Oct. 7, 1969 B. R. SULLIVAN 3,471,132

SMOG REDUCING CARBURETOR

Filed Dec. 14, 1967 2 Sheets-Sheet 1

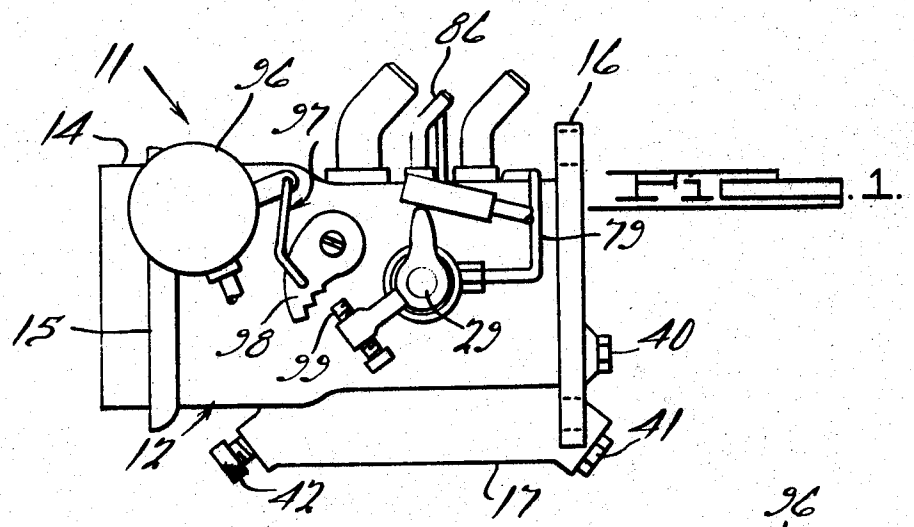


Fig. 1.

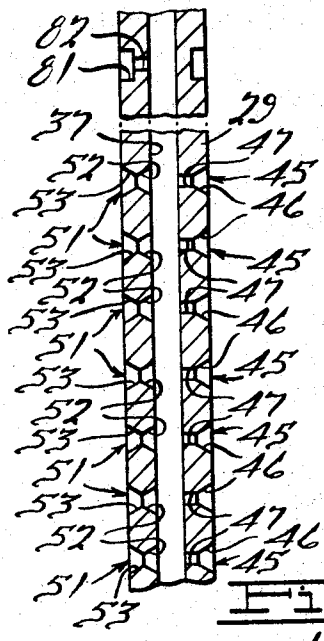


Fig. 5.

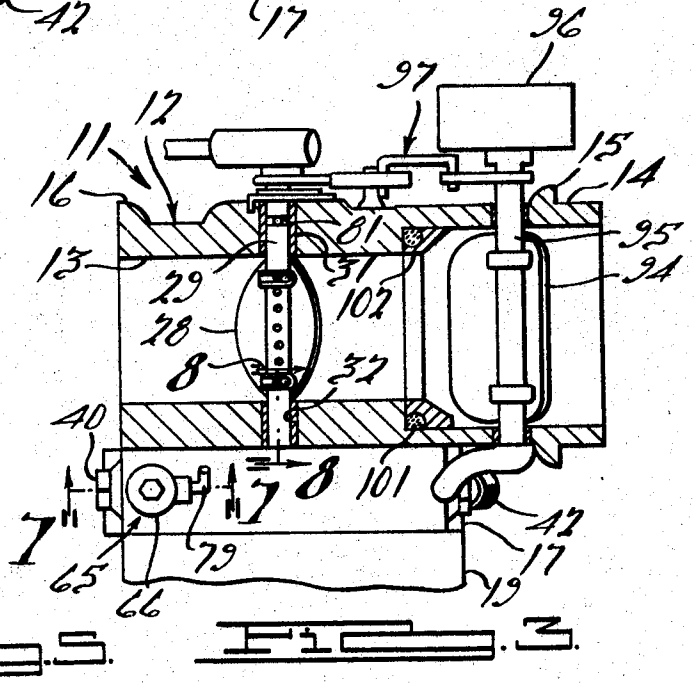


Fig. 3.

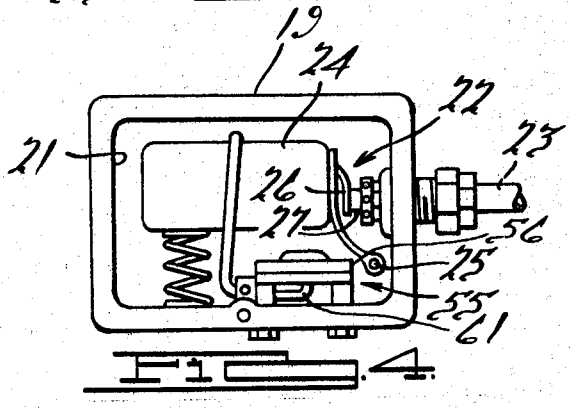


Fig. 4.

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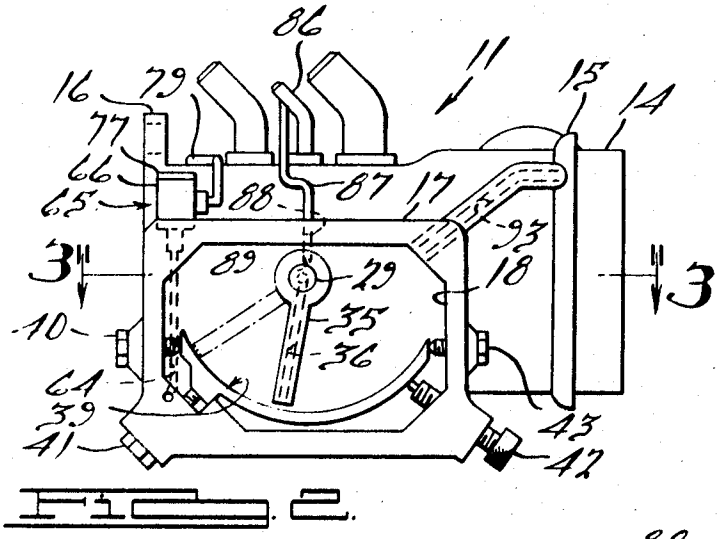


FIG. 2.

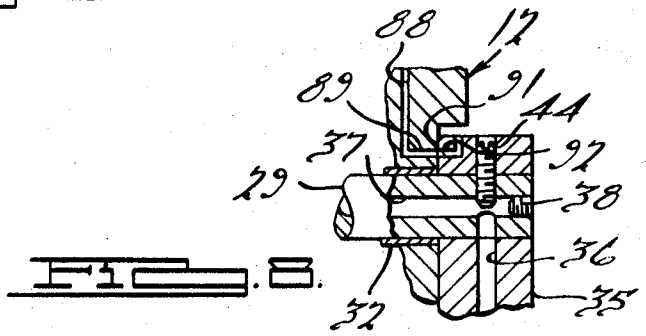


FIG. 8.

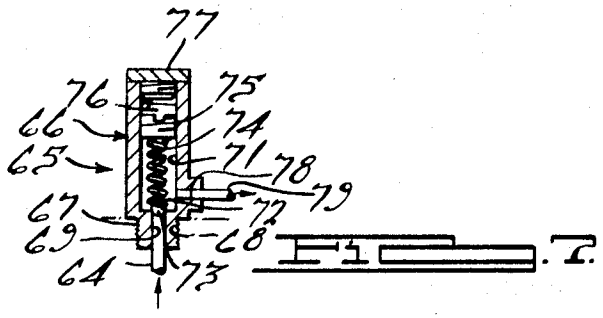


FIG. 7.

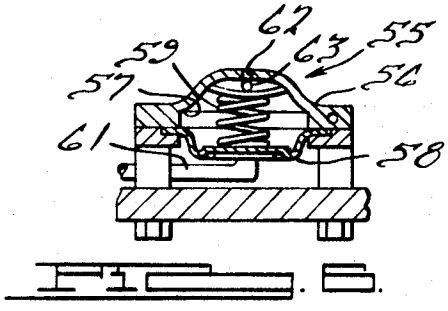


FIG. 6.

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SMOG REDUCING CARBURETOR

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U.S. Cl. 261—34 9 Claims

ABSTRACT OF THE DISCLOSURE

A venturiless carburetor of the type wherein the movement of the throttle valve controls the rate of fuel discharge and wherein the fuel is discharged through the throttle valve shaft. The carburetor embodies several features for improving combustion of the engine and for reducing the emission of smog producing constituents. The smog reducing features include an accelerating pump having a discharge circuit responsive to induction system vacuum for bleeding fuel into the carburetor during severe decelerations, an improved fuel discharge nozzle bar and a system for retarding the spark advance on such decelerations.

BACKGROUND OF THE INVENTION

This invention relates to a charge forming device for an internal combustion engine and more particularly to a charge forming device that improves engine combustion and reduces the emission of smog producing constituents from the engine induction system.

The internal combustion engine is widely recognized as a prime contributing factor to the smog conditions present in many areas. Inefficient or incomplete combustion within the engine causes the exhaust gases to contain constituents that are recognized to contribute to a photochemical reaction giving rise to a group of air pollutants called smog. Although various approaches have been resorted to to purify the exhaust gases, these approaches, for the most part, have been directed toward the treating of the exhaust gases rather than toward improving the combustion within the engine. One of the major contributors to incomplete combustion is the carburetor or charge forming device of the engine. As is well known, the function of the carburetor is to create a fuel-air mixture that can be burned efficiently within the engine. Carburetor design, however, dictates many compromises in performance that results in incomplete combustion under certain circumstances. One engine operating condition under which the combustion characteristics are at their worst is upon extreme decelerations.

It is, therefore, a principal object of this invention to provide a charge forming device that will improve the combustion of the associated engine.

It is another object of this invention to provide a charge forming device for an internal combustion engine that will result in a reduction in the amount of smog producing constituents by the engine.

It is another object of this invention to provide a charge forming device that reduces engine exhaust emissions upon decelerations.

SUMMARY OF THE INVENTION

A charge forming device embodying this invention is particularly adapted for use with internal combustion engines. The charge forming device embodies means that define an induction conduit adapted to discharge into the induction system of the associated engine. Fuel discharge circuit means discharge fuel into the induction passage and the flow through the induction passage is controlled by a throttle valve. An accelerating pump is provided that is responsive to rapid opening movement of the throttle

valve for discharging fuel into the induction conduit upon rapid acceleration. Means are provided responsive to induction system pressure posterior to the throttle valve for drawing fuel from the accelerating pump into the induction passage when the induction system vacuum exceeds a predetermined value for improving the engine combustion characteristics upon decelerations.

A charge forming device embodying another feature of the invention incorporates a fuel discharge bar that improves the mixture distribution at the discharge end of the charge forming device. The discharge bar extends at least in part across the induction conduit of the charge forming device. A fuel source is connected to a fuel conduit that extends through the fuel bar for delivering fuel to the fuel discharge bar. A group of ram passages are formed in the discharge bar extending transversely from its fuel conduit to the induction conduit on the anterior side of the fuel discharge bar for introducing air into the fuel conduit. A group of discharge passages in the fuel discharge bar extend transversely from its fuel conduit to the induction conduit on the posterior side of the fuel discharge bar for discharging fuel into the induction conduit. At least one group of the passages in the fuel bar is formed with a restricted area throat at one point along their length for altering the flow rate therethrough to improve the mixture distribution.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a side elevational view of a charge forming device embodying this invention.

FIGURE 2 is a side elevational view of the charge forming device taken from the side opposite to FIGURE 1 with a portion of the charge forming device removed to more clearly show the construction.

FIGURE 3 is a cross-sectional view taken generally along the line 3—3 of FIGURE 2.

FIGURE 4 is a side elevational view of the portion of the charge forming device removed from FIGURE 2.

FIGURE 5 is an enlarged cross-sectional view of the nozzle discharge bar of the charge forming device.

FIGURE 6 is an enlarged cross-sectional view of the accelerating pump of the charge forming device.

FIGURE 7 is an enlarged cross-sectional view taken along the line 7—7 of FIGURE 3.

FIGURE 8 is an enlarged cross-sectional view taken generally along the line 8—8 of FIGURE 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The reference numeral 11 indicates generally a charge forming device embodying this invention. The charge forming device 11 is of the side draft type and further is of the type wherein a venturi section as such is not incorporated. It is to be understood, however, that certain of the inventive features disclosed herein may be used in conjunction with other types of carburetors.

The charge forming device 11 is comprised of a main body portion 12 that forms a generally straight sided horizontally extending induction conduit 13. The end of the body portion 12 adjacent the upstream side of the induction conduit 13 is formed with an air horn section 14 around which a mounting flange 15 is formed to supportingly engage an air cleaner or the like. The end of the body portion 12 adjacent the discharge end of the induction conduit 13 is formed with an outwardly extending flange 16 for attachment of the charge forming device 11 to an intake manifold of an associated internal combustion engine (not shown) or to any other suitable component of the engine induction system.

One side of the body portion 12 is formed with an outwardly extending segment 17 (FIGURE 2) in which a portion of a fuel bowl cavity 18 is formed. The fuel bowl

cavity 18 is closed by a cover assembly 19 (FIGURE 4) in which a complementary fuel bowl cavity portion 21 is formed. When the cover 19 is assembled onto the body portion 12, the cavity 21 registers with the cavity 18 to provide an enlarged volume fuel bowl.

A constant head of fuel is maintained in the fuel bowl by means of a float operated valve assembly, indicated generally by the reference numeral 22. The valve assembly 22 controls the flow of fuel from a fuel supply line 23 into the fuel bowl and is operated by means of a float 24 that is pivotally supported within the fuel bowl by means of a pivot pin 25. An adjustable tang 26 carried by the float 24 is adapted to engage the head of a needle valve 27 of the valve assembly 22 in a known manner.

As has been noted, the induction passage 13 is generally straight sided. That is, no venturi as such is formed in the induction passage 13. A throttle valve 28 is affixed to a throttle valve shaft 29 that is journaled, as at 31 and 32, by the body portion 12 on opposite sides of the induction passage 13. The throttle valve 28, therefore, regulates the air flow through the induction passage 13. The throttle valve shaft 29 may be appropriately connected to the accelerator linkage of the associated internal combustion engine in any known manner.

Fuel is discharged from the fuel bowl 18 into the induction passage 13 via the throttle valve shaft 29, which also functions as a fuel discharge nozzle bar by means of the construction now to be described. A vane 35 is affixed to an end of the throttle valve shaft 29 that extends into the fuel bowl 18. The vane 35 is formed with a radially extending passage 36 that extends from its lower terminus to a fuel conduit 37 that extends coaxially through the throttle valve shaft 29. The outer end of the passage 37 is closed, as by a plug 38. The lower end of the vane 35 is juxtaposed to a fuel metering member, indicated generally by the reference numeral 39, which is supported within the fuel bowl 18 at its lower end. A plurality of adjustment screws 40, 41, 42 and 43 are tapped into the body portion segment 17 and engage the fuel metering member 39 to adjust its shape and to adjust the gap between the lower end of the vane 35 and the fuel metering surface of the member 39 at various angular positions of the vane 35. Generally the size of this gap increases as the vane 35 moves from the idle position, as shown in the dotted line position in FIGURE 2, toward the fully opened position. A metering screw 44 is threaded into the upper end of the vane 35 and extends into the conduit 37 adjacent the terminus of the passage 36. The metering screw 44 may be adjusted to give further control over the fuel discharge rate, particularly at wide open throttle conditions.

A group of ram passages, indicated generally by the reference numerals 45, extend transversely through the throttle shaft 29 from the upstream side of the induction conduit 13 into the fuel conduit 37 (FIGURE 5). The ram passages 45 each have a converging section 46 that terminates at a reduced area throat formed adjacent a generally straight section 47 that meets the conduit 37. Ram air flowing through the induction passage 13 will enter the ram passages 45 and be accelerated by the converging sections 46 to form a mixture with the fuel in the conduit 37. This mixture is discharged into the induction conduit 13 on the downstream side of the throttle valve 28 by means of a group of discharge passages, indicated generally by the reference numeral 51. The discharge passages 51 each have a venturi shape made up of a converging section 52 that extends from the fuel conduit 37 toward the downstream side of the induction conduit 13. Each of the converging sections 52 terminates at a throat from which a respective diverging section 53 extends. The flow rate through the discharge passages 51 will be altered by the shape of these passages further aiding in the mixture distribution prior to its discharge into the induction conduit 13.

The relationship of the size of the throats of the ram passages 45 to the size of the throats of the discharge passages 51 may be altered dependent upon the characteristics of the engine with which the charge forming device 11 is used. Generally it is preferable to have the ram passages 45 of a fixed size with the discharge passages 51 being altered in size dependent upon the cubic inch displacement of the associated engine. The ram passages 45 are normally larger in diameter than the discharge passages 51 and the size of the discharge passages 51 is increased as the engine size decreases. It should also be noted that since the throttle valve shaft 29 rotates with the throttle valve 28 the angular relationship of the passages 45 and 51 with respect to the induction conduit 13 will be dependent upon throttle opening. The throttle valve 28 is adjustably connected to the throttle valve shaft 29 to permit adjustment of this relationship.

An accelerating pump, indicated generally by the reference numeral 55 (FIGURES 4, 6 and 7), is provided to discharge additional amounts of fuel into the induction conduit 13 as the throttle valve 28 is opened suddenly. As is well known, upon sudden throttle openings the fuel discharge rate tends to lag the increase in air flow due to the greater resistance to flow of the fuel. The accelerating pump 55 compensates for this difference in the change in flow rates. The accelerating pump 55 is positioned in the fuel bowl portion 21 provided for by the cover plate 19 and consists of a generally inverted cup-shaped member 56 defining a downwardly facing cavity 57. The mouth of the cavity 57 is closed by a flexible diaphragm 58. A coil compression spring 59 is contained within the cavity 57 and urges the diaphragm 58 to a distended position wherein the cavity 57 has its maximum volume. A lever 61 engages the underside of the diaphragm 58 to control its position. As the diaphragm 58 moves to its distended position, fuel is drawn into the cavity 57 through an inlet passage 62 that extends through the cup-shaped member 56 and into the fuel bowl 21. A ball check valve 63 permits fuel introduction, but precludes the reentry of fuel into the fuel bowl 21 when the diaphragm 58 is moved upwardly under the action of the lever 61. An accelerating pump discharge passage (not shown) extends from the cavity 57 through the housing of the accelerating pump 55 and cover plate 19 to a mating passage 64 (FIGURE 2) formed in the body portion 12.

As the throttle valve 28 is moved to its idle position, the lever 61 moves to the position shown in FIGURE 6 and the coil spring 59 distends the diaphragm 58 drawing fuel into the cavity 57 through the inlet passage 62. A check valve, to be described, in the accelerating pump discharge circuit precludes reverse fuel flow through the accelerating pump discharge passage during this action. When the throttle valve 28 is rapidly opened, the lever 61 is pivoted through an appropriate linkage (not shown) forcing the diaphragm 58 upwardly and compressing the spring 59. The check valve 63 seats under these conditions and fuel is forced through the accelerating pump discharge passage into the passage 64.

The upper end of the passage 64 extends to a deceleration control valve, indicated generally by the reference numeral 65 and shown in the most detail in FIGURE 7. The deceleration control valve 65 is comprised of a generally cylindrical member 66 having a male threaded lower end 67 that is tapped into a female threaded opening 68 in the body portion 12. The male threaded portion 67 has a concentrically disposed fuel passage 69 that is in registry with the fuel passage 64. The upper end of the fuel passage 69 meets a cylindrical bore 71 formed in the cylindrical portion 66 of the deceleration control valve. A valve seat 72 is formed at the intersection of the fuel passage 69 with the bore 71 and a ball check valve 73 coacts with the seat 72 to control the flow of fuel from the passage 69 into the bore 71. A coil spring 74 is received within the bore 71 and engages the ball check valve 73 at one end and an adjustment plug 75 at its other

end. The adjustment plug **75** is threaded into a female threaded end **76** of the bore **71**, the outer end of which is closed by a removable plug **77**. The axial position of the adjustment plug **75** within the bore **71** determines the preload on the coil spring **74** and the point at which the ball check valve **73** will open.

A transversely extending passage **78** extends through the wall of the cylindrical portion **66** from the bore **71** on the downstream side of the check valve **73**. A fuel supply passage **79** extends from the passage **78** across the top of the body portion **12** to the opposite side of the charge forming device **11** (FIGURE 2). The outlet end of the conduit **79** extends into the body portion **12** and terminates adjacent an annular recess **81** formed around the throttle valve shaft **29** (FIGURES 3 and 5). A transversely extending passage **82** extends from the recess **81** into the fuel conduit **37** of the throttle valve shaft **29**. O-ring seals (not shown) may be positioned on opposite sides of the annular recess **81** to preclude fuel leakage.

When the accelerating pump **55** discharges fuel through the conduit **64**, the ball check valve **73** will be unseated and additional fuel is driven through the conduit **79** into the throttle valve fuel conduit **37** for discharge into the induction conduit **13** through the discharge passages of the throttle valve shaft **29** which have been previously described. As has been previously noted, one engine operating condition under which emission of smog producing constituents is relatively high is upon extreme decelerations. Under this condition the throttle valve is closed and the engine operates somewhat like a pump. Combustion efficiency is generally extremely poor when this occurs. The suction or vacuum created under this condition is transmitted through the conduit **79** to the bore **71** on the downstream side of the ball check valve **73**. The precompression of the spring **74** is set so that the ball check valve **73** will be unseated at a predetermined, relatively high induction system vacuum as occurs under such decelerations. Additional fuel can then be drawn into the induction conduit **13** from the accelerating pump cavity **54** through the accelerating pump discharge passage and through the passage **64**. Tests of the disclosed charge forming device have proven that the amount of certain smog producing constituents in the exhaust gas are substantially reduced through the use of this construction wherein additional fuel is discharged into the induction conduit **13** on the downstream side of the throttle valve **28** on such decelerations.

Vehicles equipped with ignition distributors incorporating a vacuum advance system generally pick off the vacuum signal from the carburetor. The vacuum advance system of the distributor tends to retard the degree of spark advance under high load, low manifold vacuum conditions. Conversely, the spark is advanced under conditions of relatively high manifold vacuum. It has been found that the emission of smog producing constituents can be reduced by retarding the spark under extreme deceleration conditions. The disclosed charge forming device **11** also incorporates a device for accomplishing this spark retard, which device is now to be described.

A pressure conduit **86** (FIGURE 2) is provided in the carburetor body portion **12** and extends from an appropriate position in the induction conduit **13** to the vacuum advance system of the distributor of the associated engine (not shown). An atmospheric bleed passage **87** merges into the vacuum advance conduit **86** and terminates in a passage **88** formed in the charge forming device body portion **12**. The passage **88** terminates at a transversely extending passage **89** that is closed at its outer end by an adjacent surface **91** of the vane **35** when the vane **35** is in any position other than its idle position. A passage **92** is formed in the vane **35** extending from the surface **91** to the upper portion of the fuel bowl **18**. This area is vented to the atmosphere by means of a fuel bowl vent passage **93** that extends through the body portion **12** into the air horn **14**. In addition to providing an atmospheric vent, the fuel bowl vent **92** insures that any gas which may vaporize in the fuel bowl will be drawn into the induction conduit **13** rather than being discharged to the atmosphere. When the throttle valve **28** is in its idle position, the passage **92** registers with the passage **89** and vents the advance circuit of the distributor to the atmosphere. This will have the effect of retarding the spark and reducing exhaust emissions on decelerations.

The charge forming device **11** also incorporates an automatic choke comprised of a choke valve **94** that is supported for rotation within the air horn **14** on a choke valve shaft **95**. The choke valve shaft **95** is connected to a temperature responsive mechanism **96** of any known type to appropriately position the choke valve **94** and facilitate cold weather operation. The choke valve shaft **95** is also connected by means of linkage **97** to a fast idle cam **98** that coacts with an adjustable stop **99** carried by the throttle valve shaft **29** to provide for fast engine idle during choke operation.

Faster warmup and better vaporization of the fuel during cold weather operation is further facilitated by a heating element **101** that is supported within a ring **102** in the induction conduit **13** between the choke valve **94** and throttle valve **28**. The heating element **99** may be an electrical resistance unit, a water heated tube or any other suitable mechanism for heating the air passing through the induction conduit **13**.

While it will be apparent that the preferred embodiment of the invention disclosed is well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. A charge forming device for an internal combustion engine comprising means defining an induction conduit adapted to discharge into the induction system of the associated engine, fuel discharge circuit means for discharging fuel into said induction conduit, throttle valve means in said induction conduit for controlling the flow through said induction conduit, accelerating pump means responsive to rapid opening movement of said throttle valve for discharging fuel into said induction conduit, and means including an adjustable check valve responsive to induction system pressure posterior to said throttle valve for drawing fuel from said accelerating pump means into said induction conduit when the engine induction system vacuum exceeds a predetermined value.

2. A charge forming device as set forth in claim **1** wherein the accelerating pump means discharges into the induction conduit posterior to the throttle valve.

3. A charge forming device as set forth in claim **1** wherein the induction conduit is formed from a substantially straight section, the fuel discharge circuit means including fuel metering means responsive to the position of the throttle valve.

4. A charge forming device as set forth in claim **3** wherein the accelerating pump means discharges through the fuel discharge circuit means independently of the fuel metering means.

5. A charge forming device as set forth in claim **4** wherein the fuel metering means comprises a vane fixed for rotation with the throttle valve means and a cooperating fuel metering member juxtaposed to one end of said vane.

6. A charge forming device for an internal combustion engine comprising means defining an induction conduit adapted to discharge into the induction system of the associated engine, said induction conduit having generally straight sides, a throttle valve shaft extending across said induction conduit and supported for rotation on opposite sides of said induction conduit, a throttle valve fixed to said throttle valve shaft and within said induction conduit for controlling the flow through said induction conduit, a fuel source, a fuel metering member supported within said fuel source, a fuel metering vane affixed to said throt-

tle valve shaft and extending into said fuel source adjacent said fuel metering member, said vane having a fuel metering passage extending therethrough from a point adjacent said fuel metering member to said throttle valve shaft, a fuel conduit extending through said throttle valve shaft from said fuel metering passage into the portion of said throttle valve shaft in said induction conduit, a group of ram passages extending through said throttle valve shaft from said fuel conduit to said induction conduit on the anterior side of said throttle valve for ram air induction into said fuel conduit, a group of discharge passages extending through said throttle valve shaft from said fuel conduit to said induction conduit on the posterior side of said throttle valve for discharging fuel from said fuel conduit into said induction conduit, an accelerating pump, said accelerating pump including a variable volume fluid chamber, means responsive to the movement of said throttle valve shaft for altering the volume of said chamber, fuel intake means extending from said fuel source into said fluid chamber for filling said fluid chamber with fuel upon closing movement of said throttle valve and an accelerating pump fuel discharge passage, and accelerating pump discharge passage means extending from said accelerating pump fuel discharge passage to said fuel conduit of said throttle valve shaft at a point spaced from said vane.

7. A charge forming device as set forth in claim 6 wherein the accelerating pump discharge passage means includes pressure responsive decelerating valve means for precluding reverse fuel flow through said accelerating pump discharge passage means upon closing movement of said throttle valve and for the discharge of fuel therethrough upon opening movement of said throttle valve, said pressure responsive deceleration valve means being adapted to open at a preselected relatively high induction system vacuum for bleeding fuel into said induction conduit upon severe decelerations.

8. A charge forming device as set forth in claim 7 wherein at least one of the group of passages in the throttle valve shaft is provided with a restricted area throat for accelerating the flow therethrough.

9. A charge forming device for an internal combustion engine comprising means defining an induction conduit adapted to discharge into the induction system of the associated engine, a fuel source, a fuel discharge bar extending at least in part into said induction conduit, means for supporting said fuel discharge bar for rotation relative to said induction conduit, a throttle valve affixed to said fuel discharge bar for regulating the flow through said induction conduit in relation to the angular position of said fuel discharge bar, said fuel discharge bar defining a fuel conduit extending therethrough, means for delivering fuel from said fuel source to said fuel conduit of said fuel discharge bar, fuel metering means operatively connected to said fuel discharge bar and rotatable therewith for regulating the amount of fuel delivered to said fuel discharge bar by said last named means, a group of ram passages formed in said fuel discharge bar extending transversely from said induction conduit on the anterior side of said fuel discharge bar to said fuel conduit for introducing air into said fuel conduit, and a group of discharge passages in said fuel discharge bar extending transversely from said fuel conduit to said induction conduit on the posterior side of said fuel discharge bar for discharging fuel into said induction conduit, at least one of said group of passages being formed with a restricted area throat at a point along its length for altering the flow rate therethrough and for improving the mixture distribution discharged by said fuel discharge bar.

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U.S. Cl. X.R.

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