

May 29, 1934.

F. D. FUNSTON ET AL

1,960,993

CHARGE FORMING DEVICE

Filed Aug. 2, 1929

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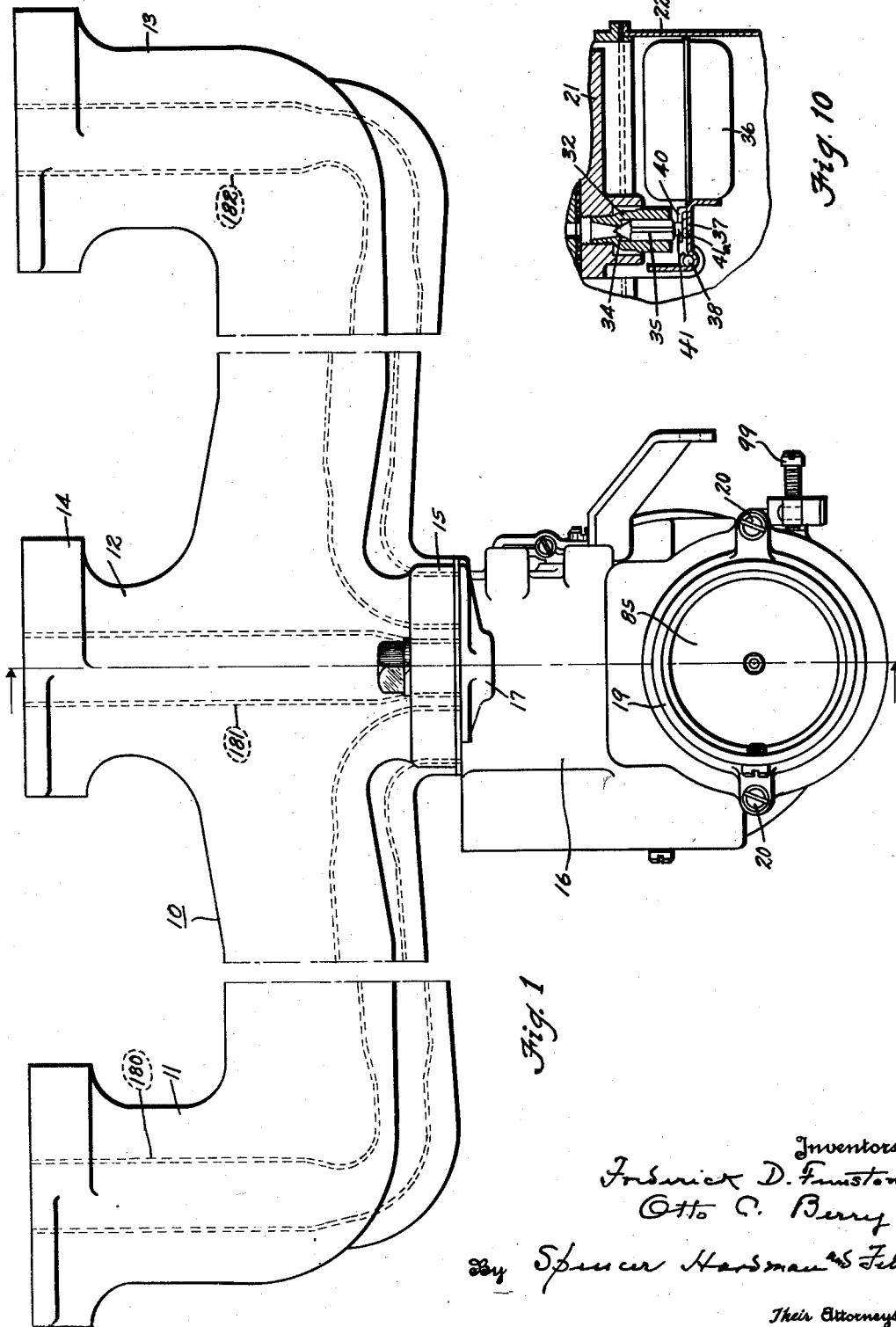


Fig. 1

Fig. 10

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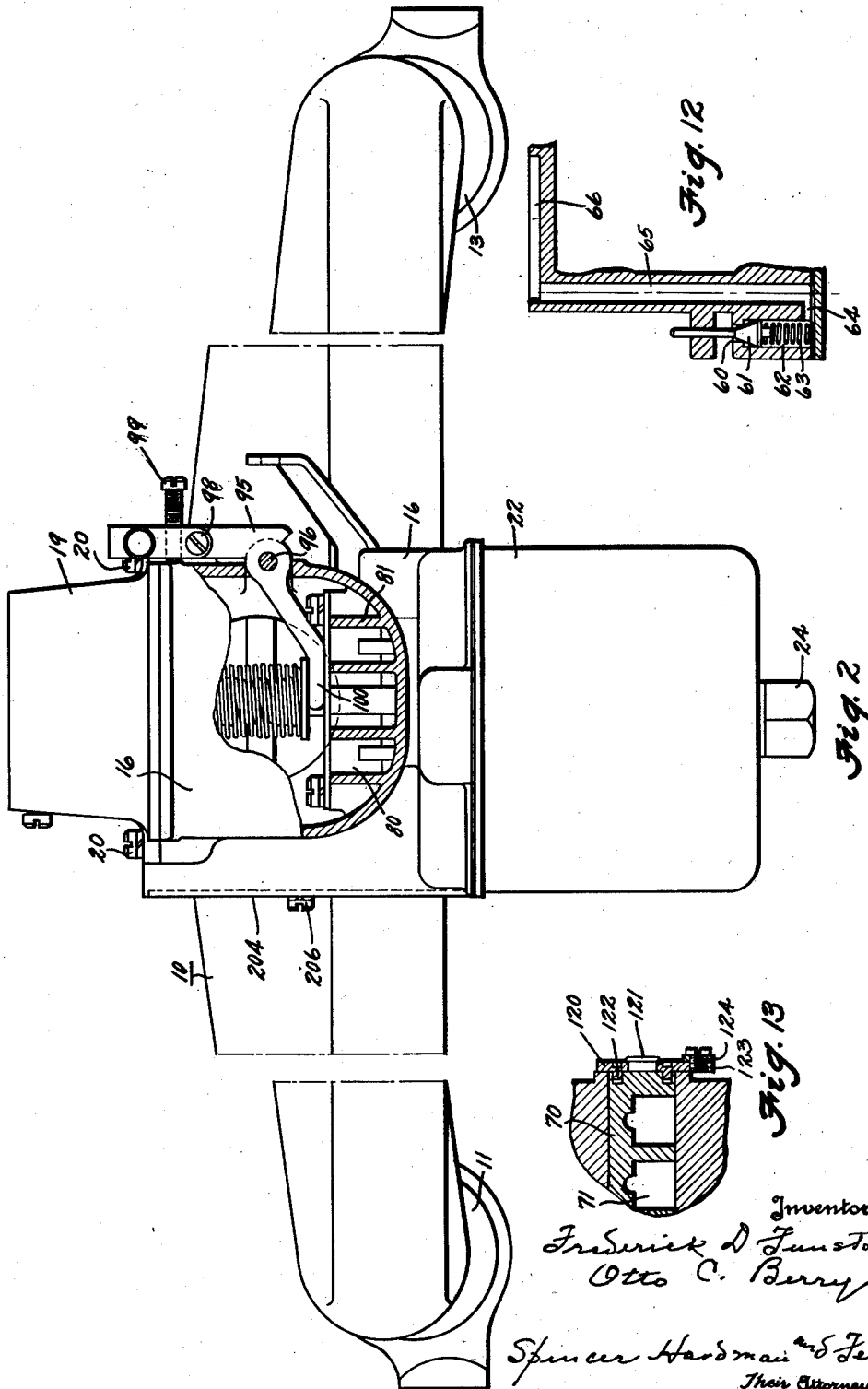
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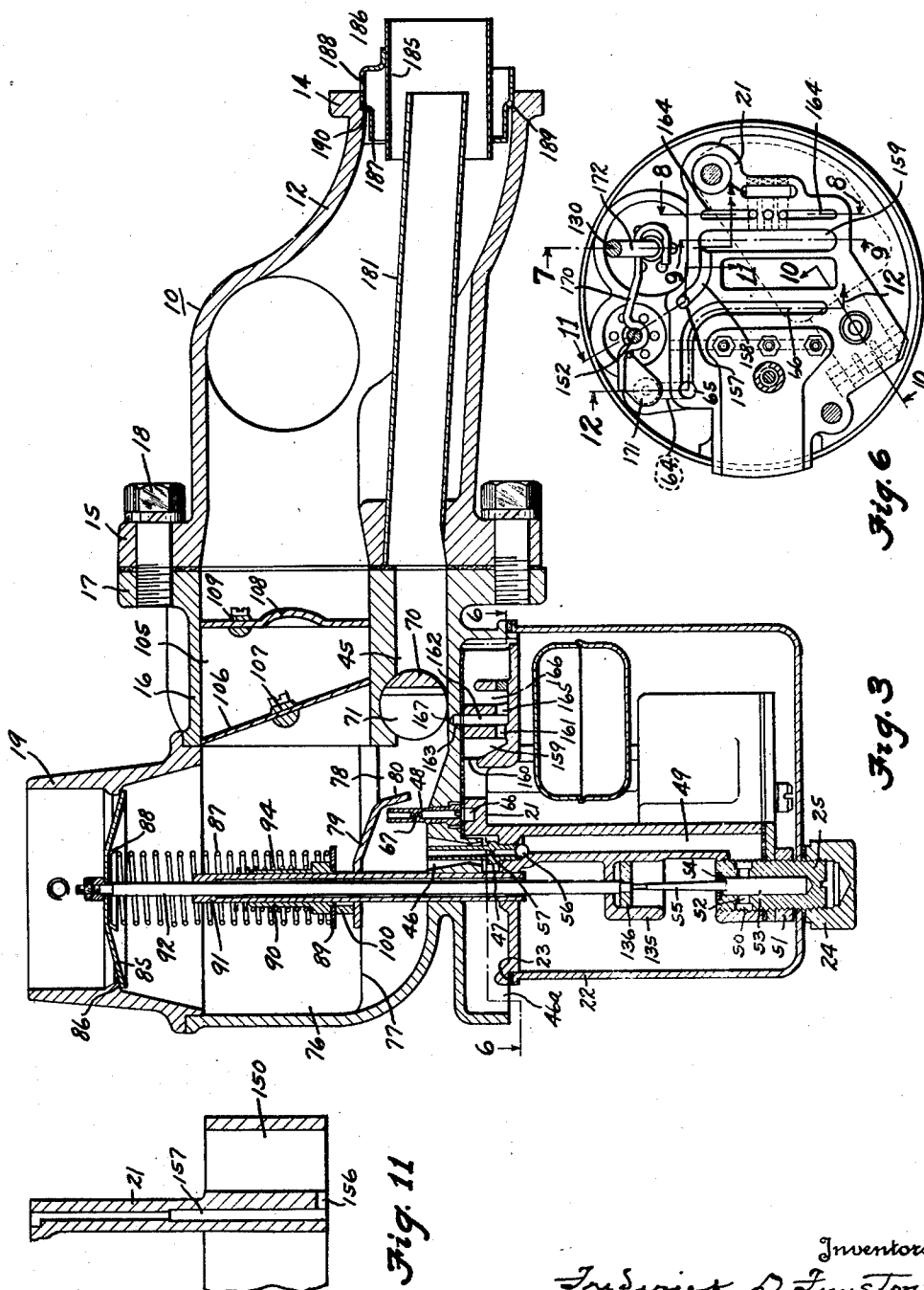
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CHARGE FORMING DEVICE

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5 Sheets-Sheet 4

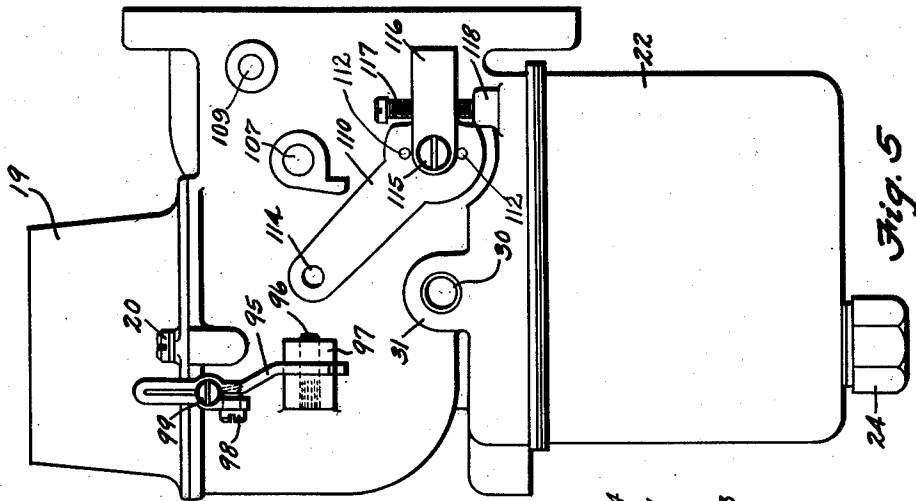


Fig. 5

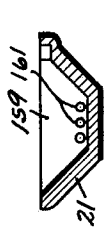


Fig. 9



Fig. 8

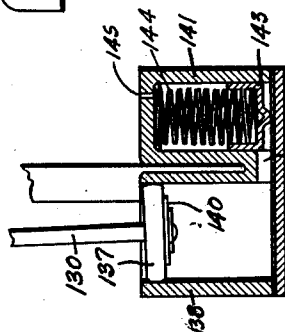


Fig. 7

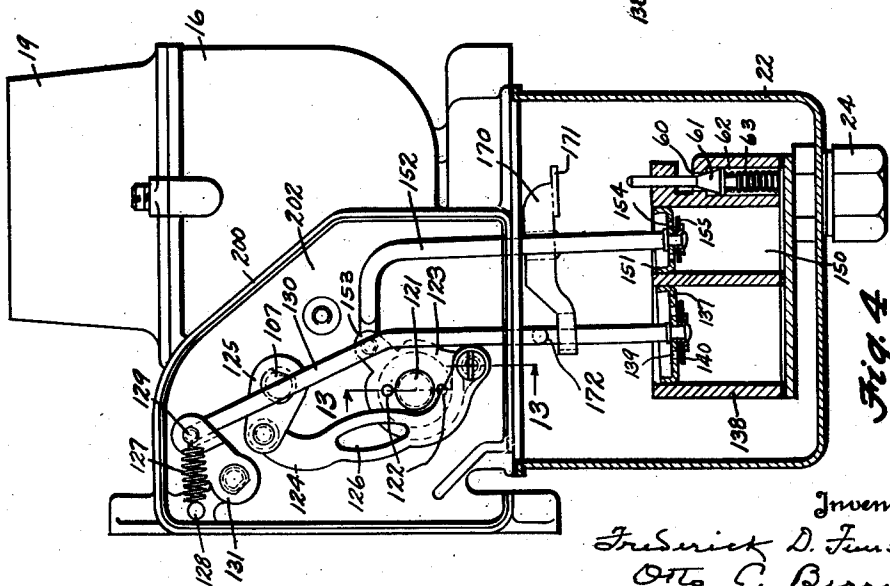


Fig. 4

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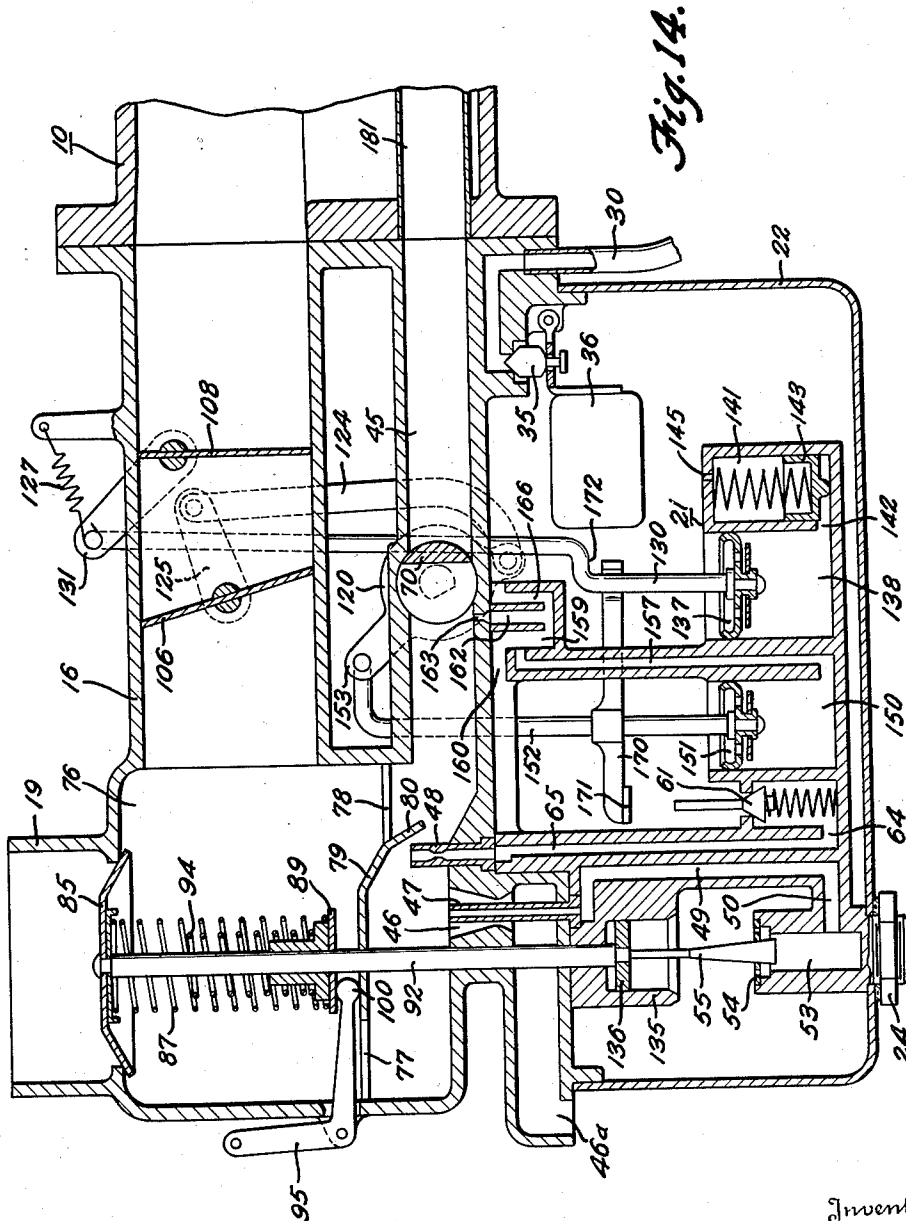
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5 Sheets-Sheet 5



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CHARGE FORMING DEVICE

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Application August 2, 1929, Serial No. 383,093

31 Claims. (Cl. 261-41)

This invention relates to charge forming devices for internal combustion engines, and most particularly to that type of charge forming device which comprises a plurality of primary carburetors, one for each intake port of the engine, which are adapted to deliver a primary mixture of fuel and air to a plurality of secondary carburetors located adjacent the engine intake ports, where additional air is mixed with the primary mixture before the latter enters the engine cylinders.

It is the principal object of the present invention to provide a charge forming device of the character above referred to, which is simple in construction and is improved in general design, particularly with respect to the means for controlling the supply of fuel and air under various operating conditions so as to provide a mixture of the proper quantity and quality under all operating conditions which may be met.

It is a further object of the invention to provide a device of this character which can be more readily and economically manufactured than earlier devices of a similar character.

With these general objects in view, one feature of the invention resides in the provision of novel means for supplying fuel to the primary mixing chambers, which consists of a plurality of fuel jets for each of said chambers, one of which jets is operable to supply fuel to the mixing chamber at all times and the flow of fuel from which is controlled by the velocity head at said fuel jets, while the other of said jets is operable only after the throttle has been opened a predetermined amount and the flow of fuel from which is controlled substantially by the static suction of the air chamber.

A further feature of the invention resides in the provision of novel means for regulating the supply of fuel to said fuel jets, which comprises a fuel valve operated by the main air valve so as to meter the fuel in accordance with the position of the said air valve.

Another feature of the invention resides in the provision of primary mixture passages, which communicate directly with the atmosphere and also with the main air chamber and a plurality of fuel jets in each primary mixture passage, one of which is positioned in that branch of the passage which communicates with the atmosphere.

A still further feature of the invention consists in the provision of a dashpot for preventing fluttering of the main air valve by means of which

both spring and closing movements of said air valve are retarded.

Another feature of the invention comprises improved means for controlling the operation of the throttle valves, auxiliary air valve and the fuel pump for enriching the mixture during acceleration, which is so constructed that a single operating member controls the opening of the throttle valves, is effective to operate the fuel pump and to close the auxiliary air valve.

A still further feature of the invention resides in the provision of a dashpot for controlling the opening movement of the auxiliary air valve, which is provided with a piston having its outer edge of spherical form so that said piston will not bind in its cooperating cylinder when the piston rod is not parallel to the axis of said cylinder, and a fuel pump having a piston of the same design.

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 embodiment of one form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a plan view of a charge forming device embodying this invention, the manifold being broken away in order to show the end portions thereof.

Fig. 2 is a side elevation of the device shown in Fig. 1 looking toward the engine and being broken away to show certain parts in section.

Fig. 3 is a vertical section on the line 3-3 of Fig. 1.

Fig. 4 is a side elevation of the main carburetor unit viewed from the left in Fig. 1 and showing certain parts in section, and having the cover plate over the throttle operating mechanism removed to show said mechanism.

Fig. 5 is a side elevation of the main carburetor unit viewed from the right in Fig. 1.

Fig. 6 is a horizontal section on the line 6-6 of Fig. 3.

Figs. 7, 8, 9, 10, 11, and 12 are all detail, fragmentary sections on the lines 7-7, 8-8, 9-9, 10-10, 11-11, and 12-12 of Fig. 6.

Fig. 13 is a detail section on the line 13-13 of Fig. 4.

Fig. 14 is a diagrammatic sectional view.

The device disclosed herein comprises a main air manifold 10, having three outlet branches 11, 12, and 13, each of which is adapted to communicate with one of the intake ports of a multicylinder engine. These branches are each pro-

vided with an attaching flange 14 which is adapted to be attached to the engine block in the usual way. Adjacent the inlet, the manifold is provided with a flange 15, to which the main carburetor unit hereinafter described, is adapted to be secured, as shown in Fig. 3.

The carburetor unit comprises the main housing 16 in the form of a single casting, having a flange 17 adapted to be secured by screws 18 to the flange 15. A valve-controlled air inlet coupling 19 is secured in position over an opening in the top of the housing by screws 20, as shown in Fig. 1, or in any other desirable manner. An air cleaner may be connected to the coupling if desired. A casting 21 in which the fuel supply passage and other fuel passages and dashpot chambers are formed as later described, is secured in any desirable way to the bottom of the main housing, a suitable gasket being provided between the castings to prevent leakage. A sheet metal fuel bowl 22 is held tight against an annular shoulder 23 on the bottom of the main casting in any suitable manner, for example, by means of the nut 24 threaded on a plug 25, which is screwed into the casting 21 and projects through the bowl as shown in Fig. 3. A gasket may be provided to prevent leakage around said plug.

A fuel supply line leading from a main source of fuel supply, is adapted to be connected with a passage 30 formed in a boss 31 projecting from the main housing, as shown in Figs. 5 and 10. The passage 30 is of angular form and screwed into the vertical portion of the said passage, is a nipple 32, as shown in Fig. 10. The passage through the nipple communicates with the passage 30 and is restricted at 34 to form a valve seat with which the fuel valve 35 cooperates. This valve is of square cross section, as shown in the drawings, so as to permit a flow of fuel to pass the valve when the latter is off its seat, and is controlled by a float 36, secured to an arm 37, mounted on a pin 38, rotatably mounted in the casting 21. The arm 37 to which the float is secured, has formed integrally therewith, two projecting lugs 40 extending substantially parallel to the arm 37, and forming a slot therebetween in which engages a reduced neck 41 formed on the fuel valve between the body portion 35 and an enlarged head 41a, which lies between the lugs 40 and arm 37, when the device is assembled. The float operates in the usual manner to maintain a substantially constant fuel level in bowl 22.

A plurality of mixture passages indicated in their entirety by the reference character 45 and hereinafter more fully described, are formed in the lower part of the main housing 16. These mixture passages communicate with the external atmosphere through passages 46 leading to a primary air inlet 46a and also with a main air chamber more fully described hereinafter. Supplying fuel to each mixture passage are two fuel nozzles 47 and 48, which project into the branch passage 46 and the mixture passage 45 respectively. The nozzle 47 is effective to supply fuel to the mixture passage at all engine speeds and at all open positions of the throttle, while the nozzle 48 is effective to supply fuel to the mixture passage only after the primary throttle has been opened a predetermined amount and the engine is running at a predetermined speed.

Fuel is supplied to the nozzle 47 by a vertical passage 49, formed in the casting 21 and communicating at its lower end with an annular

channel 50 formed in the plug 25, which is screwed into the casting 21 and held in any adjusted position by a lock nut 51. The channel 50 communicates with orifices 52, which connect with a vertical bore 53 in the plug 25. This bore is restricted at its upper end by a perforated disk 54, received in the recess formed in the top of the plug 25 and surrounding a fuel valve 55 formed on the bottom of the main air valve stem, as more fully set forth hereinafter. As the air valve is moved to different positions, the valve 55 is moved correspondingly to variably control the amount of fuel flowing from fuel bowl 22 into the bore 53, from which it passes through the orifices 52, the channel 50 and the vertical passage 49 to a horizontal channel 56 communicating with all of the fuel nozzles 47. Each fuel nozzle 47 is provided with a fuel metering restriction 57.

Fuel is supplied to the nozzles 48 on relatively high speeds through a port 60 controlled by a valve 61, which is received in a bore 62 in the casting 21 and is normally held in closed position by means of a spring 63, received in said bore. A horizontal passage 64 connects the bore with a vertical passage 65 leading to a horizontal channel 66 formed in the top of the casting 21 and communicating with all of the nozzles 48. Each of said nozzles 48 is provided with a fuel metering restriction 67. The valve 61 is opened by means hereinafter described in detail, when the throttle has reached a relatively wide open position, for example, that position normally occupied by the throttle when the engine is running at a speed corresponding approximately to a vehicular speed of 50 to 55 miles per hour on a level.

At all positions of the throttle between fully closed position and that above referred to, the nozzles 47 are effective to supply all of the fuel to the mixture passages. The fuel supplied by the nozzles 47 is mixed with air admitted through the passage 46, while the fuel supplied by the nozzles 48 is mixed with air supplied to the primary mixture passage from the main air chamber and with the mixture supplied to passages 45 from the passages 46. The primary mixture thus formed is conveyed by primary mixture conduits hereinafter described, to the secondary mixing chambers where, under certain operating conditions, it is mixed with additional air to form a mixture of the desired proportions and quantity to operate the engine under those conditions. The primary mixture passages are controlled by a single throttle valve 70, which extends across all of the primary mixture passages and is provided with grooves 71 which register with said passages. As above set forth, the primary mixture passages 45 communicate with the external atmosphere by means of passages 46, which are in the form of three Venturi tubes, each of which surrounds one of the fuel nozzles 47 and increases the velocity of air flow past said nozzle, to better atomize the fuel issuing therefrom. The primary mixture passages also communicate with a main air chamber 76 by means of orifices 77 and 78, positioned anterior and posterior to the nozzles 48 respectively. Between these orifices, and extending horizontally, is a partition plate 79 having its posterior edge bent downwardly and provided with three projections 80 which project into the primary mixture passages immediately in advance of the nozzles 48 so as to restrict the area of said passages at this point for the purpose of sufficiently reducing the velocity of air

flow at the nozzles 48, to prevent formation of a velocity head at these nozzles, and to maintain at such nozzles the static-suction of the air chamber. The orifices 77 and 78 communicate with all three of the primary mixture passages, which are separated from each other by vertical partitions 81 integral with the main housing, as shown in Fig. 2.

The major portion of the air supplied to the primary mixing chambers is admitted through the air inlet coupling 19 and is controlled by means of a valve 85, normally held against its seat 86 by a spring 87 received between a cup-shaped member 88, secured to the valve stem immediately below the valve, and a flange 89, projecting from a sleeve 90, slidably mounted on a fixed sleeve 91, which is secured in any desirable manner in the main housing and provides a guide for the valve stem 92. Under normal operating conditions, the sleeve 90 occupies the position shown in Fig. 3, but may be lifted from this position by means of the choke mechanism to compress the spring 87 in order to increase the resistance offered by the spring to opening of the air valve. Surrounding the sleeve 90 is another spring 94 which is much stronger than the spring 87. This spring may be moved into engagement with the air valve by the choke mechanism when the latter is fully operated to hold the air valve completely closed and facilitate starting.

The choke mechanism comprises a bell crank lever 95 pivoted on a pin 96, screwed into a boss 97, formed on the outside of the main housing. The upper end of the choke lever is bent over as indicated in Fig. 5, and the two ends of the lever are held together by means of a screw 98. A suitable operating connection may be clamped between the two parts of said lever and extend to a point convenient to the operator of the vehicle. A stop screw 99 engages threads on the inner surfaces of the parts of the lever and is adapted to contact with the main housing to determine the normal inoperative position of said lever. By adjusting the screw to different positions, the normal pressure of the spring 87 on the air valve may be regulated as desired. One arm of the lever 95 projects through the wall of the main housing and is provided with a toe 100, which lies beneath the flange 89 and lifts the flange as previously described, when the lever is moved in a clockwise direction, as in Fig. 2.

In this device sufficient air to carry the starting fuel from the nozzles 47 to the engine intake ports when the choke mechanism is operative, is admitted through the passage 46. The valve 85 admits air directly to the main air chamber 76, which supplies air to the primary mixture passages through orifices 77 and 78. Air also flows from the main air chamber to the secondary mixing chambers through a main air conduit 105, controlled by a manually operable valve 106, secured in any desirable manner to a shaft 107, rotatably mounted in the main housing and a suction operated valve 108, secured to a shaft 109, which is positioned off center with respect to the valve and is also journaled in the main housing. The operating mechanism for these valves will be described hereinafter. During operation at all engine speeds below a predetermined speed, for example, that corresponding to a vehicular speed of 20-25 miles per hour on the level, the mixtures supplied to the engine by the primary mixture passages is of properly combustible proportions and is conveyed to the engine without mixture with additional air in the secondary mixing

chambers. At higher engine speeds than this, the valves controlling the flow of air through the secondary air passage are open to supply additional air and increase the quantity of mixture supplied to the engine.

The valve 106 is operated by the primary throttle operating means after said primary throttle has made a certain predetermined amount of independent movement, subsequent to which the valve 106 is moved simultaneously with said primary throttle. To this end the primary throttle is provided with an operating arm 110, fitted on a spindle projecting from one end of the said throttle and provided with two projecting pins 112 on its rear face, which are received in corresponding recesses in the end of the throttle, to prevent movement of said arm relative to the throttle when the parts are assembled. The arm 110 is provided with a hole 114 in its free end in which some suitable operating connection extending to a point convenient to the operator may be attached. Secured to the end of the aforementioned spindle by a screw 115, is an arm 116, which prevents movement of the arm 110 longitudinally of the throttle and also supports a stop screw 117, adapted to engage a lug 118, formed on the main housing to determine the closed position of the throttle. By adjusting the screw 117, the idling speed of the engine may be regulated as desired.

On the other end of the primary throttle is an operating plate 120, which is received on a short stub shaft or spindle 121, projecting from the end of the throttle and is secured thereon by riveting the end of the shaft or in any other suitable way. The plate is provided with pins 122 similar to the pins 112 which are received in recesses in the same manner to prevent rotating movement of the plate 120 relative to the throttle. Pivotaly connected to an ear 123 projecting from the plate is a link 124, the upper end of which is pivotally connected to arm 125 secured in any desirable manner to the end of the shaft 107, so as to move the arm 125 simultaneously with the operating plate 120 in the following manner. The parts are so arranged that when the primary throttle 70 is moved toward open position from its substantially closed position, the point of connection of the link 124 with the ear 123 moves in a clockwise direction, as viewed in Fig. 4, and during the first part of the throttle movement this point of connection moves in the arc of a circle, substantially the same as that the center of which is the point of connection of the link 124 with the arm 125, so that while moving in this arc there will be no movement of the said point of connection nor of the arm 125. After the movement above described, when the primary throttle has moved through a predetermined distance, the point of connection of the link 124 with the arm 125 no longer moves in an arc concentric with said point of connection, but its movement is effective to move the ear 123 in a clockwise direction and thus move the valve 106 toward its open position. The pivotal connections of the link 124 with the plate 120 and the arm 125 are sufficiently loose to prevent binding of the parts during the throttle movements. Closing or counter-clockwise movement of the primary throttle and the plate 120 will obviously move the valve 106 to closed position. It will be noted that a slot 126 is formed in the operating link 124, as shown in Fig. 4, for the purpose of slightly varying the length of the link in order to improve the operation of the parts. By inserting a suitable tool in the

slot, the slot may be widened, which will slightly shorten the link 124.

The valve 108 is opened entirely by engine suction, but until the valve 106 is opened, as previously described, said valve 108 is held closed by a spring 127 connected at one end to a pin 128, projecting from the housing and at its other end to the bent over end 129 of a link 130, projecting through the arm 131 which is secured in any desirable way to the shaft 109. As the valve 106 is opened, the pressure differential between the two sides of the valve 108 is sufficient to overcome the resistance of the spring above described and that of a dashpot, which will be described hereinafter, and open the valve 108. The valve 108 is adapted to be closed by the action of the spring and by a positively actuated closing means, which will be described later.

On opening movement of either or both the throttles 70 and 106, the suction in the air chamber 76 is increased and the main air valve 85 is opened against the pressure of its controlling spring to permit an increased flow of air past said valve. It has been found that during opening movements of the valve, it will flutter if allowed to open freely, and to prevent fluttering, a dashpot of ordinary conventional form is provided to control the motion of said valve. The dashpot comprises a cylinder 135 formed in the casting 21, closed at the top and open at the bottom as indicated in Fig. 3. A piston 136 is secured to the lower end of the stem 92 in any desired manner and slides within the cylinder 135, having a substantially tight fit to retard the motion of the air valve in either direction sufficient to hold the valve steady. The cylinder of this dashpot, being submerged in the fuel within the fuel bowl, is adapted to be filled with fuel by leakage around the piston. When the throttle is sufficiently open to cause the engine to run at high speed, the air valve is opened far enough to move the piston 136 below the cylinder 135, so that at high speeds the dashpot is ineffective to retard the movement of the valve.

On opening of the throttle, it has been found necessary to provide a somewhat enriched mixture in order to properly operate the engine during the acceleration period for reasons which are well-known to those skilled in this art. For this purpose, the device disclosed herein is provided with a fuel pump operated by the primary throttle and designed to temporarily supply additional fuel to the primary mixture passages as hereinafter described. It has also been found necessary in order to secure the desired mixture enrichment, to provide means for retarding the opening of the valve 108 during opening movements of the main air throttle 106. This is necessary in order to produce a sufficient pressure differential between the ends of the primary mixture conduits to create a velocity of flow through these conduits sufficient to transport the enriched primary mixture from the fuel nozzles to the secondary mixing chambers almost instantaneously. It is a considerable distance from the nozzles to the secondary mixing chambers where the primary mixture is mixed with air flowing through passage 105, and if the valve 108 be permitted to open freely, an appreciable time interval would be necessary for the rich and relatively heavy primary mixture to travel through this distance, obviously a greater time interval than that required for pure air to travel from the air throttle 106 to said secondary mixing chamber. By retarding the opening of the valve 108, the time interval

required by the primary mixture to reach the secondary mixing chambers is reduced, while that required for pure air to reach said chambers is increased, in fact these intervals are substantially equalized with the result that the enriched primary mixture and secondary air reach the secondary mixing chambers at substantially the same time.

In order to retard the opening movement of the valve 108, the link 130, hereinbefore referred to, is connected at its lower end in any desirable way to a dashpot piston 137, which is slidable in a cylinder 138, formed in the casting 21. The piston is provided with holes 139, permitting a flow of fuel thereto as the piston moves upwardly and a check valve 140 to prevent the passage of fuel through the piston on its downward movement. It will be obvious that upward movement of the piston is substantially unretarded, while downward movement, which takes place on opening of the valve 108, is retarded to delay the opening of said valve. In order to regulate the retarding effect of the above described dashpot so as to retard the opening of the valve to substantially the same extent whatever the position of the valve may be when its opening movement begins, an auxiliary cylinder 141 is provided which is formed in the casting 21 immediately adjacent the cylinder 138, and is connected therewith by a passage 142 at the bottom of the cylinder. Sliding within the cylinder is a piston 143, which is normally held in the position shown in Fig. 7 by a spring 144, received between the piston and the top of the cylinder. On downward movement of the piston 137, the auxiliary piston 143 is lifted by the pressure which is applied to the fuel beneath said piston by the dashpot piston. The fuel above the piston 143 is forced out of the cylinder during the upward movement of said piston through a small hole 145 in the top of the cylinder and the rate of escape of fuel through this orifice determines the retarding effect of the dashpot on the valve 107. After the valve has completed any opening movement, the spring 144 forces the piston 143 downwardly until it occupies the position it occupied at the beginning of the opening movement of said valve and the cylinder 141 is filled with fuel from the reservoir, which flows into said cylinder through the orifice 145. It should be clear, therefore, that the piston 143 always occupies the same position at the beginning of any opening movement of the valve 107, so that the retarding effect of the dashpot on the valve is substantially the same for every opening movement thereof.

According to this invention, the pump for supplying additional fuel to the primary mixture passage is operated by the primary throttle during its opening movement. The pump comprises a cylinder 150 formed in the casting 21, and a piston 151 slidable therein. The piston is operated by a rod 152, pivotally connected to an ear 153, projecting from the operating plate 120. The rod 152 is connected to the piston in any suitable manner and the piston is provided with holes 154 therethrough, which are closed by a check valve 155 to permit free upward movement of the piston by preventing passage of the fuel through the piston on its downward movement so that during such downward movement fuel is forced through a horizontal passage 156 at the bottom of the pump cylinder to a fuel delivery passage 157, which connects at its upper end with a horizontal channel 158, leading to a fuel well 159, formed in the top of the casting 21 and communicating with the

atmosphere through the relatively large opening 160. A passage 161 leads from the well to three vertical passages 162, the middle one of which communicates directly with a vertical passage 163 opening into the primary mixture passage at the point immediately anterior to the primary throttle. The two outer passages 162 communicate with horizontal channels 164, formed in the top of the casting 21, as shown in Fig. 6. These passages at their outer ends, communicate with the two outer passages 163 supplying fuel to the two outer primary mixture passages. Air is admitted to each of the passages 162 through horizontal passages 165 connecting with the lower ends of the passages 162, and also communicating with an air inlet well 166, which, at its upper end communicates directly with the space above the fuel level in the chamber 22, as shown in Fig. 3. The air admitted through the passage 160 maintains atmospheric pressure in the well 159, while the air admitted through the passages 165 is mixed with the fuel flowing through the passages 162 to form an emulsion of fuel and air which is drawn into the primary mixture passages through the passages 163. This air is admitted primarily for the purpose of preventing the building up of sufficient suction in the various fuel delivery passages between the pump cylinder and the mixture passages to draw fuel from the pump cylinder by suction, whereby the fuel is only delivered to the mixture passages on operation of the pump. Each of the vertical passages 163 is provided with restriction 167 adjacent its outlet to regulate the flow of fuel.

The operating rod 152 is employed to operate the valve 61, which controls the high speed fuel inlet and also is effective to positively close the auxiliary air valve 108. For these purposes an arm 170 having an ear 171 projecting therefrom is secured to the rod 152 by welding or in any other desirable manner. The ear 171 extends over the end of the valve 161 so that when the throttle is opened through a predetermined distance, the ear engages and opens said valve to supply fuel to the nozzles 48.

At the opposite end of the arm 170, it is bent, as indicated in Fig. 6, and extends around the rod 130 a short distance below a horizontal bend 172 in said rod. It will be obvious that on closing movement of the throttle, the arm 170 is lifted and engages the bend 172 to positively close the valve 108.

It will be noted that the rods 130 and 152 are not actually coaxial with the cylinders 138 and 150 respectively. Accordingly, pistons of cylindrical cross section would bind in their cylinders during the reciprocation of such pistons. To prevent this difficulty, the pistons 137 and 151 are formed with the outer surface of such pistons of spherical form, as indicated clearly in Figs. 4, 7 and 14. By using pistons of this design, the operating rods for such pistons may assume any angular position with respect to the cooperating cylinders without interfering with the free operation of the pistons.

The primary mixture passages 45 register with three primary mixture tubes 180, 181 and 182, as shown in Fig. 1. These tubes are formed of sheet metal and are positioned in the intake manifold, as indicated in Fig. 1, terminating at one end at the flange 15, where the manifold is attached to the carburetor unit and at the other end at a point adjacent the intake ports. The tubes extend through the outlet branches 11, 12 and 13,

and are cast in position in said manifold during the casting of the latter.

The secondary mixing chambers are located adjacent the outlet ends of the primary mixture conduits above described, and comprise means for accelerating and straightening the flow of air past the ends of said tubes. This means comprises an inner tube 185, which is spaced from the primary mixture tube and is secured by a spider 186 to an outer tube 187, which is provided with an enlargement 188, forming a shoulder 189, where it joins with the smaller portion. When the device is assembled, the shoulder 189 is adapted to engage the shoulder 190 formed in the outlet branch of the manifold and the other end of the enlarged portion 188 engages a similar shoulder in the engine block. The primary mixture conduits terminate about midway of the length of the inner tube so that air moving past the end of each conduit is compelled to move in a substantially straight path, while the tubes above described, restrict the outlet branches of the manifold to some extent and thereby accelerate the flow at the ends of the primary mixture conduits. This restriction is not as great as in early forms of this device where Venturi tubes have been employed surrounding the outlets of the primary mixture conduits. For this reason, there is less tendency to reduce the volumetric efficiency by the restriction of flow adjacent the engine ports.

It will be observed that the main housing 16 is provided with a wall 200 projecting therefrom on the left side, as viewed in Figs. 1 and 2. The space within the wall, indicated by the reference numeral 202, constitutes a chamber in which the operating mechanism for the valves 106 and 108 is housed. A cover plate 204 is held in engagement with the wall 200 by a screw 206 passing through said cover plate and adapted to be screwed into the main housing. The valve operating mechanism is in this way housed in a substantially fully closed chamber, in which it is protected from dirt and accidental damage.

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 comprising a mixing chamber, an air inlet chamber supplying air thereto, a plurality of fuel inlets for supplying fuel to said mixing chamber, means for effecting a flow of fuel from one of said fuel inlets by the velocity head produced by the flow of air past the said inlet, and means including a member for deflecting the flow through the mixing chamber so as to reduce its aspirating effect on the other of said fuel inlets, said member also reducing the effective cross-sectional area of the mixing chamber immediately adjacent to said other fuel inlet, whereby substantially the static suction of the air chamber is maintained at said other fuel inlet.

2. A charge forming device for internal combustion engines comprising a mixing chamber, an air inlet chamber supplying air thereto, a plurality of fuel inlets for supplying fuel to said mixing chamber, means for effecting a flow of fuel from one of said fuel inlets by the velocity head produced by the flow of air past the said inlet, means for maintaining at the other of said fuel inlets substantially the static suction

of the air chamber, said last mentioned means including a member for deflecting the flow through the mixing chamber so as to reduce its aspirating effect on said other fuel inlet and said member also reducing the effective cross-sectional area of the mixing chamber immediately adjacent to said other fuel inlet, and means for rendering said other fuel inlet effective only at high speeds.

3. A charge forming device for internal combustion engines comprising a mixing chamber, an air inlet chamber supplying air thereto, low and high speed fuel inlets for supplying fuel to said mixing chamber, means for creating a velocity head at the low speed fuel inlets and means for effecting flow of fuel from the high speed inlet in accordance with the static suction of the air chamber, said last mentioned means including a member for deflecting the flow through the mixing chamber so as to reduce its aspirating effect on the high speed fuel inlet and said member also reducing the effective cross-sectional area of the mixing chamber immediately adjacent to said high speed fuel inlet.

4. A charge forming device for internal combustion engines comprising a mixing chamber, an air inlet chamber supplying air thereto, a plurality of fuel inlets for supplying fuel to said mixing chamber, means for effecting a flow of fuel from one of said fuel inlets by the velocity head produced by the flow of air past the said inlet, means for maintaining at the other of said fuel inlets substantially the static suction of the air chamber, and means for controlling the flow of fuel to said first mentioned fuel inlet in accordance with said air chamber suction.

5. A charge forming device for internal combustion engines comprising a mixing chamber, an air valve controlling admission of air thereto, a throttle regulating the flow of mixture therefrom, a passage communicating with said mixing chamber and with the atmosphere, a fuel inlet located in said passage to provide fuel for operation at relatively low and intermediate speeds, said fuel inlet being so located in said passage that a velocity head is created at the outlet of said fuel inlet by the flow of air through said passage, an auxiliary fuel inlet communicating directly with the mixing chamber for supplying fuel at high engine speeds, and means including a member reducing the effective cross-sectional area of the mixing chamber immediately adjacent to said auxiliary fuel inlet, said member being adapted to deflect the flow through the mixing chamber so as to reduce its aspirating effect on said auxiliary fuel inlet, whereby substantially the static suction of the air chamber is maintained at said auxiliary fuel inlet.

6. A charge forming device for internal combustion engines comprising a mixing chamber, an air inlet for said mixing chamber, a low speed fuel inlet and a high speed fuel inlet, an auxiliary air inlet for supplying air to said chamber anteriorly and posteriorly of said fuel inlets, an air valve controlling said auxiliary air inlet, means operated by the air valve for regulating the flow through said low speed fuel inlet, a throttle valve regulating the flow of mixture through said chamber, and means operated by the throttle for controlling the flow of fuel through said high speed fuel inlet.

7. A charge forming device for internal combustion engines comprising a mixing chamber, a passage communicating with said mixing cham-

ber and with the atmosphere, a fuel inlet in said passage for supplying fuel at low and intermediate speeds, an auxiliary fuel inlet for supplying fuel at high speeds, an air inlet for supplying air to the mixing chamber anteriorly and posteriorly of said auxiliary fuel inlet; an air valve controlling said air inlet, means operated by said air valve for regulating the flow through the first mentioned fuel inlet, a throttle valve regulating the flow of mixture through said mixing chamber, and means operated by the throttle for controlling the flow of fuel through said auxiliary fuel inlet.

8. A charge forming device for internal combustion engines comprising a mixing chamber, an air valve controlling admission of air thereto, a throttle regulating the flow of mixture therefrom, a passage communicating with said mixing chamber and with the atmosphere, a fuel inlet located in said passage, means in said passage to accelerate the flow of air adjacent the fuel inlet, an auxiliary fuel inlet communicating with the mixing chamber, and means to retard the flow of air past said auxiliary fuel inlet, the last mentioned means including a member for deflecting the flow through the mixing chamber so as to reduce its aspirating effect on the auxiliary fuel inlet, said member also reducing the effective cross-sectional area of the mixing chamber immediately posteriorly of said auxiliary fuel inlet, whereby a substantially static suction is maintained at said auxiliary fuel inlet.

9. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage having an air inlet and adapted to deliver a primary mixture of air and fuel to said secondary mixing chamber, an air valve for regulating the admission of air to said mixing chamber, a plurality of fuel inlets for supplying fuel to said primary mixture passage, a primary throttle for controlling said primary mixture passage, means operated by the air valve for controlling the flow through one of said fuel inlets and means operated by the primary throttle for controlling the flow through the other of said inlets.

10. A charge forming device for internal combustion engines comprising a plurality of secondary mixing chambers, a plurality of primary carburetors adapted to deliver a primary mixture of fuel and air thereto, a primary throttle for controlling the flow through all of said primary carburetors, a plurality of fuel inlets in each of said primary carburetors, an air valve controlling the admission of air to all of said secondary mixing chambers, means operated by said air valve for controlling the flow of fuel to one of said fuel inlets in each primary carburetor, and means operated by the primary throttle for controlling the flow through the other of said fuel inlets in each primary carburetor.

11. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a valve for controlling said air inlet, means for controlling the movement of said valve comprising means for resisting the first part of the opening movement of said air valve, said resisting means being so constructed that it offers no resistance to the motion of the air valve during the last part of its opening movement.

12. A charge forming device for internal combustion engines comprising a mixing chamber, main fuel and air inlets for supplying fuel and air thereto, a second fuel inlet for supplying

- additional fuel at relatively high speed operation, a throttle, a third fuel inlet a pump operated by the throttle on opening movements thereof to inject additional fuel into the mixing chamber during the acceleration period through said third fuel inlet and means operated by the pump when the throttle is opened at relatively high speeds for controlling the flow through said second fuel inlet.
- 10 13. 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 thereto, means for supplying fuel and air to said primary mixture passage, a primary throttle controlling the flow through said passage, a secondary air passage adapted to supply air to said secondary mixing chamber, a secondary throttle controlling the flow through said secondary air passage, operating mechanism for operating the two throttles concurrently, said mechanism including an operating link pivotally connected to said secondary throttle and so connected to the primary throttle that it is adapted to swing about its pivot point during a part of the movement of said primary throttle without moving the secondary throttle.
- 15 14. 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 thereto, means for supplying fuel and air to said primary mixture passage, a primary throttle controlling the flow through said passage, a secondary air passage adapted to supply air to said secondary mixing chamber a secondary throttle controlling the flow through said secondary air passage, an auxiliary air valve in said secondary air passage and means operated by the primary throttle for positively operating both said secondary throttle and said auxiliary air valve.
- 20 15. 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 thereto, means for supplying fuel and air to said primary mixture passage, a primary throttle controlling the flow through said passage, a secondary air passage adapted to supply air to said secondary mixing chamber, a secondary throttle controlling the flow through said secondary air passage, an auxiliary air valve in said secondary air passage, a pump for supplying additional fuel during the acceleration period and means operated by the pump for closing the auxiliary air valve.
- 25 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 thereto, means for supplying fuel and air to said primary mixture passage, a primary throttle controlling the flow through said passage, a secondary air passage adapted to supply air to said secondary mixing chamber, a secondary throttle controlling the flow through said secondary air passage, an auxiliary air valve in said secondary air passage, a pump for supplying additional fuel during the acceleration period, an auxiliary fuel inlet for supplying additional fuel to the mixture passage, and means operated by the pump for controlling the effectiveness of said auxiliary fuel inlet and for closing the auxiliary air valve.
- 30 17. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a valve for controlling said air inlet, means for retarding the first part of the opening movement of said valve comprising a dash pot having a cylinder and a piston slidable therein, said dash pot being so constructed that the piston is disengaged from the cylinder during the last part of the opening movement of said valve, whereby such movement of the valve is unretarded.
- 35 18. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a suction operated valve for controlling the air inlet adapted to open progressively as the engine speed increases, means for retarding the opening of the valve when the engine is operating at relatively low speed comprising a dash pot having a cylinder and a piston slidable therein, said dash pot being so constructed that the piston is disengaged from the cylinder during opening of the valve at relatively high engine speed, whereby the opening of the valve under such operating conditions is substantially unretarded.
- 40 19. A charge forming device for internal combustion engines comprising an air supply chamber, a primary mixing chamber in which a rich mixture of fuel and air is formed and which receives air from said air supply chamber, a primary mixture passage in which the primary mixture is mixed with additional air, said passage communicating with said primary mixing chamber, a secondary mixing chamber into which the primary mixture passage is adapted to deliver the mixture of fuel and air carried thereby, a secondary air passage adapted to supply air to said secondary mixing chamber, a plurality of fuel inlets for supplying fuel to said primary mixing chamber, means for effecting a rapid flow of air past one of said inlets so as to produce a velocity head adjacent said inlet to cause a flow of fuel therefrom, and means for maintaining at another of said fuel inlets substantially the static suction of the air chamber.
- 45 20. A charge forming device for internal combustion engines comprising an air supply chamber, a primary mixing chamber in which a rich mixture of fuel and air is formed and which receives air from said air supply chamber, a primary mixture passage in which the primary mixture is mixed with additional air, said passage communicating with said primary mixing chamber, a secondary mixing chamber into which the primary mixture passage is adapted to deliver the mixture of fuel and air carried thereby, a secondary air passage adapted to supply air to said secondary mixing chamber, high and low speed fuel inlets for supplying fuel to said primary mixing chamber, means for effecting a rapid flow of air past said low speed fuel inlet so as to produce a velocity head adjacent said fuel inlet to effect a flow of fuel therefrom, means for maintaining substantially the static suction of the air supply chamber at the high speed fuel inlet, and means for preventing a flow of fuel from said high speed fuel inlet during operation of the engine at low speed.
- 50 21. A charge forming device for internal combustion engines comprising an air supply chamber, a primary mixing chamber in which a rich mixture of fuel and air is formed and which receives air from said air supply chamber, a primary mixture passage in which the primary mixture is mixed with additional air, said passage communicating with said primary mixing chamber, a secondary mixing chamber into which the

primary mixture passage is adapted to deliver the mixture of fuel and air carried thereby, a secondary air passage adapted to supply air to said secondary mixing chamber, high and low speed fuel inlets for supplying fuel to said primary mixing chamber, means for effecting a rapid flow of air past said low speed fuel inlet so as to produce a velocity head adjacent said fuel inlet to effect a flow of fuel therefrom, means for maintaining substantially the static suction of the air supply chamber at the high speed fuel inlet, a throttle controlling the flow of mixture through said mixture passages and means for preventing a flow of fuel from the high speed fuel inlet until the throttle reaches a predetermined position.

22. A charge forming device for internal combustion engines comprising an air supply chamber, a primary mixing chamber in which a rich mixture of fuel and air is formed and which receives air from said air supply chamber, a primary mixture passage in which the primary mixture is mixed with additional air, said passage communicating with said primary mixing chamber, a secondary mixing chamber into which the primary mixture passage is adapted to deliver the mixture of fuel and air carried thereby, a secondary air passage adapted to supply air to said secondary mixing chamber, high and low speed fuel inlets for supplying fuel to said primary mixing chamber, means for effecting a rapid flow of air past said low speed fuel inlet so as to produce a velocity head adjacent said fuel inlet to effect a flow of fuel therefrom, means for maintaining substantially the static suction of the air supply chamber at the high speed fuel inlet, a throttle controlling the flow of mixture through said mixture passages and means operable by the throttle for controlling the flow of fuel from said high speed fuel inlet, said means being adapted to prevent a flow of fuel from said high speed fuel inlet until the throttle has made a predetermined opening movement.

23. A charge forming device for internal combustion engines comprising an air supply chamber, a primary mixing chamber which receives air from said air chamber, a primary mixture passage which receives the mixture from said mixing chamber and in which said mixture is mixed with additional air, a secondary mixing chamber into which the primary mixture passage is adapted to deliver a mixture of fuel and air, a secondary air passage adapted to supply air to said secondary mixing chamber, a passage communicating with the primary mixing chamber and having an air inlet, a fuel nozzle supplying fuel to said passage, flow accelerating means in said passage adapted to create a velocity suction adjacent the nozzle therein to effect a flow of fuel from said nozzle, and a second fuel inlet communicating directly with the primary mixing chamber, and means for maintaining at said last named fuel inlet substantially the static suction of the air chamber.

24. A charge forming device for internal combustion engines comprising an air supply chamber, a primary mixing chamber which receives air from said air chamber, a primary mixture passage which receives the mixture from said mixing chamber and in which said mixture is mixed with additional air, a secondary mixing chamber into which the primary mixture passage is adapted to deliver a mixture of fuel and air, a secondary air passage adapted to supply

air to said secondary mixing chamber, a passage communicating with the primary mixing chamber and having an air inlet, a fuel nozzle supplying fuel to said passage, a Venturi tube in said passage surrounding the nozzle therein to cause a flow of air at high velocity past the nozzle, a second fuel inlet communicating directly with the primary mixing chamber, and a restricted outlet connecting the primary mixing chamber with the primary mixture passage whereby the flow of air through the primary mixing chamber is maintained at such low velocity that the suction therein is substantially the static suction of the air supply chamber.

25. A charge forming device for internal combustion engines comprising an air supply chamber, a primary mixing chamber which receives air from said air chamber, a primary mixture passage which receives the mixture from said mixing chamber and in which said mixture is mixed with additional air, a secondary mixing chamber into which the primary mixture passage is adapted to deliver a mixture of fuel and air, a secondary air passage adapted to supply air to said secondary mixing chamber, a passage communicating with the primary mixing chamber and having an air inlet, a fuel nozzle supplying fuel to said passage, a Venturi tube in said passage surrounding the nozzle therein to cause a flow of air at high velocity past the nozzle, a second fuel inlet communicating directly with the primary mixing chamber, a restricted outlet connecting the primary mixing chamber with the primary mixture passage, whereby the flow of air through the primary mixing chamber is maintained at such low velocity that the suction therein is substantially the static suction of the air chamber, and means for preventing any flow of fuel from said second fuel inlet until the engine is running at relatively high speed.

26. A charge forming device for internal combustion engines comprising an air supply chamber, a primary mixing chamber which receives air from said air chamber, a primary mixture passage which receives the mixture from said mixing chamber and in which said mixture is mixed with additional air, a secondary mixing chamber into which the primary mixture passage is adapted to deliver a mixture of fuel and air, a secondary air passage adapted to supply air to said secondary mixing chamber, a passage communicating with the primary mixing chamber and having an air inlet, a fuel nozzle supplying fuel to said passage, a Venturi tube in said passage surrounding the nozzle therein to cause a flow of air at high velocity past the nozzle, a second fuel inlet communicating directly with the primary mixing chamber, a restricted outlet connecting the primary mixing chamber with the primary mixture passage, whereby the flow of air through the primary mixing chamber is maintained at such low velocity that the suction therein is substantially the static suction of the air chamber, a throttle, and means operable by the throttle for preventing any flow of fuel from said second fuel inlet until the throttle has made a predetermined opening movement.

27. A charge forming device for internal combustion engines comprising an air supply chamber, a primary mixing chamber which receives air from said air supply chamber and in which a mixture of air and fuel is formed, a primary mixture passage communicating with the primary mixing chamber and receiving fuel mixture therefrom, a secondary mixing chamber into which the

primary mixture passage delivers a primary mixture of fuel and air, a secondary air passage supplying air to said secondary mixing chamber, a plurality of fuel inlets for supplying fuel to the primary mixing chamber, means for effecting a rapid flow of air past one of said inlets so as to produce a velocity suction adjacent said inlet, means for maintaining at another of said inlets substantially the static suction of the air supply chamber, means for delivering fuel to the primary mixture passage during the acceleration period, and means for maintaining a flow at high velocity through the said mixture passage, whereby fuel supplied during the acceleration period is carried to the engine without appreciable delay.

28. A charge forming device for internal combustion engines comprising an air supply chamber, a primary mixing chamber which receives air from said air supply chamber and in which a mixture of air and fuel is formed, a primary mixture passage communicating with the primary mixing chamber and receiving fuel mixture therefrom, a secondary mixing chamber into which the primary mixture passage delivers a primary mixture of fuel and air, a secondary air passage supplying air to said secondary mixing chamber, a passage having an air inlet and communicating with the primary mixing chamber, a fuel nozzle therein, means for effecting a flow of air past said nozzle at high velocity to create a velocity suction at said nozzle, a second fuel inlet supplying fuel directly to the primary mixing chamber, a restricted outlet from the primary mixing chamber connecting with the primary mixture passage whereby substantially the static suction of the air supply chamber is maintained in said primary mixing chamber, means supplying fuel directly to the primary mixture passage during the acceleration period, and means for effecting a flow at high velocity through said primary mixture passage, so that the fuel supplied during the acceleration period is carried to the engine without appreciable delay.

29. A charge forming device for internal combustion engines comprising an air supply chamber, a primary mixing chamber which receives air from said air supply chamber and in which a mixture of air and fuel is formed, a primary mixture passage communicating with the primary mixing chamber and receiving fuel mixture therefrom, a secondary mixing chamber into which the primary mixture passage delivers a primary mixture of fuel and air, a secondary air passage supplying air to said secondary mixing chamber, a plurality of fuel inlets for supplying fuel to the primary mixing chamber, means for effecting a rapid flow of air past one of said inlets so as to produce a velocity suction adjacent said inlet, means for maintaining at another of said inlets substantially the static suction of the air supply chamber, a suction op-

erated air valve for controlling admission of air to the air supply chamber, means operated by said air valve for variably regulating the flow of fuel from one of said fuel inlets, a throttle, and means operated by the throttle for controlling the effectiveness of another of said fuel inlets.

30. A charge forming device for internal combustion engines comprising an air supply chamber, a primary mixing chamber which receives air from said air supply chamber and in which a mixture of air and fuel is formed, a primary mixture passage communicating with the primary mixing chamber and receiving fuel mixture therefrom, a secondary mixing chamber into which the primary mixture passage delivers a primary mixture of fuel and air, a secondary air passage supplying air to said secondary mixing chamber, a plurality of fuel inlets for supplying fuel to the primary mixing chamber, means for effecting a rapid flow of air past one of said inlets so as to produce a velocity suction adjacent said inlet, means for maintaining at another of said inlets substantially the static suction of the air supply chamber, a suction operated air valve for controlling admission of air to said air supply chamber and means operated by said air valve for variably regulating the flow of fuel from one of said fuel inlets during opening movements of said air valve, a throttle, and means operated by the throttle for preventing a flow of fuel from the other of said fuel inlets until the throttle has made a predetermined opening movement.

31. A charge forming device for internal combustion engines comprising an air supply chamber, a primary mixing chamber which receives air from said air supply chamber and in which a mixture of air and fuel is formed, a primary mixture passage communicating with the primary mixing chamber and receiving fuel mixture therefrom, a secondary mixing chamber into which the primary mixture passage delivers a primary mixture of fuel and air, a secondary air passage supplying air to said secondary mixing chamber, a plurality of fuel inlets for supplying fuel to the primary mixing chamber, means for effecting a rapid flow of air past one of said inlets so as to produce a velocity suction adjacent said inlet, means for maintaining at another of said inlets substantially the static suction of the air supply chamber, a suction operated air valve for controlling admission of air to said air supply chamber and means operated by said air valve for variably regulating the flow of fuel from the fuel inlet subject to a velocity suction, a throttle and means operated by the throttle for preventing a flow of fuel from the fuel inlet subject to static suction until the throttle has made a predetermined opening movement.

OTTO CARTER BERRY.
FREDERICK D. FUNSTON.