86 to act on diaphragm 84 in a direction to close servo valve 140 and thereby decreases the servo fuel pressure. The air section 82 of the servo regulator operates to urge the servo valve 140 toward closed position with a force that varies as a function of mass air flow to the engine. Chamber 96 is connected to the throat of venturi 24. Chamber 98 is connected to the air duct to sense a pressure proportional to inlet or air scoop pressure. Control of the differential pressure across the air diaphragm 100 is obtained by establishing a flow of air from the impact air inlet 108 through the automatic mixture control 18 and out through the venturi. The automatic mixture control 16 modifies the differential pressure across the diaphragm 100 to compensate for changes in air density. The position of the servo valve 140 is thus determined as a function of the differential in air pressure between the venturi and a point in the air passage anterior the throttle and of the differential in fuel pressure on opposite sides of the metering restrictions. It is to be noted that the servo regulator automatically compensates for variations in inlet fuel

pressure in that servo pressure varies directly with variations in the inlet pressure which effects a corresponding change in metered fuel pressure whereby the metered head or pressure drop across the metering restrictions remains constant with changes in inlet fuel pressure.

During idling, when the air flow through the induction passage is low and subject to fluctuation, sufficient and/or accurate force may not be available to properly operate the air section of the servo regulator. During the idle operation condition of low air flows, idle spring 138 reacts through diaphragm 100 against abutment 136 producing a force on lever 122 which tends to close the servo valve 140. Spring 138 is of relatively low rate so as to produce a substantially constant force within its range of operation. When the air differential pressures acting on diaphragm 100 have reached a predetermined value the lost motion in the connection 128 between lever 122 and diaphragm 100 is taken up to form a solid link between the lever and diaphragm thus rendering spring 138 ineffective. The effect of idle spring 138 is shown graphically in FIGURE 6. During the idle operation when idle spring 138 is effective the servo regulator 14 functions to maintain a constant differential between unmetered and metered fuel. The idle valve 62 forms the controlling metering restriction during idling operation and is variable in accordance with the position of the throttle valve so as to modulate the amount of fuel supplied to the engine during idling operation as a function of throttle position. It is to be noted that the servo regulator 14 functions to maintain the pressure drop across the idle valve 62 constant irrespective of changes in inlet fuel pressure.

The acceleration device 146 is operated upon opening movement of the throttle through the cam 168 which causes the diaphragm 158 to be moved upwardly forcing the fuel in chamber 160 to lift diaphragm 156 and acceleration valve 154 upwardly whereby servo fuel pressure from chamber 68 is bled off to the low pressure source through conduits 152 and 150. Spring 164 urges diaphragm 156 downwardly forcing fuel from chamber 160 through the restriction 162 to the source through conduit 150. The time that acceleration valve 154 remains open is thus determined as a function of the amount of opening of the throttle valve and the time required for spring 164 to force fuel from chamber 160 through the restriction 162.

Fuel may be cut off to the engine when it is desired to stop the engine by rotating the manual mixture control 36 to the position shown in FIGURE 3 wherein inlet fuel is cut off both to the servo regulator 14 and to the metering section 16. When the manual mixture control 36 is placed in cut-off, the fuel pressures in the metering section and servo regulator drop to a value determined by the discharge spring 78 which may be in the order of a few pounds. This is a substantial improvement over prior art devices where the full force of inlet fuel pressure is applied to the fuel diaphragm in the device at cut-off. The application of inlet fuel pressure to the fuel diaphragms at idle cut-off in the prior art devices has caused the diaphragms to become distorted or damaged so as to impair the accuracy of the metering system.

It is to be noted that the servo regulator 14 requires very small fuel and air differential pressures to operate the servo valve 140. The flow of servo fuel need be only a small amount whereby the air and fuel diaphragms are required to move only slightly such as in the order of a few thousandths of an inch. Due to the small movement of the diaphragm, mean effective area changes of the diaphragm and spring forces of the diaphragm are negligible. Also due to the small air pressure differential required to operate the air diaphragm, the air induction passage may be opened up so that the venturi constitutes a less restriction than in prior art devices to thereby permit better breathing and increased air flow to the engine. By removing the idle spring from effective position

when a predetermined air pressure differential exists across the air diaphragm 160 it is unnecessary to provide contoured valves or cams and the like to compensate for the idle spring force throughout the remainder of the operating range of the engine as is the case in many of the prior art devices. Due to the servo regulator action, one servo regulator design can be used for a wide range of engines having widely differing capacities.

Referring now to the embodiment shown in FIGURE 7 the charge forming device is substantially identical to the embodiment shown in FIGURES 1 through 5 and similar parts are designated by corresponding primed numbers. As shown in FIGURE 7, the discharge from the charge forming device may be from a plurality of nozzles rather than from a single nozzle as shown in FIGURES 1 through 5. As shown in FIGURE 7, discharge port 76' is connected by means of conduit 172 to a flow divider 174 and thence by means of branch conduits 176 to a plurality of nozzles 178 respectively connected to the branch conduits 176 to discharge into the induction passage 22' adjacent the inlet valve of a respective cylinder 180 of the engine. Nozzles 178 are provided with ports 182 which open to the atmosphere.

The operation of the embodiment shown in FIGURE 7 is the same as for the embodiment previously described with the exception that the fuel discharge from the charge forming device 10' takes place adjacent the inlet valves of the individual cylinders of the engine.

Although the invention has been described with reference to the particular embodiments disclosed in the drawings, it will be apparent that many changes or rearrangements of the parts may be made without departing from the spirit of the invention.

I claim:

1. In a fuel supply system for an internal combustion engine, a conduit for supplying fuel to the engine, said conduit having an inlet adapted for connection to a source of fuel under pressure, a metering restriction in said conduit disposed to receive unmetered fuel at inlet pressure, a valve in said conduit downstream of said restriction to control the flow of metered fuel therethrough, servo means responsive to the differential between inlet and metered fuel pressures and to a pressure varying as a function of air flow to the engine for urging said valve toward closed position, and means responsive to metered fuel pressure for urging said valve toward open position.

2. A charge forming device for an internal combustion engine having a source of fuel under pressure and an air duct comprising, a fuel conduit adapted to supply fuel to the engine, said conduit having an inlet adapted for connection to said source, fuel metering means in said conduit disposed to receive unmetered fuel at inlet pressure, a valve in said conduit downstream of said restriction, a pressure responsive movable wall operatively connected to said valve and being subjected on one side to metered fuel pressure which tends to open said valve, servo means for supplying a servo fuel pressure to the other side of said wall which tends to close said valve, said servo pressure being regulated as a function of the differential in pressure at spaced points in the air passage and of the differential in fuel pressure on opposite sides of said metering means, and means for maintaining a substantially constant pressure differential between metered fuel pressure and servo fuel pressure.

3. A charge forming device for an internal combustion engine having a source of fuel under pressure and an air duct with a throttle therein comprising, a fuel conduit adapted to supply fuel to the engine, said conduit having an inlet adapted for connection to said source, fuel metering means in said conduit disposed to receive unmetered fuel at inlet pressure, a valve in said conduit downstream of said restriction, a pressure responsive movable wall operatively connected to said valve and being subjected on one side to metered fuel pressure which tends to open said valve, servo means for supplying a servo fuel pres-

sure to the other side of said wall which tends to close said valve, said servo pressure being regulated as a function of the differential in pressure at spaced points in the air passage and of the differential in fuel pressure on opposite sides of said metering means, and means responsive to opening movement of said throttle for reducing the servo pressure whereby metered fuel acting on said wall may move said valve toward an increased open position.

4. A charge forming device for an internal combustion engine having a source of fuel and an air duct comprising, a fuel supply conduit having an inlet and outlet, fuel pressurizing means connecting said source to said inlet, means connecting said outlet to the engine, inlet metering means in said conduit disposed to receive unmetered fuel at inlet pressure, a valve in said conduit downstream of said metering means, means defining a pair of chambers, a pressure responsive movable wall separating said chambers and being operatively connected to said valve, means for conducting metered fuel from said conduit downstream of said restriction to one of said chambers, means for connecting the other of said chambers to said conduit upstream of said metering restriction, a valve in said last mentioned connecting means, and means for maintaining a substantially constant pressure differential between metered fuel pressure and the pressure downstream of said last mentioned valve, and means responsive to the differential in pressure at spaced points in the air duct and to the differential in fuel pressures on opposite sides of said metering means for controlling said last mentioned valve.

5. A charge forming device for an internal combustion engine having a source of fuel and an air duct with a throttle therein comprising, a fuel supply conduit having an inlet and outlet, fuel pressurizing means connecting said source to said inlet, means connecting said outlet to the engine, metering means in said conduit disposed to receive unmetered fuel at inlet pressure, a valve in said conduit downstream of said metering means, means defining a pair of chambers, a pressure responsive movable wall separating said chambers and being operatively connected to said valve, means for conducting metered fuel from said conduit downstream of said restriction to one of said chambers, means for connecting the other of said chambers to said conduit upstream of said metering restriction, a valve in said last mentioned connecting means, means responsive to the differential in pressure at spaced points in the air duct and to the differential in fuel pressures on opposite sides of said metering means for controlling said last mentioned valve, a passage connecting said last mentioned chamber to said source, a valve in said passage, and means operatively connecting said last mentioned valve with said throttle whereby said valve will be urged toward open position upon opening movement of said throttle.

6. A charge forming device for an internal combustion engine having a source of fuel and an air passage with a venturi and a throttle therein comprising a fuel conduit adapted to connect said source to the engine, fuel metering means in said conduit, a valve in said conduit downstream of said metering means, said valve being urged toward open position by metered fuel pressure, means defining a pair of air chambers and a pair of fuel chambers, a pair of diaphragms mounted to be respectively subject to the differential pressures between said air chambers and said fuel chambers, means respectively connecting said air chambers to said venturi and to said air passage anterior to the throttle, means respectively connecting said fuel chambers to said conduit upstream and downstream of said metering means, lever means connecting said diaphragms, and means operatively connecting one of said diaphragms to said valve to urge said valve toward closed position.

7. A charge forming device for an internal combustion engine having a source of fuel and an air duct with a

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venturi and a throttle mounted therein comprising a fuel conduit adapted to connect said source to the engine, a metering restriction in said conduit, means defining a pair of air chambers, a diaphragm separating said air chambers, means respectively connecting said air chambers to said venturi and to said air duct anterior to the throttle, means defining a metering fuel chamber and an unmetered fuel chamber, a diaphragm separating said fuel chambers, means respectively connecting said metered and unmetered fuel chambers to said conduit downstream and upstream of said restriction, a lever pivoted intermediate its ends respectively connected on opposite sides of its pivot point to said diaphragms, means defining a servo fuel chamber, passage means connecting said unmetered fuel chamber to said servo fuel chamber, a valve operatively connected to one of said diaphragms being disposed to control the flow through said passage, a control valve in said conduit downstream of said restriction, a movable wall operatively connected to said control valve and being subjected on opposite sides to metered fuel pressure, and the pressure in said servo fuel chamber.

8. A charge forming device for an internal combustion engine having a source of fuel and an air duct with a venturi and a throttle therein comprising a fuel conduit adapted to connect said source to the engine, metering means in said conduit, means defining a pair of air chambers, a diaphragm separating said air chambers, means respectively connecting said air chambers to said venturi and to said air duct anterior to the throttle, means defining a metered fuel chamber and an unmetered fuel chamber, a diaphragm separating said fuel chambers, means respectively connecting said metered and unmetered fuel chambers to said conduit downstream and upstream of said metering means, means defining a servo fuel chamber, a passage connecting said unmetered fuel chamber to said servo fuel chamber, a valve in said passage operatively connected to said second mentioned diaphragm, a pivoted lever operatively connected at one end to said second mentioned diaphragm, a one-way connection between the other end of said lever and said first mentioned diaphragm, a spring urging said lever and first mentioned diaphragm apart, an abutment connected to said first mentioned diaphragm to limit the movement thereof in one direction, a control valve in said conduit, a diaphragm in said servo fuel chamber responsive to the differential between servo chamber fuel pressure and metered fuel pressure and being operatively connected to said control valve.

9. A fuel supply system for an internal combustion engine having a source of fuel and air duct with a venturi and a throttle therein comprising a fuel conduit having an inlet and being adapted to supply fuel to the engine, fuel pressurizing means connecting said source to said inlet, metering means disposed in said conduit to receive unmetered fuel at inlet pressure, a valve in said conduit downstream of said metering means, means defining a metered fuel chamber and a servo fuel chamber, a movable wall separating said chambers and being operatively connected to said valve, means connecting said metered fuel chamber to said conduit downstream of said metering means, a passage connecting said servo chamber to said conduit upstream of said metering means, a servo valve in said passage, means responsive to the differential in pressures between said venturi and a point in said air duct anterior to the throttle and to the differential in fuel pressures on opposite sides of said metering means for controlling said servo valve, a passageway connecting said servo chamber to said source, a restriction in said passageway, a by-pass around said restriction, a valve for controlling said by-pass, a pair of spaced diaphragms defining a fluid chamber therebetween, a restricted conduit connecting said fluid chamber to said source, means operatively connecting one of said diaphragms to said last mentioned valves, means operatively connecting the other

of said diaphragms to said throttle, and resilient means urging said last mentioned valve toward closed position.

10. A charge forming device for an internal combustion engine having a source of fuel and an air duct with a venturi and a throttle therein comprising a fuel conduit adapted to connect said source to the engine, metering means in said conduit, a valve in said conduit downstream of said restriction, means defining a metered fuel chamber and a servo fuel chamber, a movable wall separating said chambers and being operatively connected to said valve, means connecting said metered fuel chamber to said conduit downstream of said metering means, means connecting said servo fuel chamber to said conduit upstream of said metering means, a servo valve controlling the flow through said last mentioned means, a first diaphragm responsive to the differential in fuel pressures on opposite sides of said metering means, means connecting said first diaphragm to said servo valve, a second diaphragm responsive to the differential in air pressures between said venturi and a point in said duct anterior to said throttle, a lever operatively connected to said first diaphragm, a spring reacting between said second diaphragm and said lever urging said servo valve toward closed position, abutment means connected to said lever formed to operatively engage said second diaphragm when said lever and diaphragm are a predetermined distance apart whereby said spring is rendered ineffective upon engagement of said abutment with said second diaphragm.

11. A charge forming device for an internal combustion engine having a source of fuel and an induction passage comprising a fuel conduit adapted to supply fuel to the engine and having an inlet adapted to be connected to said source, metering means disposed in said conduit to receive unmetered fuel at inlet pressure, a valve in said conduit downstream of said metering means to control metered fuel flow therethrough, means defining a pair of chambers, a pressure responsive movable wall separating said chambers and being operatively connected to said valve, means for conducting metered fuel from said conduit downstream of said metering means to one of said chambers, means for connecting the other of said chambers to said conduit upstream of said metering means, a valve in said last mentioned connecting means, means responsive to induction passage pressure and to the differential in pressure between inlet fuel pressure and metered fuel pressure for controlling said last mentioned valve, and means for maintaining a substantially constant pressure differential between metered fuel pressure and the pressure downstream of said last mentioned valve.

12. A charge forming device for an internal combustion engine having a source of fuel and an induction passage comprising a fuel conduit having an inlet and an outlet, said inlet being adapted for connection to said source, metering means disposed in said conduit to receive unmetered fuel at inlet pressure, a valve in said conduit downstream of said metering means to control metered fuel flow therethrough, means defining a pair of chambers, a pressure responsive movable wall separating said chambers and being operatively connected to said valve, means for conducting metered fuel from said conduit downstream of said metering means to one of said chambers, means for connecting the other of said chambers to said conduit upstream of said metering means, a valve in said last mentioned connecting means, means responsive to induction passage pressure and to the differential in pressure between inlet fuel pressure and metered fuel pressure for controlling said last mentioned valve, means for maintaining a substantially constant pressure differential between metered fuel pressure and the pressure downstream of said last mentioned valve, a flow divider connected to said outlet and having a plurality of branch outlets, and a nozzle connected to each of said branch outlets and being disposed to discharge fuel into said induction passage.

13. A charge forming device for an internal combustion engine having a source of fuel and an air duct with a venturi and a throttle therein comprising a fuel conduit having an inlet and being adapted to supply fuel to the engine, fuel pressurizing means adapted to connect said source to said inlet, metering means disposed in said conduit to receive unmetered fuel at inlet pressure, means defining a pair of air chambers, a diaphragm separating said air chambers, means respectively connecting said air chambers to said venturi and to said air duct anterior to the throttle, means defining a metered fuel chamber and an unmetered fuel chamber, a diaphragm separating said fuel chambers, means respectively connecting said metered and unmetered fuel chambers to said conduit downstream and upstream of said restriction, means connecting said diaphragms, means defining a servo fuel chamber, a passage connecting said unmetered fuel chamber to said servo chamber, a servo valve in said

passage operatively connected to said second mentioned fuel diaphragm, a diaphragm in said servo fuel chamber, means for maintaining a substantially constant pressure differential between metered fuel pressure and the pressure in said servo fuel chamber, a valve in said conduit downstream of said metering means operatively connected to said last mentioned diaphragm, and a valve in said conduit upstream of said metering means manually actuable to close said conduit whereby the fuel supply to said fuel chambers is cut off.

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