

April 21, 1936.

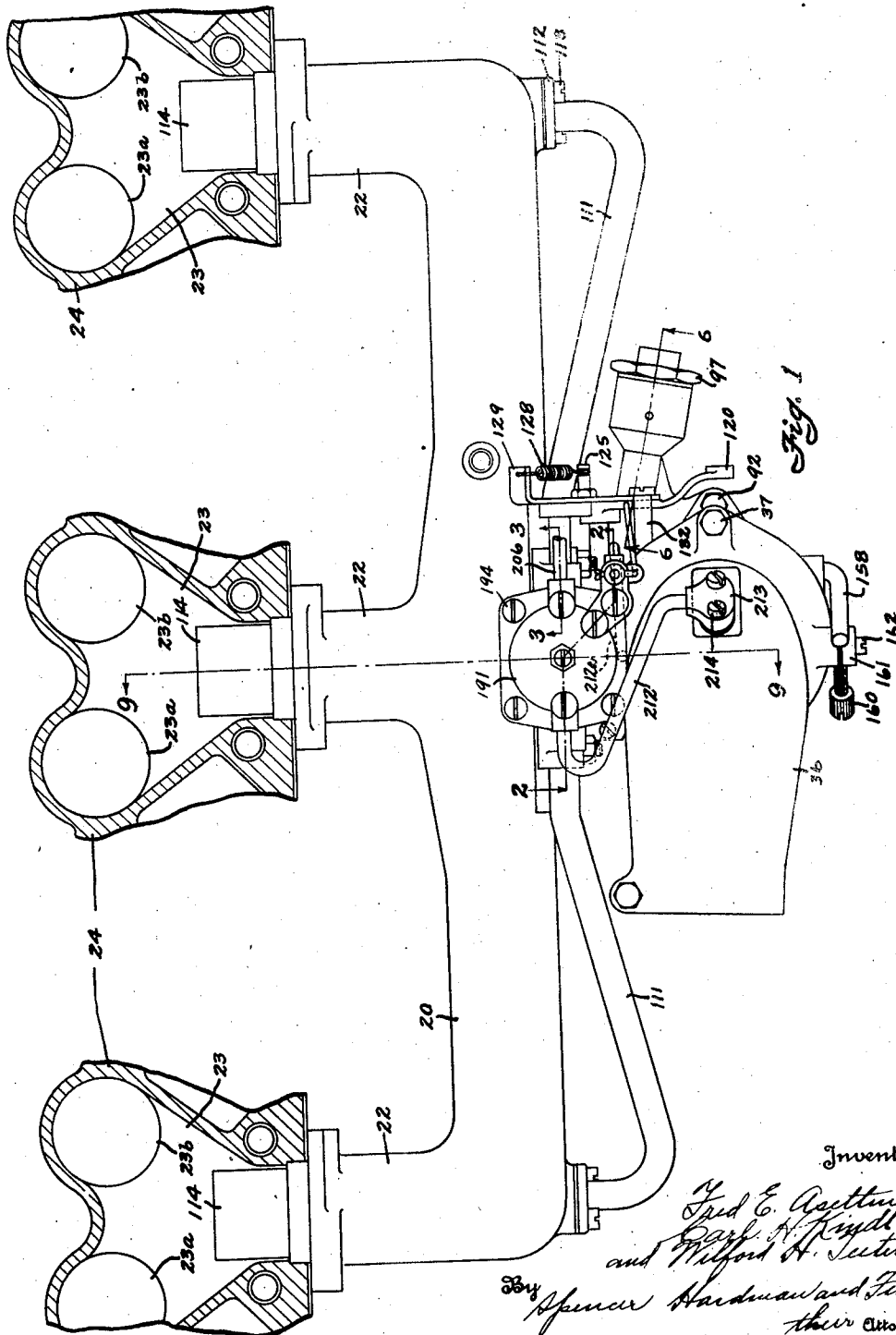
F. E. ASELTINE ET AL

2,038,157

CHARGE FORMING DEVICE

Filed Sept. 22, 1927

5 Sheets-Sheet 1



April 21, 1936.

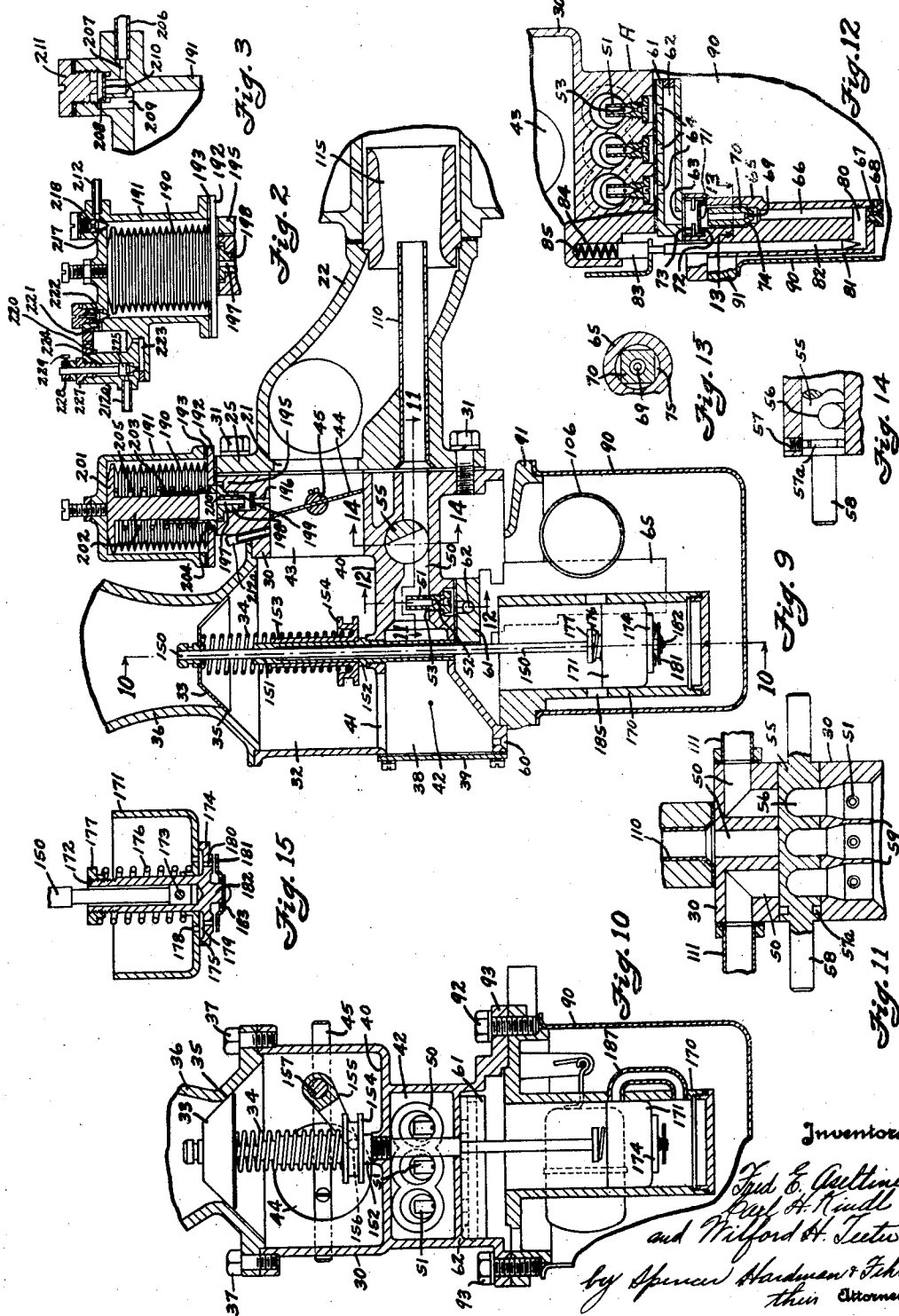
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CHARGE FORMING DEVICE

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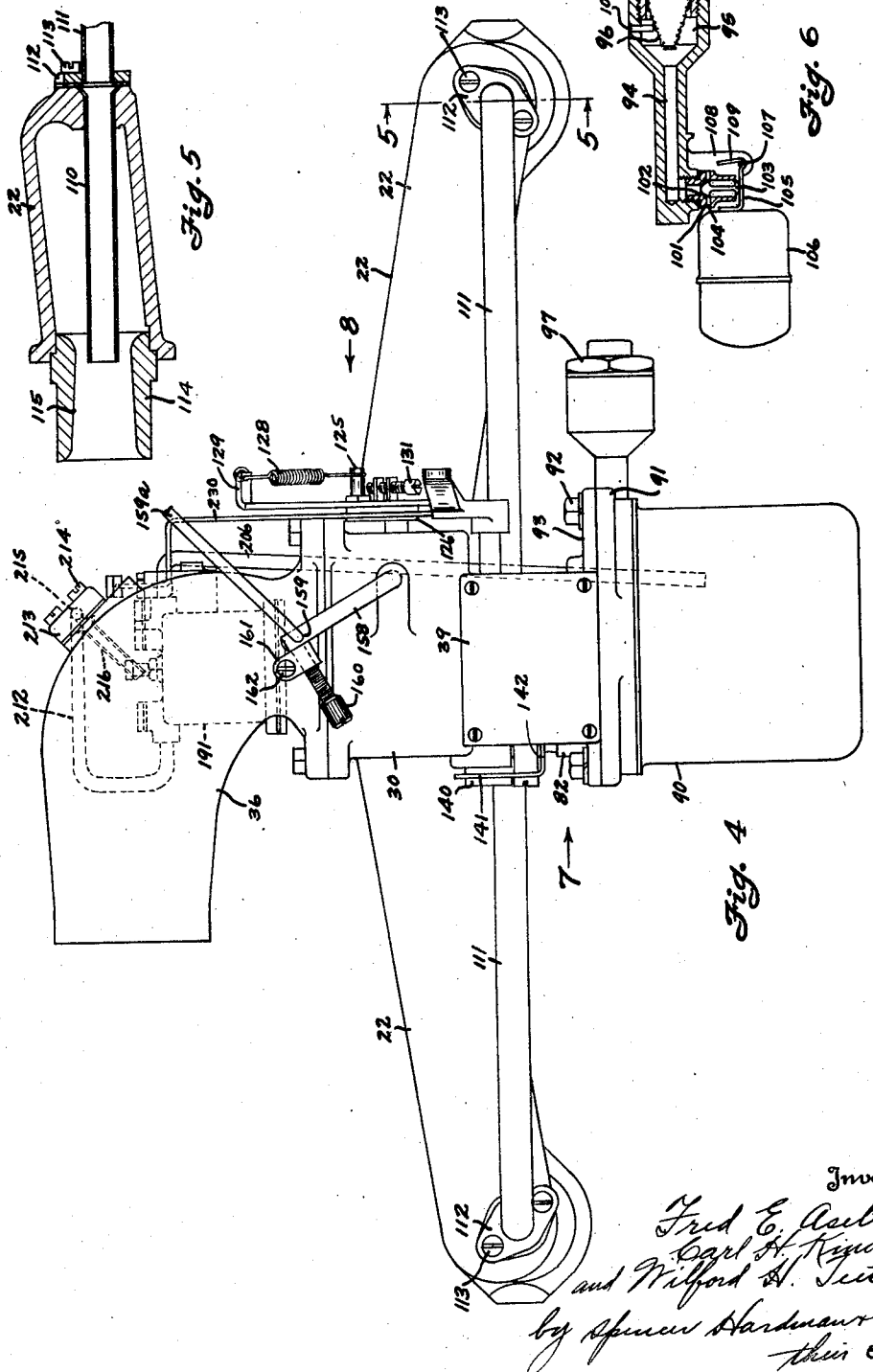
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CHARGE FORMING DEVICE

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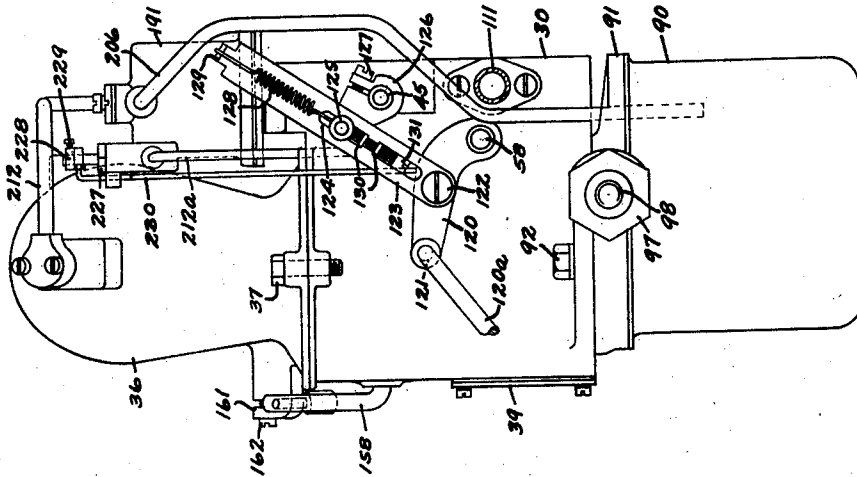


Fig. 8

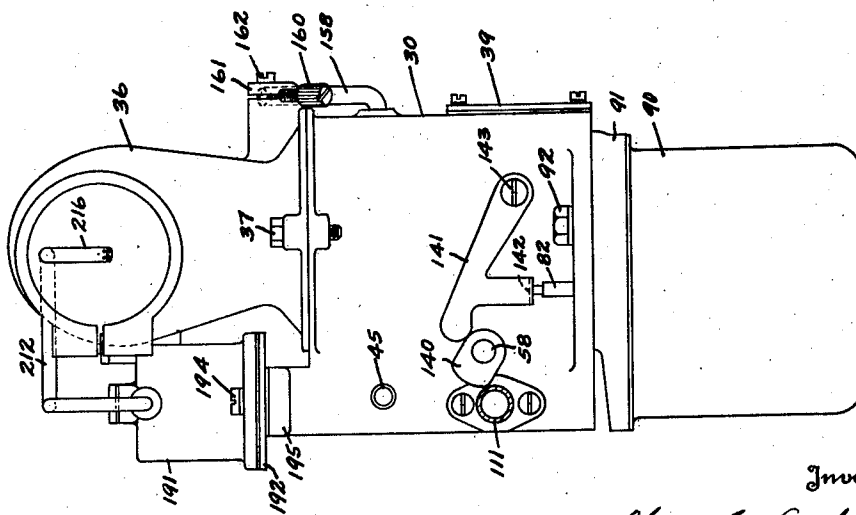


Fig. 7

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CHARGE FORMING DEVICE

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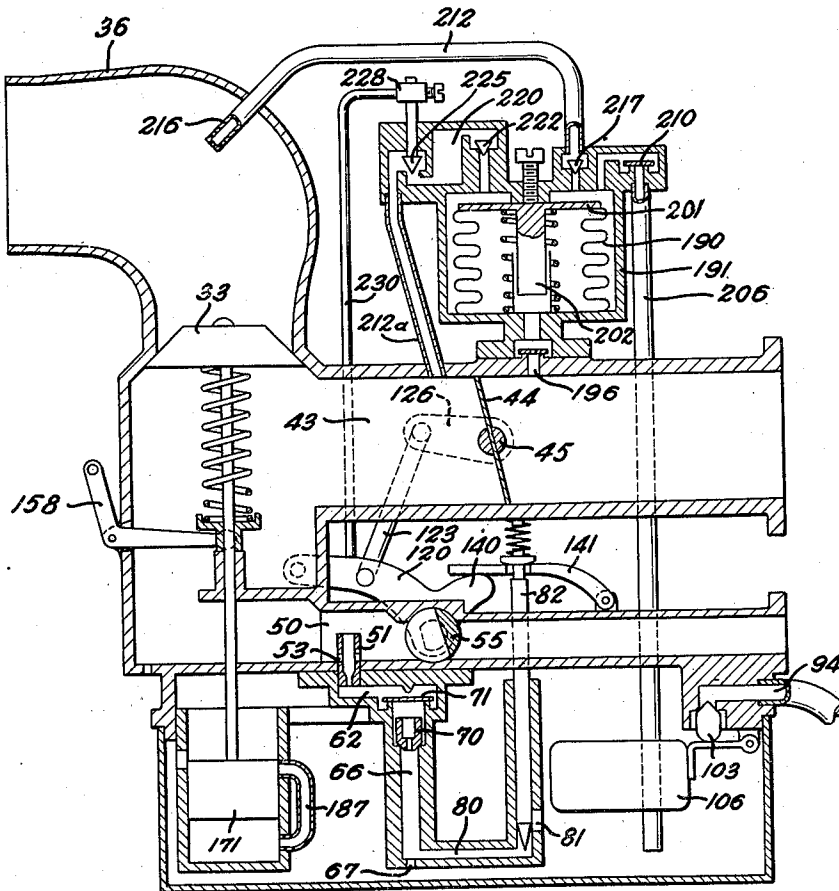


Fig. 16.

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UNITED STATES PATENT OFFICE

2,038,157

CHARGE FORMING DEVICE

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Application September 22, 1927, Serial No. 221,373

40 Claims. (Cl. 123—119)

This invention relates to charge forming devices for multicylinder internal combustion engines and more particularly to the type of charge forming device or carburetor comprising a plurality of primary fuel mixing chambers or primary carburetors one for each intake port of the engine and cooperating respectively with a plurality of secondary fuel mixing chambers or secondary carburetors each located adjacent an engine intake port and receiving fuel-air mixture from a pipe connected with one of the primary carburetors and receiving air when required through one branch of an air manifold which supplies air to all of the secondary carburetors. The primary carburetors receive their liquid fuel from a common fuel bowl in which the level is controlled by a float valve.

Examples of carburetors of this nature are illustrated in the patents of W. H. Teeter, No. 1,819,526, and Fred E. Aseltine and W. H. Teeter, No. 1,819,495. In the charge forming devices disclosed in these applications, a plurality of primary carburetors are provided, one for each intake port. The fuel mixture from such primary carburetors is conveyed to the secondary mixing chambers located adjacent the various engine intake ports where it is mixed with additional air. In these devices, the throttling of the engine is effected by a single primary throttle which controls all the primary carburetors, and a single main throttle controlling the air flow through the main air manifold. These throttles are operated from a common operating mechanism which is so arranged that the primary throttle controls the quantity of mixture passing to the engine at speeds up to a vehicular speed of 20-25 miles per hour, after which the main air throttle begins to open and becomes the main controlling element regulating the mixture outflow.

The general objects of the devices disclosed in the patents above referred to, are first, to provide a mixture of fuel and air having the desired fuel and air ratio under all conditions of operation and to deliver equal quantities of this mixture to each cylinder of the engine under various conditions of load and speed, without requiring the heating of the fuel or fuel mixture before it is delivered to the engine intake. Various devices are provided in the carburetors disclosed in the above applications for controlling the flow of fuel and air under various operating conditions so as to secure a mixture having the desired fuel and air ratio under every possible condition of engine operation.

The charge forming device forming the subject

of the present invention is similar in general construction to those disclosed in the aforementioned patents, and the principal object of this invention is to provide improved mechanism for controlling the proportions of fuel and air in the fuel mixture and to improve and simplify the construction of the device.

One feature of the invention consists in the provision of a fuel injecting pump, operative under certain operating conditions for injecting fuel into the ingoing air at two points both posterior and anterior to the main air inlet valve, to provide the rich fuel mixture necessary for acceleration at higher speed.

Another feature of the invention lies in the provision of improved means for retarding the opening movement of the air valve to provide an enriched mixture for acceleration at speeds below that at which the fuel injection pump is effective.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a plan view of the present invention shown in connection with an engine cylinder head block, portions of which are shown in horizontal section.

Figs. 2 and 3 are sectional views on the lines 2—2 and 3—3 respectively of Fig. 1.

Fig. 4 is a side elevation of the present invention.

Fig. 5 is a sectional view on the line 5—5 of Fig. 4.

Fig. 6 is a sectional view on the line 6—6 of Fig. 1.

Fig. 7 is an end view looking in the direction of the arrow 7 in Fig. 4.

Fig. 8 is an end view looking in the direction of the arrow 8 in Fig. 4.

Fig. 9 is a sectional view on the line 9—9 of Fig. 1.

Fig. 10 is a sectional view on the line 10—10 of Fig. 9.

Fig. 11 is a horizontal section on the line 11—11 of Fig. 9.

Fig. 12 is a fragmentary section on the line 12—12 of Fig. 9.

Fig. 13 is an enlarged sectional view on the line 13—13 of Fig. 12.

Fig. 14 is a fragmentary sectional view on the line 14—14 of Fig. 9.

Fig. 15 is an enlarged vertical sectional view of the dashpot piston and piston rod, blow-off valve and check valve.

Fig. 16 is a diagrammatic view illustrating all of the fuel passages supplying fuel to one of the primary carburetors.

Referring to the drawings, 20 designates an air manifold having an inlet at 21 (see Fig. 9) and having three branch pipes 22 each connected with a cylinder head intake port 23. Each intake port 23 supplies fuel to a pair of engine cylinders through cylinder valve ports 23a and 23b. In Fig. 1, the cylinder head is shown in three separate fragments 24 but it will be understood that it may be an integral structure. The air manifold 20 is secured to the cylinder block 24 in any suitable manner similar to that employed for attaching the conventional intake manifold to the cylinder head. Adjacent its intake, the manifold 20 is provided with an attaching flange 25 to which may be bolted the carburetor unit which will now be described.

The main carburetor unit comprises a housing 30, in the form of a single casting, which is attached to the flange 25 by screws 31. The housing 30 provides an air chamber 32, the admission of air to which is controlled by an air valve 33 which is normally closed by a spring 34 against the valve seat 35 provided by an air horn 36. The member 36 is attached to the member 30 by screws 37. For convenience in manufacture the member 30 is provided with an opening 38 which is closed by a plate 39. The bottom wall 40 of the chamber 32 is provided with a large opening 41 to allow passage of air from the chamber 32 to a chamber 42 from which air is supplied to the primary carburetors to be described. The air chamber 32 is connected with the air manifold inlet 21 by a passage 43 controlled by an air throttle valve 44 mounted on a shaft 45 which is supported as shown in Fig. 10 by the side walls of the chamber 30.

Referring to Figs. 9 to 15 inclusive, there are as many primary carburetors as there are cylinder head ports, for example, three for a six-cylinder engine as disclosed. Each primary carburetor is provided by fuel-mixture passage or mixing chamber 50 into which there extends an upwardly projecting fuel nozzle 51 provided with a metering orifice 52, open at its upper end and provided with small holes 53 adjacent the bottom of the passage 50. The fuel issues only from the holes 53 at idling and low speeds and light load; and above 10 to 15 miles per hour at light load for example, the fuel issues from the top of the nozzle 51. At idling or low speed, light load, the depression at any nozzle 51 is insufficient to lift the fuel through the outlet at the top of the nozzle, but does lift the fuel to a point intermediate the orifices 53 and top of the nozzle which establishes a gravity head at the said orifices 53, and causes the fuel to flow therefrom under the influence of such gravity head. The three primary carburetor passages 50 are arranged closely together in a horizontal row as shown in Figs. 10, 11 and 12 so that they may be controlled by a simple throttle valve member or cylinder 55 provided with notches 56 in alignment with the passages 50 respectively. The valve 55 is held against endwise movement by a screw 57 engaging a groove 57a in the valve (see Fig. 14), and the valve has spindles 58 projecting therefrom for connecting it with controls to be described and supporting it for rotation.

The passages 50 are separated at their entrances by relatively thin partitions 59 which tend to prevent the interference of one carburetor with another. The connection of the air inlets of the primary carburetors with the air chamber 42 tends to equalize the distribution of fuel to the engine intake ports. This connection is believed to eliminate eddies in the primary carburetors. The presence of eddies in the primary carburetors would interfere with equal distribution since the eddies are not constant in effect but are erratic. This connection also tends to equalize the depression applied to all three carburetors, which might otherwise be unequal due to differences in the length of the primary tubes.

During the choking of the carburetor when the air valve 33 is held closed, air is admitted to the air chamber 42 through small holes 60 in the bottom wall of the chamber 42 in order to carry the liquid fuel to the engine for starting purposes. During the engine operation most of the air for the primary carburetors is admitted to the chamber 42 from the main air chamber 32; therefore it is apparent that the sub-atmospheric pressure at the fuel nozzles 51 will be substantially the same as in the main air chamber 32, up to a certain engine speed which in this carburetor is a speed corresponding to a vehicular speed of 20-25 miles per hour on a level. At higher speeds the velocity head becomes effective on the primary jets to form a super rich mixture, and is compensated for by opening the air valve 44 to admit additional air as later described.

The bottom wall of the housing 30 supports a block 61 providing a distributing canal or manifold 62 having an entrance at 63 and a plurality of outlets 64, one for each fuel nozzle 51. The block 61 in turn supports a fuel metering block 65 which projects downwardly into the float bowl and provides a passage 66 into which fuel is normally metered through an orifice 67 provided by a metering bushing 68. As fuel passes upwardly to the passage 66 it must normally all pass through a metering orifice 69 in a flow operated valve 70, and thence past a check valve disc 71 normally resting upon a seat 72 and limited in its upward movement by stops 73. Above certain engine speeds, the velocity of the flow of liquid through the passage 66 is sufficient to raise the flow control valve 70 from its seat 74 so that fuel may flow also around the valve through passages 75, shown more particularly in Fig. 13, as well as through the metering passage 69. Under certain conditions, liquid fuel may be admitted through the passage 66 also through a passage 80 into which fuel may pass through a port 81 when a valve 82 shown in Fig. 12 is lifted. The stem of the valve 82 terminates in a head 83 which is vertically slidable within a recess 84 provided by the housing 30. A spring 85 in this recess urges the valve 82 into closed position. The valve 82 is lifted by connections from the primary throttle 55 after a certain movement of the latter, such valve operating connections being more fully described hereinafter.

The liquid fuel which is supplied to all of the primary carburetors through the holes 67 and 81 is contained in a fuel bowl 90 suspended from a frame 91 attached by screws 92 to a flange 93 provided by the member 30. Liquid fuel is admitted to the bowl 90 through a passage 94 provided in the frame 91 as shown in Fig. 6. This passage has an enlarged screen chamber 95 containing a fine mesh screen 96 supported by a fitting 97 having a tapped hole 98 for receiving a

fuel supply pipe. The screen 96 is retained against endwise movement by a peg 100. The passage 94 communicates with passages in the valve seat member 101 providing a seat 102 for a valve 103 and having side outlet passages 104 through which fuel may pass when the valve 103 drops from its seat. The valve 103 is pushed upwardly against its seat by a lever 105 carrying a float member 106. Lever 105 is pivotally mounted on a pin 107 supported by downwardly extending brackets 108 integral with the frame 91 and an extension 109 of the lever 105 limits counterclockwise movement of the lever and therefore retains the valve 103 within the valve seat member 101 when the float 106 falls.

The primary mixing chambers are formed in what may be termed a distributor block A, which is cast integrally as part of the housing 30, said block A projecting downwardly from the partition 40 as indicated in Fig. 9.

Referring to Fig. 11, the center one of the primary mixing chambers 50 is in direct communication with a primary mixture tube 110 extending into the central branch 22 of the manifold 20; and each of the other carburetor passages 50 is provided within the block A with a right angle bend leading into a primary mixture pipe 111 having one end attached to the block A and the other end attached to a flange 112 which is attached by screws 113 as shown in Figs. 1, 4 and 5 to the air manifold 20 at a point in alignment with one of its end branches 22. This connection places the outlet end of each pipe 111 in direct communication with a primary mixture pipe 110 extending through each of the end branches 22 as shown in Fig. 5. Each engine intake port 23 provides a secondary carburetor in which the primary mixture issuing from the pipe 110, may be mixed with air issuing from each branch of the air manifold. It has been found advantageous to provide each engine intake port 23 with a bushing 114 providing a Venturi passage 115. This passage has been found to increase the velocity of the primary mixture flowing through the tube 110 and therefore aids in acceleration of the engine. The venturi also assists in mixing the primary fuel mixture with the air in the secondary carburetor. Other flow accelerating means may be substituted for the venturi if desired.

The operating connections for the primary throttle valve 55 and the air throttle valve 44 will now be described. It has been found desirable under part load conditions and for speed up to a certain amount, for example, to an engine speed corresponding to a vehicle speed of 20-25 miles per hour to supply all of the engine fuel mixture by the primary carburetors only and above such certain speed to gradually open the air throttle 44 so that more air will be added to the primary mixture in the secondary carburetors in order that the fuel mixture will not become too rich during higher speeds. Accordingly, the throttles are so coordinated that the air throttle 44 will not be opened until the primary throttle 55 has been opened to a certain extent from its idling position shown in Fig. 9. As shown in Figs. 8 and 9, the primary throttle shaft 58 carries the main operating lever 120 having an aperture 121 for receiving a control rod 120a which may be operated in the usual manner by an accelerator pedal or by a lever located at the top of the steering column of the vehicle propelled by the engine. The lever 120 is pivotally connected by screw 122 with a link 123 provided with a slot

124 for receiving a stud screw 125 threaded in the free end of a lever 126 which is clamped in adjusted position around the air valve shaft 45 by a screw 127. A spring 128 connects the stud 125 with an ear 129 at the upper end of the link 123. Two ears 130 integral with the link 123 and formed by punching them from the main body of the link are provided with aligned tapped holes for receiving a screw 131 which may engage the stud 125. In Fig. 8, the levers 120 and 126 are in normal position corresponding respectively to the idle position of the throttle 55 and the closed position of the throttle 44 as shown in Fig. 9. The lever 120 is maintained in the desired position by its connection with the control rod 120a. The spring 128 tends to move the lever 126 clockwise and hence maintains the valve 44 in closed position. When the lever 120 is moved counterclockwise to open the primary throttle, the upper end of the slot 124 engages the stud 125, thereby causing the valve 44 to be opened after the valve 55 has been opened a certain amount. Further counterclockwise movement of the lever 120 as viewed in Fig. 8 will cause both valves to move toward open position and their movement in this direction is limited by the engagement of the lever 126 with a stop 132. As the lever 120 is moved clockwise to close the valve 55, the valve 44 will be moved into closed position through the connection including the link 123, the spring 128 and the lever 126. After the valve 44 has been closed the lever 120 may be moved in a clockwise direction until the screw 131 engages the stud 125. Since the valve 44 cannot move any further in a clockwise direction from its closed position shown in Fig. 9, the valve 55 cannot be moved any further into closed position after the screw 131 engages the stud 125. Therefore by turning the screw the idle position of the throttle 55 can be adjusted.

When the engine is running idle, the air throttle 44 will be closed, the primary valve 55 will be in idling position as shown in Fig. 9, and the automatic air valve 33 will be slightly open. As the throttle 55 is opened to increase the speed of the engine, the depression in chamber 32 below the air valve will increase and the opening of the air valve 33 will increase automatically to admit air to the primary carburetor so that the required engine power will be obtained. Below a certain engine speed corresponding to a vehicle speed of 20-25 miles per hour, for example, air valve 44 will remain closed so that all of the engine fuel mixture will be supplied through the primary mixture tubes 110 by the primary carburetors. At a primary throttle position of about 20-25 miles per hour vehicle speed on a level road for example, the air throttle 44 will begin to open so that part of the air admitted by the valve 33 will be supplied by the air manifold to the secondary carburetor in order that the fuel mixture will not be too rich for good performance and economy when on part load at intermediate speeds.

As has been stated previously, under engine operating conditions producing relatively high suction at the primary nozzles 51 and consequently relatively high velocity of the flow of fuel through the passage 66, the metering valve 70 will be lifted to permit the passage of a greater amount of fuel to the distributing canal 62. Normally this valve remains seated to keep the mixture lean below a certain medium speed, for example a vehicle speed of 30 miles per hour, when the vehicle is running on the level; or

under a certain lower speed under full load conditions.

The check valve 71 prevents the dropping of the column of liquid located above the level of the seat 72 in passage 66 down to the level of the fuel in bowl 90 when the engine speed is suddenly reduced producing a consequent reduction in depression at the nozzles and velocity of fuel flow. Thus the valve 71 prevents starving the engine for a period, so that the engine will operate smoothly upon a sudden reduction in speed.

When only the primary throttle 55 is open all of the liquid fuel is metered through the orifice 67 in order to keep the mixture lean for relatively low speed and light load operation or part throttle positions. For higher speed or greater load requiring the opening of the air throttle 44, it is desirable to meter more fuel into the passage 66. Therefore the valve 82 is caused to begin to lift as the valve 44 starts to open by means comprising a cam 140 attached to the shaft 58 and engageable with a lever 141 having a notched ear 142 for receiving a portion of the stem of valve 82 as shown in Figs. 7 and 12. The lever 141 is pivoted upon a screw 143 attached to a side wall of the housing 30. The frame 91 and the fuel bowl 90 project laterally beyond this housing so that the valve 82 may extend directly downwardly into the fuel bowl. It is apparent from Fig. 7 that after the cam 140 has been moved in a clockwise direction as viewed in Fig. 7 a certain amount corresponding to an opening movement of the valve 55 as viewed in Fig. 9, the cam 140 will move the lever 141 in a clockwise direction as viewed in Fig. 7 in order to cause it to lift the valve 82. As the throttle 55 is moved toward closed position, the cam 140 will move away from the lever 141 to permit the spring 85 to close the valve 82. The opening of this valve begins at about 20 miles per hour, vehicle speed, for example, and continues during a considerable movement of the throttle. For example, the vehicle speed may be about 50 miles per hour when running on a level road before the valve 82 is entirely open.

The control of the air valve 33 for the purpose of choking the carburetor for priming the engine when starting will now be described. The air valve 33 is supported by a valve stem 150 which is supported for vertical movement by a guide 151 screwed into the wall 40 of the housing 30 and extending at its lower end through a hole in the bottom wall of the chamber 42. The guide 151 is provided with a shoulder 152 for limiting the downward movement of a sleeve 153 which is slidable upon the exterior of the guide 151. The spring 34 is located between the valve 33 and a grooved collar or spring seat 154 provided by the sleeve 153. Except when the carburetor is choked for starting the engine the sleeve remains in the position shown in Fig. 9 against the shoulder 152. When it is desired to choke the engine, the sleeve 153 is moved upwardly to increase the compression of the spring 34 so that the valve 33 will be held closed and all the air for the primary carburetors will be taken in through the opening 60 and a very rich mixture will be produced due to the high depression at the fuel nozzles 51. The sleeve 153 is moved upwardly by a bifurcated lever 155 carrying studs 156 which are received by the grooved collar 154. The lever 155 is attached to a shaft 157 provided upon the exterior of the housing 30 with the lever arm 158 having a hole 159 for receiving a carburetor choke rod 159a. The spring

34 will return the lever 158 to the position shown in Fig. 4 against the end of an adjustable stop screw 160 after the choke rod 159a has been released. The stop screw 160 is screwed into a clamp bracket 161 integral with the part 36 and is clamped in any desired position of adjustment by a clamp screw 162.

To prevent the fluttering of the air valve 33 and to retard its movement toward open position for purposes of acceleration, a dashpot is provided, including a cylinder 170 located within the fuel bowl 90 and cooperating with a piston 171 which is slidable upon a piston rod 172 connected by a pin 173 with the lower end of the valve rod 150. The piston rod 172 is provided with a flange 174 having an annular bead 175 which functions as a valve seat, the valve being provided by the bottom of the piston 171. A spring 176 confined between the piston and a nut 177 screwed to the piston rod 172 tends to maintain the piston in contact with the valve seat 175. The bottom of the piston is provided with ports 178 communicating with an annular space 179 between the bottom of the piston and the flange 174. The piston 171 and the flange 174 provide a blow-off valve, the operation of which will be described later. The flange 174 is provided with ports 180 which may be closed by a check valve disc 181 which is guided for vertical movement upon an extension 182 of the piston rod 172. The check valve disc 181 is held adjacent the flange 174 by a washer 183 attached to the lower end of the piston rod 172. Fuel is admitted to the cylinder 170 from the main fuel chamber 90 through a hole 185 in the cylinder wall. The dashpot cylinder is provided with a by-pass pipe as shown in Fig. 12, for the purpose of producing a variable retarding effect in accordance with the position of the piston 171 relative to the cylinder 170. The by-pass pipe normally has its upper end closed by the dashpot piston when the air valve is closed. As the piston descends on opening movement of the air valve the said upper end of the by-pass is uncovered by the piston, thus relieving the dashpot action and allowing the piston to descend without material resistance after the by-pass is entirely uncovered.

While the engine is idling, the air valve 33 is opened but slightly because the depression in the chamber 32 is low. If the throttles are opened, as when accelerating the vehicle, the depression increases, and the valve 33 tends to open quickly but its motion is retarded by the dashpot since the check valve 181 closes the holes 180 in the flange 174, requiring the liquid in the cylinder 170 all to leak around the piston 171. This damping effect persists relatively undiminished until the by-pass 187 begins to be uncovered by the piston, during which interval, a richer mixture will be supplied to the engine for purpose of acceleration. Because of the greater inertia of the fuel, if the air valve were allowed to freely open on opening movements of the throttles, the increase in air flow would take place much more rapidly than the increase in fuel flow, which would result for a time in a weakening of the fuel mixture, until the effect of inertia was overcome. By retarding the opening of the air valve this increase in air flow can be prevented and by retarding the valve opening sufficiently this weakening of the mixture can not only be prevented, but a mixture richer in the fuel content may be provided for purposes of acceleration.

The damping gradually diminishes as the by-

pass 187 is being uncovered to allow the valve 33 to open rapidly and supply air to the engine to give the required power as the fuel flow and engine speed increase. The relation of the bypass to the piston determines the duration of the valve-damping and this relation is varied automatically according to the position of the primary throttle 55. The greater the initial opening of the throttle 55 at the time it is suddenly opened further to accelerate, the less will be the damping action. This variation is present because less damping of the air valve would be required when moving from a 20 to a 25 mile-per-hour throttle position than from a 10 to a 25 mile-per-hour position, assuming that the grade of the road is substantially the same under both conditions.

Under certain operating conditions where the increase in depression below the air valve is very sudden, it is not advisable to retard the opening of the air valve. At such time the pressure upon the liquid in the dashpot may be great enough to overcome the spring 176, whereupon the piston will be lifted from the flange 174 of the piston rod to permit escape of liquid through the holes 178 in the bottom of the piston. As soon as the piston separates from the flange 174 it will remain separated until the pressure is relieved. Thus it is seen in the present example, the retarding of the air valve may be relieved entirely if the throttles be very suddenly opened to a certain high speed position.

Under part load conditions and up to certain throttle openings, the dashpot constitutes means for enriching the fuel mixture for acceleration. If it is desired to accelerate to higher speeds requiring a substantial opening of the air throttle, the rich mixture for acceleration is supplied by a suction controlled siphon pump which injects fuel into the air intake just above the air valve 33, and also supplies fuel to the secondary air passage at a point between the said air valve and the main air throttle 44.

This pump comprises a flexible bellows 190 located in a housing 191 secured by screws to a plate 192 with a packing washer 193 therebetween to prevent leakage. This assembly is secured by screws 194 to a boss 195 projecting upwardly from the main housing. Means are provided to establish communication between the main air passage 43 and the interior of the bellows 190, such means comprising a passage 196 in the wall of the housing 30 and a passage 197 in a bushing 198 screwed into a recess in the boss 195. A check valve 199 is received in the above mentioned recess between the end of the passage 196 and the lower end of the bushing 198, said check valve having a small orifice 200 formed therein for a purpose hereinafter more fully set forth. The bellows is formed with a solid head 201 at the top to which the flexible wall of said bellows is secured and depending from and integral with said head is a rod 202 which is received within a guide sleeve 203 having a flange 204 at its lower end which fits tightly in a hole formed in the center of plate 192 and rests on top of bushing 198. The rod and guide sleeve keep the bellows vertical during its expanding and collapsing movements. A spring 205 surrounding the rod and guide sleeve normally keeps the bellows expanded as shown in Fig. 9.

Fuel is delivered to the space in housing 191 outside the bellows through a pipe 206, the lower end of which extends below the fuel level in the fuel chamber 90. The upper end of this pipe is

received in a boss on housing 191 and connects with a passage 207 in the boss which in turn communicates with an enlarged chamber 208 in the boss having a delivery outlet 209. A check valve 210 is received in chamber 208 and prevents return flow through the pipe 206. A screw 211 provides access to the check valve.

Two fuel delivery pipes 212 and 212a conduct fuel from the fuel space outside the bellows 190 to deliver fuel to the main air intake passage at two different points. The pipe 212 is connected at its other end to a fitting 213 secured by screws 214 to the air intake horn 36. This fitting has a fuel passage 215 therein which forms a means of communication between the pipe 212 and a short tube 216 extending into the air horn to deliver fuel into the ingoing air stream. This tube is secured in the wall of the air horn in any desirable manner. A check valve 217 is received in a chamber 218 on the wall of the housing 191, and controls flow through the pipe 212. The pipe 212a is connected at its outlet end in a hole in the housing 30 immediately anterior to the main air throttle 44, as shown in Fig. 9. This pipe is received at its intake end in a recess formed in a projecting portion of the housing 191. A fuel well 220 is formed in this projecting portion of the housing 191 and is connected with the fuel space around the bellows by a passage 221 controlled by a check valve 222 similar to the valve 217. An L-shaped passage 223 connects the well 220 and a chamber 224 formed in the projecting portion of housing 191 and communicating with the delivery pipe 212a. A valve 225 is received in the chamber 224 and controls flow of fuel from passage 223 to the chamber. This valve projects through a plug 227 closing the chamber 224 and has a collar 228 secured by a set screw 229 to its upper end. An operating wire 230 is fixed to the collar and is bent horizontally and downwardly in such a manner that its lower end engages the upper surface of the primary throttle operating lever to be operated thereby in a manner later described.

The above described pumping mechanism operates in the following manner, reference being had to the diagrammatic view in Fig. 16. At all times when the main air throttle 44 is closed or nearly closed the high manifold vacuum maintained at points posterior to said throttle is communicated to the interior of the bellows 190 through the suction passage 196. This high vacuum collapses the bellows until the depending rod 202 engages bushing 198, creates a vacuum in the space around the bellows in housing 191 and draws fuel through the supply pipe 206 to fill such space. If the valve 44 is suddenly opened the manifold vacuum is reduced, the bellows expands and forces fuel out through the delivery pipe 212 and passage 221. The fuel passing through pipe 212 is delivered directly and immediately to the ingoing air stream through the tube 216. The valve 225, however, is closed on opening movements of the valve 44, since the valve operating stem 230 engages the upper side of throttle operating lever 120 and is permitted to drop to seat the valve as said lever moves counterclockwise to open the throttles. Therefore on expanding of the bellows fuel is forced into the well and is retained there until the throttle lever 120 is raised to close the throttle when said lever will lift the operating wire 230 unseating valve 225 and permitting fuel to flow from the well through pipe 212a into passage 43 just anterior to the valve 44. This fuel will remain on the walls

of the passage 43 until the valve 44 is again opened to increase the engine speed, when such fuel will be immediately drawn into the secondary mixing chambers to enrich the fuel mixture for acceleration. This fuel travels a lesser distance than that injected into the air intake above the air valve, and passes immediately into an area of high vacuum where it is at least partially vaporized so that the time interval required for this fuel to reach the secondary mixing chambers is appreciably less than that necessary for the fuel injected into the air horn to travel from that point to the secondary mixing chambers. In this device therefore in which the additional fuel for acceleration is more immediately available, the movable dashpot cylinder heretofore employed to increase the retarding effect on opening of the air valve is not necessary and the present structure has been simplified by eliminating such movable cylinder, thus doing away with a considerable number of moving parts, with consequent reduction in cost of manufacture. Moreover, it is obvious that by providing two supplies of additional fuel for acceleration, which are successively drawn into the secondary mixing chambers, the pump disclosed herein is effective to enrich the mixture over a longer period of time than the pump employed in the earlier applications above referred to. In this device the dashpot is effective to take care of acceleration at all speeds up to that speed at which the main air throttle starts to open, after which fuel is provided by the suction operated pump and by manual operation of the fuel valve 82 to enrich the mixture for acceleration at speeds above that at which throttle 44 begins to open.

The check valve 199 with the small orifice 200 therein is provided for the purpose of preventing too sudden expansion of the bellows and consequently too rapid pumping of fuel to the mixture passage. On increase of pressure posterior to the valve 44 on opening movements thereof such pressure is communicated to the interior of the bellows rather slowly through the small hole 200 necessitating a rather gradual expansion of the bellows.

While the form of embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A charge forming device for internal combustion engines having, in combination, a mixing chamber, fuel and air inlets therefor, an air passage having a main air intake port, a throttle valve in said air passage, means for supplying additional fuel adjacent the air intake port on opening movement of the throttle, and means for supplying additional fuel to said air passage between the intake port and the throttle valve on closing movement of said throttle.

2. A charge forming device for internal combustion engines having, in combination, a mixing chamber, fuel and air inlets therefor, a main air intake port, an air passage receiving air from said main air intake port, a throttle valve therein, a fuel reservoir for supplying additional fuel to the air passage for acceleration, a fuel pump operable on opening movement of the throttle to directly inject fuel into the air intake port and fill the said fuel reservoir and a valve for controlling the flow of fuel from said reservoir.

3. A charge forming device for internal com-

bustion engines having, in combination, a mixing chamber, fuel and air inlets therefor, an air passage having a main air intake, a throttle valve therein, a fuel reservoir for supplying additional fuel for acceleration, a fuel pump operable on opening movement of the throttle to directly inject fuel into the air intake port and fill the said fuel reservoir, a valve for controlling the flow of fuel from said reservoir, and means for opening said valve as the throttle is closed.

4. A charge forming device for internal combustion engines having, in combination, a mixing chamber, fuel and air inlets therefor, an air passage having a main air intake, a throttle valve therein, a fuel reservoir for supplying additional fuel for acceleration, a fuel pump operable on opening movement of the throttle to directly inject fuel into the air intake port and fill the said fuel reservoir, a fuel conduit extending from the said reservoir to the air intake passage at a point between the air intake port and the throttle valve, a valve for controlling said passage and means for opening said valve as the throttle is closed.

5. A charge forming device for internal combustion engines having, in combination, a mixing chamber, fuel and air inlets therefor, an air passage having a main air intake, a throttle valve therein, means for injecting additional fuel for acceleration directly into the ingoing air on opening movement of the throttle and means for admitting other fuel for acceleration to the interior of the air passage adjacent and anterior to the throttle on closing movement thereof, whereby such fuel is available to enrich the mixture the instant said throttle valve starts to open.

6. A charge forming device for internal combustion engines having, in combination, a mixing chamber, fuel and air inlets therefor, a throttle valve, an air passage having a main air intake port, a valve therein, a dash pot for retarding the opening movement of said valve to provide additional fuel for enriching the mixture on acceleration at low speeds, and a suction operated pump for supplying additional fuel to enrich the mixture on acceleration at high speeds, said pump comprising a chamber and two fuel delivery passages connecting said chamber and the main intake passage at two separated points therein.

7. A charge forming device for internal combustion engines having, in combination, a mixing chamber, fuel and air inlets therefor, a throttle valve, an air passage having a main air intake port, a valve therein, a dash pot for retarding the opening movement of said valve to provide additional fuel for enriching the mixture on acceleration at low speeds, and a suction operated pump for supplying additional fuel to enrich the mixture on acceleration at high speeds, said pump comprising a chamber and two fuel delivery passages connecting said chamber and the main intake, one of said passages terminating adjacent the main air valve and the other of said passages terminating between the main air valve and the throttle valve.

8. A charge forming device for internal combustion engines having, in combination, a mixing chamber, fuel and air inlets therefor, a throttle valve, an air passage having a main air intake port, a suction operated fuel pump for supplying additional fuel to enrich the mixture on acceleration, said pump comprising a liquid chamber, a suction passage controlling the pump and connecting with the main air passage posterior to the throttle, a plurality of delivery passages com-

communicating with the liquid chamber, one of said passages conducting fuel to the air intake port, another of said passages conducting fuel to a fuel well, and a fuel passage connecting said well and the main air intake passage posterior to the said intake port.

9. A charge forming device for an internal combustion engine having, in combination, a mixing chamber, fuel and air inlets therefor, a main air intake passage, a throttle valve therein, a suction operated fuel pump for supplying fuel to enrich the mixture, said pump comprising a liquid chamber, a flexible bellows therein, a supplementary fuel reservoir, a plurality of fuel delivery passages connecting the liquid chamber with the air intake passage anterior to the throttle and with the fuel reservoir, and a suction passage connecting the interior of the bellows with the air passage posterior to the throttle.

10. A charge forming device for an internal combustion engine having, in combination, a mixing chamber, fuel and air inlets therefor, a main air intake passage, a throttle valve therein, a suction operated fuel pump for supplying fuel to enrich the mixture, said pump comprising a liquid chamber, a flexible bellows therein, a supplementary fuel reservoir, a plurality of fuel delivery passages connecting the liquid chamber with the air intake passage anterior to the throttle and with the fuel reservoir, a suction passage connecting the interior of the bellows with the air passage posterior to the throttle whereby the bellows is expanded on opening movement of the throttle to pump fuel through the delivery passages, a conduit connecting the reservoir and the air passage, a valve controlling said conduit and means for opening the valve on closing movement of the throttle to permit fuel to flow from said reservoir to the air passage.

11. A charge forming device for a multi-cylinder internal combustion engine having a plurality of intake ports, comprising a main air manifold having a plurality of outlet branches associated with said intake ports and a single main air intake passage for supplying air to such of said branches, a plurality of primary carburetors, fuel and air inlets therefor, means for connecting one of said primary carburetors with each branch of said manifold, means for providing additional fuel to enrich the fuel mixture for acceleration, said means comprising a suction operated fuel pump and a plurality of fuel delivery passages connecting said pump with the main air intake passage at a plurality of points therein.

12. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel thereto, a main air valve for controlling the admission of air to the mixture passage, a secondary air passage having a valve therein adapted to be opened only under certain operating conditions, and means for supplying additional fuel during the acceleration period only comprising a plurality of fuel delivery conduits one of which delivers fuel at a point adjacent the main air valve and the other of which delivers fuel to the secondary air passage.

13. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel thereto, a main air valve for controlling the admission of air to the

mixture passage, a secondary air passage having a valve therein adapted to be opened only under certain operating conditions, and means for supplying additional fuel during the acceleration period only comprising a plurality of fuel delivery conduits one of which delivers fuel at a point adjacent the main intake valve and the other of which delivers fuel to the secondary air passage anterior to the valve therein.

14. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel thereto, a main air intake port having a valve therein for regulating the admission of air to the mixture passage, a secondary air passage receiving air from said main air intake port, a valve in said passage, means for opening said valve only under certain operating conditions, and means for supplying additional fuel during the acceleration period only, said means comprising a plurality of fuel delivery conduits, one of which delivers fuel at a point adjacent the main intake valve, and the other of which delivers fuel to the secondary air passage.

15. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel thereto, a main air valve for controlling the admission of air to the mixture passage, said main air valve being constructed to open under all conditions of operation other than idling, a secondary air passage having a valve therein adapted to be opened only under certain operating conditions, and means for supplying additional fuel during the acceleration period only comprising a plurality of fuel delivery conduits one of which delivers fuel at a point adjacent the main intake valve and the other of which delivers fuel to the secondary air passage.

16. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air to the secondary mixing chamber, fuel and air inlets for supplying fuel and air to the primary mixture passage, an air valve in said inlet controlling the flow of air therethrough, a secondary air passage for supplying air to the secondary mixing chamber, a valve in said passage for controlling the flow therethrough, and means for enriching the mixture during the acceleration period, said means comprising a plurality of fuel delivery conduits communicating with the primary air inlet adjacent the valve therein and the secondary air passage respectively.

17. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air to the secondary mixing chamber, fuel and air inlets for supplying fuel and air to the primary mixture passage, an air valve in said inlet controlling the flow of air therethrough, a secondary air passage for supplying air to the secondary mixing chamber, a valve in said passage for controlling the flow therethrough, and means for enriching the mixture during the acceleration period, said means comprising a plurality of fuel delivery conduits communicating with the primary air inlet adjacent the valve therein and the secondary air passage respectively anterior to the valve therein.

18. A charge forming device for internal combustion engines comprising a secondary mixing

chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air to the secondary mixing chamber, fuel and air inlets for supplying fuel and air to the primary mixture passage, an air valve in said inlet controlling the flow of air therethrough, a secondary air passage for supplying air to the secondary mixing chamber, a valve in said passage for controlling the flow therethrough, means for enriching the mixture during the acceleration period, said means comprising a plurality of fuel delivery conduits communicating with the primary air inlet adjacent the valve therein and the secondary air passage respectively, and a valve in the last named conduit normally preventing a flow of fuel therethrough.

19. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air to the secondary mixing chamber, fuel and air inlets for supplying fuel and air to the primary mixture passage, an air valve in said inlet controlling the flow of air therethrough, a secondary air passage for supplying air to the secondary mixing chamber, a valve in said passage for controlling the flow therethrough, means for enriching the mixture during the acceleration period, said means comprising a plurality of fuel delivery conduits communicating with the primary air inlet adjacent the valve therein and the secondary air passage respectively, a valve in the last named conduit normally preventing a flow of fuel therethrough, and means for opening the valve in the fuel delivery conduit as the valve in the secondary air passage is closed.

20. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air to the secondary mixing chamber, a primary throttle controlling the flow through said mixture passage, fuel and air inlets for supplying fuel and air to the primary mixture passage, an air valve in said inlet controlling the flow of air therethrough, a secondary air passage for supplying air to the secondary mixing chamber, a valve in said passage for controlling the flow therethrough, means for enriching the mixture during the acceleration period, said means comprising a plurality of fuel delivery conduits communicating with the primary air inlet adjacent the valve therein and the secondary air passage respectively, a valve in the last named conduit normally preventing a flow of fuel therethrough, and means operated by the primary throttle for opening the valve in the fuel delivery conduit.

21. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air to the secondary mixing chamber, fuel and air inlets for supplying fuel and air to the primary mixture passage, a primary throttle controlling said primary mixture passage, an air valve in said inlet controlling the flow of air therethrough, a secondary air passage for supplying air to the secondary mixing chamber, a valve in said passage for controlling the flow therethrough, means for enriching the mixture during the acceleration period, said means comprising a plurality of fuel delivery conduits communicating with the primary air inlet adjacent the valve therein and the secondary air passage respectively, a valve in the last named conduit normally preventing

a flow of fuel therethrough, and means operated by the primary throttle on its closing movement for opening the valve in the fuel delivery conduit.

22. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air to the secondary mixing chamber, fuel and air inlets for supplying fuel and air to the primary mixture passage, a primary throttle controlling said primary mixture passage, an air valve in said inlet controlling the flow of air therethrough, a secondary air passage for supplying air to the secondary mixing chamber, a valve in said passage for controlling the flow therethrough, means for enriching the mixture comprising a plurality of fuel delivery conduits communicating with the air inlet adjacent the valve therein and the secondary air passage respectively, and means for forcing fuel through the first named conduit on opening movement of the throttle and enabling a flow of fuel through the second named conduit on closing movements of the throttle.

23. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air to the secondary mixing chamber, fuel and air inlets for supplying fuel and air to the primary mixture passage, a primary throttle controlling said primary mixture passage, an air valve in said inlet controlling the flow of air therethrough, a secondary air passage for supplying air to the secondary mixing chamber, a valve in said passage for controlling the flow therethrough, means for enriching the mixture comprising a plurality of fuel delivery conduits communicating with the air inlet adjacent the valve therein and the secondary air passage respectively, a fuel reservoir communicating with the conduit connecting with the secondary air passage, and a pump operative to inject fuel into the air inlet and to simultaneously supply fuel to the reservoir.

24. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air to the secondary mixing chamber, fuel and air inlets for supplying fuel and air to the primary mixture passage, a primary throttle controlling said primary mixture passage, an air valve in said inlet controlling the flow of air therethrough, a secondary air passage for supplying air to the secondary mixing chamber, a valve in said passage for controlling the flow therethrough, means for enriching the mixture comprising a plurality of fuel delivery conduits communicating with the air inlet adjacent the valve therein and the secondary air passage respectively, a fuel reservoir communicating with the conduit connecting with the secondary air passage, and a pump operative on opening movement of the throttle to inject fuel into the air inlet and to simultaneously supply fuel to the reservoir.

25. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air to the secondary mixing chamber, fuel and air inlets for supplying fuel and air to the primary mixture passage, a primary throttle controlling said primary mixture passage, an air valve in said inlet controlling the flow of air therethrough, a secondary air passage for supplying air to the secondary mixing chamber, a valve in said passage for con-

trolling the flow therethrough, means for enriching the mixture comprising a plurality of fuel delivery conduits communicating with the air inlet adjacent the valve therein and the secondary air passage respectively, a fuel reservoir communicating with the conduit connecting with the secondary air passage, a pump operative on opening movement of the throttle to inject fuel into the air inlet and to simultaneously supply fuel to the reservoir, and means operative on closing movement of the throttle to permit fuel to flow from the reservoir into the secondary air passage.

26. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air to the secondary mixing chamber, a primary throttle controlling the flow through said mixture passage, fuel and air inlets for supplying fuel and air to the primary mixture passage, a valve in said air inlet adapted to open under all operating conditions except idling, a secondary air passage supplying air to the secondary mixing chamber, a valve in said passage adapted to be opened only under certain operating conditions, and means for enriching the mixture during the acceleration period, said means comprising a plurality of fuel delivery conduits communicating with the primary air inlet adjacent the valve therein and the secondary air passage respectively.

27. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air to the secondary mixing chamber, a primary throttle controlling the flow through said mixture passage, fuel and air inlets for supplying fuel and air to the primary mixture passage, a valve in said air inlet adapted to open under all operating conditions except idling, a secondary air passage supplying air to the secondary mixing chamber, a valve in said secondary air passage, means for opening said valve only after a predetermined opening movement of the throttle, and means for enriching the mixture during the acceleration period, said means comprising a plurality of fuel delivery conduits communicating with the primary air inlet adjacent the valve therein and the secondary air passage respectively.

28. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air to the secondary mixing chamber, a primary throttle controlling the flow through said mixture passage, fuel and air inlets for supplying fuel and air to the primary mixture passage, a valve in said air inlet adapted to open under all operating conditions except idling, a secondary air passage supplying air to the secondary mixing chamber, a valve in said secondary air passage, means operated by the primary throttle for opening said valve after a predetermined opening movement of the throttle, and means for enriching the mixture during the acceleration period, said means comprising a plurality of fuel delivery conduits communicating with the primary air inlet adjacent the valve therein and the secondary air passage respectively.

29. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air to the secondary mixing chamber, a primary throttle controlling the flow through said mixture passage, fuel and air inlets for supplying fuel and

air to the primary mixture passage, a valve in said air inlet adapted to open under all operating conditions except idling, a secondary air passage supplying air to the secondary mixing chamber, a valve in said secondary air passage, means operated by the primary throttle for opening said valve after a predetermined opening movement of the throttle, and means for enriching the mixture during the acceleration period, said means comprising a plurality of fuel delivery conduits communicating with the primary air inlet adjacent the valve therein and the secondary air passage respectively, means for effecting the injection of fuel into the air inlet on opening movement of the throttle and the delivery of fuel to the secondary air passage on closing movement of said throttle.

30. A charge forming device for internal combustion engines, having in combination a mixing chamber, fuel and air inlets therefor, a throttle, a main air intake port, an air passage receiving air from said main air intake port, a fuel reservoir adapted to supply additional fuel for acceleration, a fuel inlet receiving fuel from said reservoir and supplying fuel to said air passage, a fuel pump operable on opening movements of the throttle to directly inject fuel into the air intake port and fill said fuel reservoir, and a valve operable on closing movements of the throttle to permit a flow of fuel from the reservoir.

31. A charge forming device for internal combustion engines, having in combination a mixing chamber, fuel and air inlets therefor, a throttle, a main air intake port, an air passage receiving air from said main air intake port, a fuel reservoir adapted to supply additional fuel for acceleration, a fuel inlet receiving fuel from said reservoir and supplying fuel to said air passage, a fuel pump operated by the throttle on opening movements thereof to directly inject fuel into the air intake port and a valve operated by the throttle on closing movements thereof to permit a flow of fuel from the reservoir.

32. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle, a main air intake port, an air passage receiving air from said main air intake port, a fuel reservoir adapted to supply additional fuel to the air passage during the acceleration period, a fuel pump operable on opening movements of the throttle to directly inject into the air intake port and to supply fuel to said fuel reservoir, and a valve operable on closing movements of the throttle to permit a flow of fuel from the reservoir to the secondary air passage.

33. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a main air intake port, a secondary air passage for supplying secondary air, a fuel inlet in said air passage, and a fuel pump comprising a chamber having a flexible bellows therein, and a plurality of fuel delivery conduits connecting said chamber with the air intake port and the fuel inlet in said air passage respectively.

34. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a main air intake port, a secondary air passage for supplying secondary air, a fuel reservoir adapted to supply additional fuel for acceleration, a fuel inlet in said air passage receiving fuel from said reservoir, and a fuel pump comprising a chamber having a flexible bellows therein, and a plurality of fuel

delivery conduits connecting said chamber with the air intake port and the fuel reservoir respectively.

35. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a main air intake port, a secondary air passage for supplying secondary air, a fuel inlet in said air passage, a fuel pump comprising a chamber having a flexible bellows therein, and a plurality of fuel delivery conduits connecting said chamber with the air intake port and the fuel inlet in said air passage respectively, and means for communicating the manifold vacuum to the bellows.
36. A charge forming device for internal combustion engines, having, in combination, a primary mixing chamber, a fuel inlet therefor, a throttle, a main air intake port, a secondary mixing chamber to which the primary mixing chamber supplies a primary mixture of fuel and air, a secondary air passage receiving air from said main air intake port and supplying air to the secondary mixing chamber, a fuel reservoir adapted to supply additional fuel for acceleration, a delivery passage connecting the reservoir with the secondary air passage, and a fuel pump operable on opening movements of the throttle to directly inject fuel into the air intake port and supply fuel to said fuel reservoir.
37. A charge forming device for internal combustion engines having, in combination, a mixing chamber, fuel and air inlets therefor, a main air intake port, a valve controlling said port, an air passage receiving air from said port, a throttle valve in said air passage, means operative only temporarily for supplying additional fuel to enrich the mixture during the acceleration period, said means comprising two fuel inlets, one of said inlets delivering fuel on the surface of the air

valve and the other of said inlets delivering fuel between the air valve and the throttle valve.

38. A charge forming device for internal combustion engines having, in combination, a mixing chamber, fuel and air inlets therefor, a main air intake port, an air passage receiving air from the main air intake port, a throttle valve therein, a fuel pump for directly injecting fuel into the air intake for acceleration, a fuel reservoir for supplying additional fuel to the air passage to enrich the mixture during the acceleration period, and a fuel passage connecting the pump with said reservoir, whereby the pump supplies fuel to the reservoir.

39. A charge forming device for internal combustion engines having, in combination, a mixing chamber, fuel and air inlets therefor, a main air intake port, an air passage receiving air from the main air intake port, a throttle valve therein, a fuel reservoir for supplying additional fuel to the air passage to enrich the mixture during the acceleration period, and a fuel pump operable on opening movement of the throttle to directly inject fuel into the air intake port and fill the said fuel reservoir.

40. A charge forming device for internal combustion engines having, in combination, a mixing chamber, fuel and air inlets therefor, a main air intake port, an air passage receiving air from said port, a throttle valve in said air passage, means operative only temporarily for supplying additional fuel to enrich the mixture during the acceleration period, said means comprising two fuel inlets, one of said inlets delivering fuel adjacent the air intake port, and the other of said inlets delivering fuel between the air port and the throttle valve.

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