May 23, 1933. F. E. ASELTINE 1,911,135

CHARGE FORMING DEVICE

Original Filed June 20, 1928 4 Sheets-Sheet 1

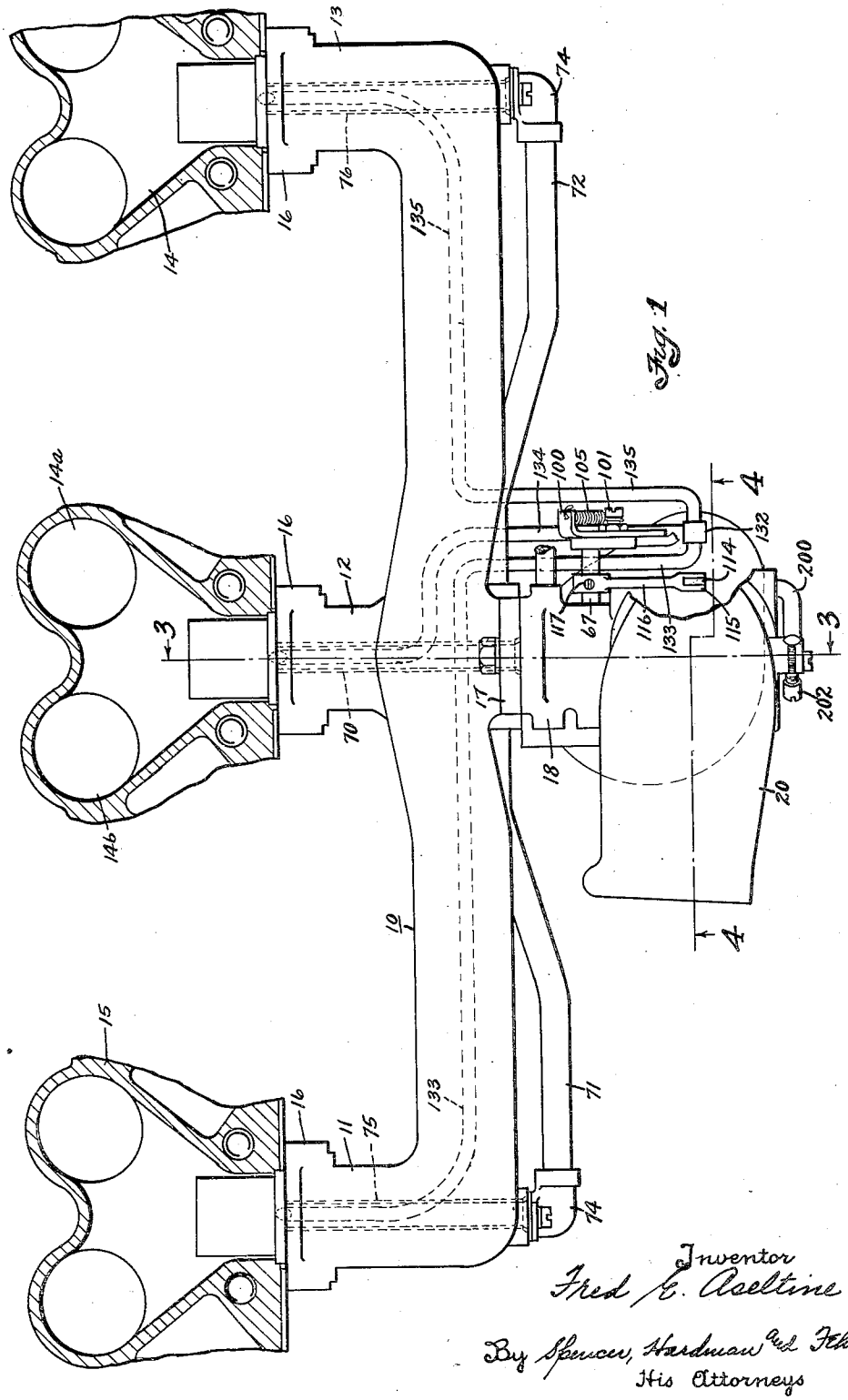


Fig. 1

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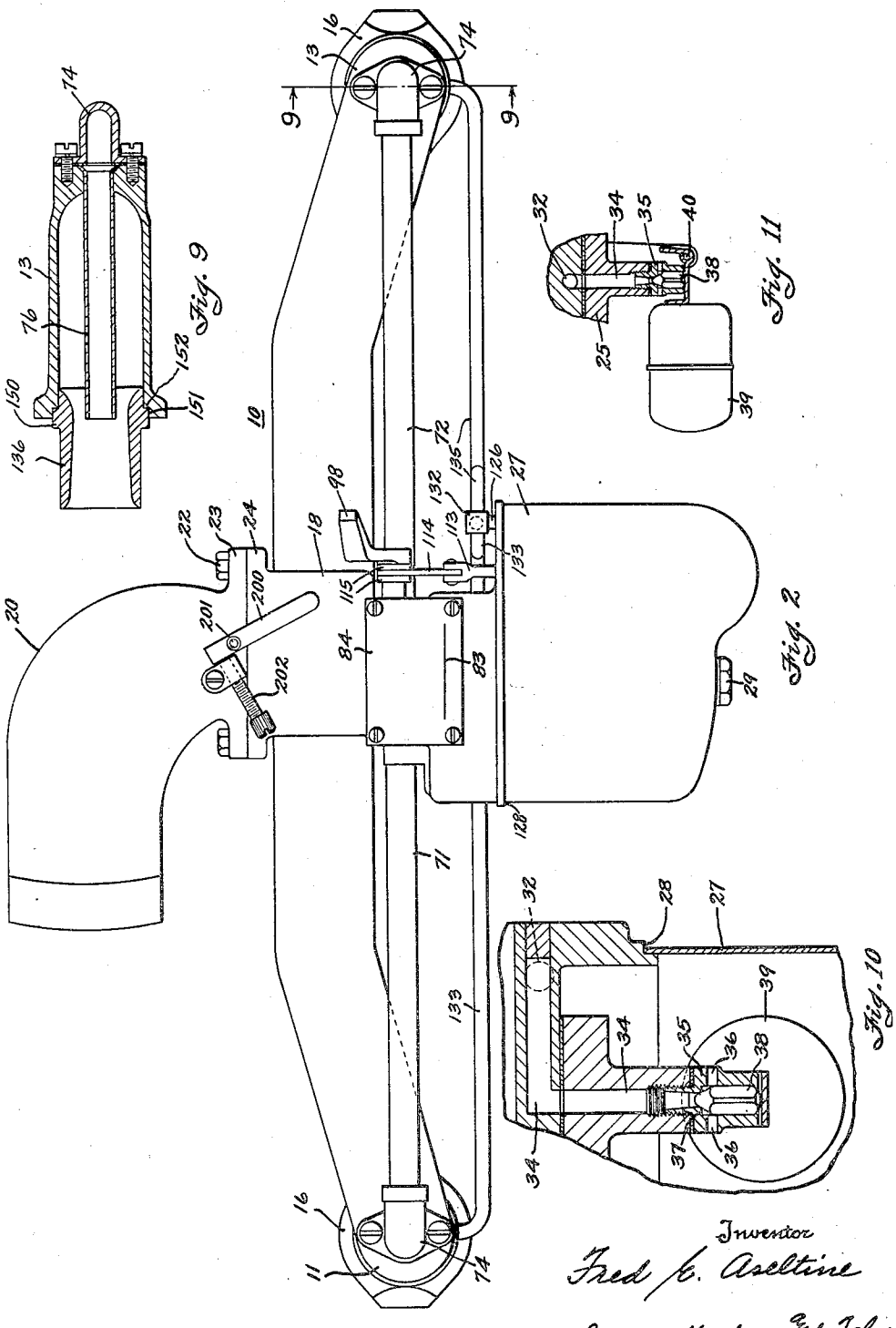
CHARGE FORMING DEVICE

Original Filed June 20, 1928 4 Sheets-Sheet 2

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CHARGE FORMING DEVICE

Original Filed June 20, 1928 4 Sheets-Sheet 3

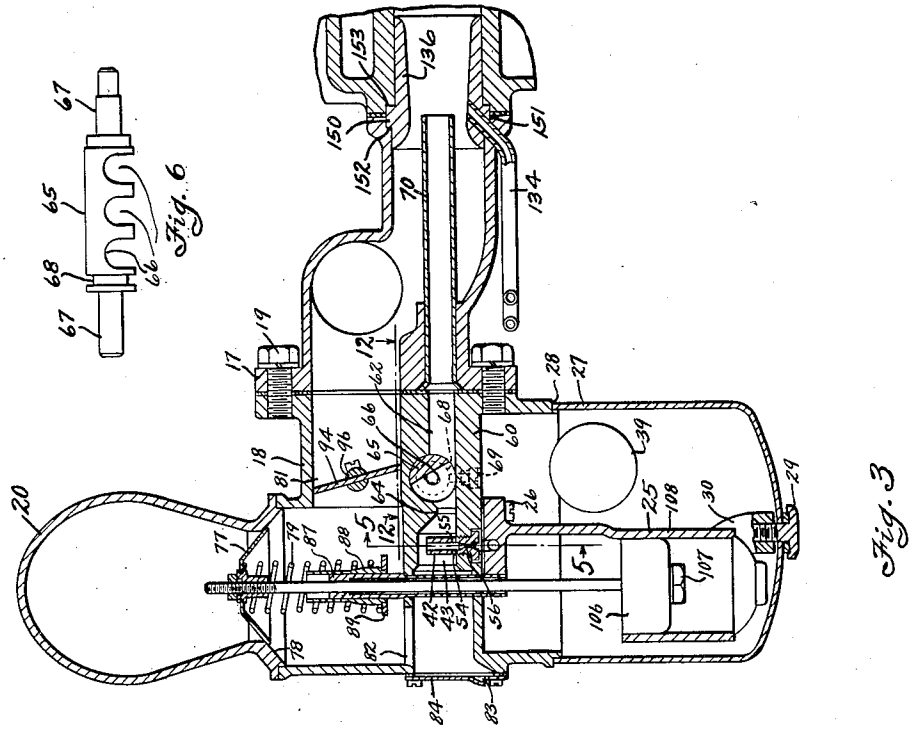

Fig. 3

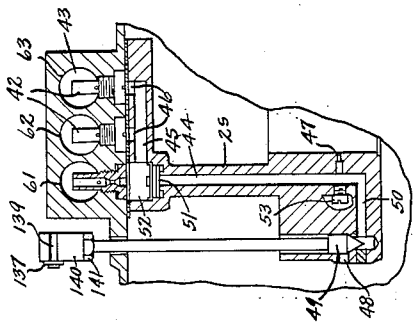

Fig. 5

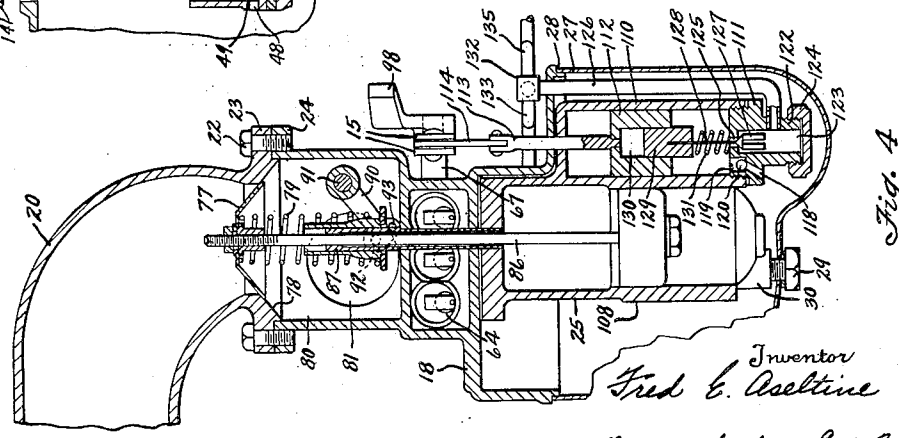

Fig. 4

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CHARGE FORMING DEVICE

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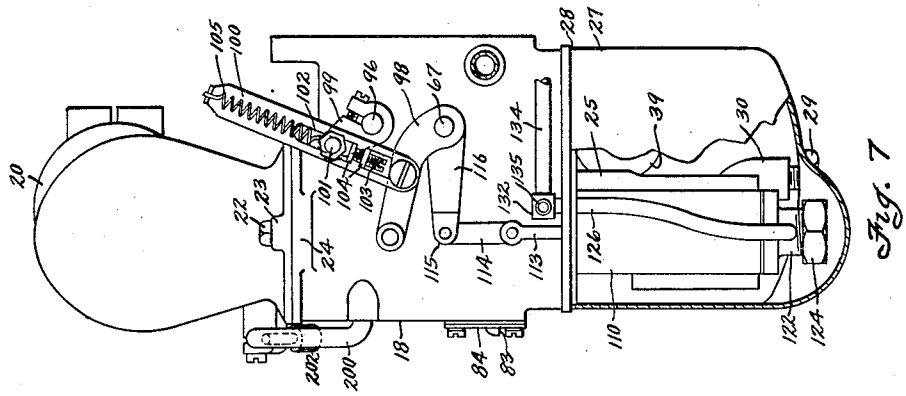

Fig. 7

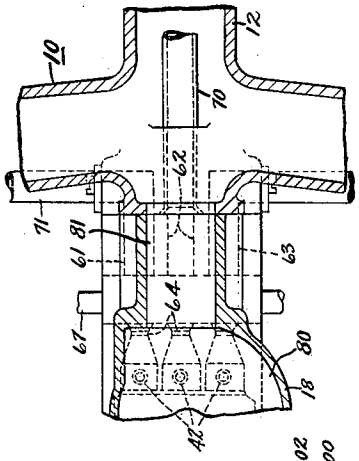

Fig. 12

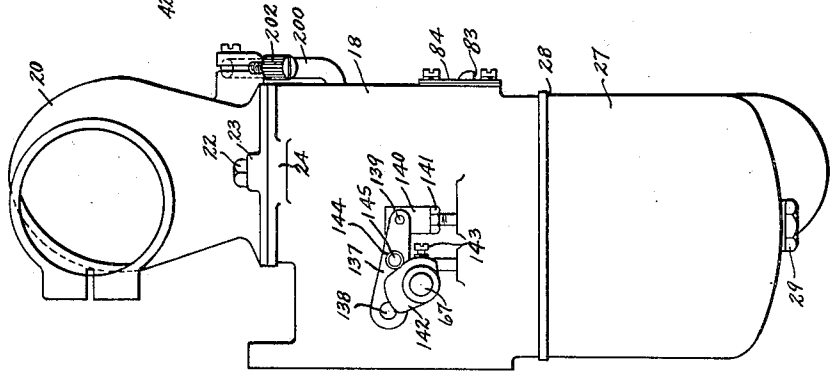

Fig. 8

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1,911,135

# UNITED STATES PATENT OFFICE

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## CHARGE FORMING DEVICE

Application filed June 20, 1928, Serial No. 286,975. Renewed April 27, 1933.

This invention relates to charge forming devices for multicylinder internal combustion engines and more particularly to that type of charge forming device comprising a plurality of primary fuel mixing chambers, one for each intake port of the engine and cooperating respectively with a plurality of secondary mixing chambers each located adjacent an engine intake port, while receiving fuel mixture from a pipe connected with one of the primary mixing chambers and receiving air when required through one branch of an air manifold which supplies air to all of the secondary mixing chambers. The air entering the manifold and the flow of fluid through the secondary mixing chambers is controlled primarily by a single air throttle, and the primary carburetors are supplied with fuel by means of a single fuel duct leading to a common float bowl.

Examples of charge forming devices of this type are shown in the copending applications of W. H. Teeter, Serial No. 221,372 filed Sept. 22, 1927, and W. H. Teeter and Fred E. Aseltine, Serial No. 221,371 filed Sept. 22, 1927.

The general objects of the devices disclosed in the above mentioned applications are to provide a fuel mixture having proper proportions of fuel and air under all operating conditions and to secure equal distribution of this mixture to the various engine cylinders. To accomplish these objects various mixture proportioning means are provided including means operable to enrich the mixture on opening movements of the throttle in order to increase the power to facilitate acceleration.

It is the primary object of the present invention to provide novel and improved means to enrich the mixture which is more positive in its action, simpler in construction and operable more nearly simultaneously with the opening of the throttle than devices of this character heretofore known.

It is an additional object of the invention to provide a means for enriching the fuel mixture which is operable on rapid opening movements of the throttle, but is ineffective when the throttle is opened slowly.

It is a further more specific object of the invention to provide means, positively operated on opening of the throttle for forcing additional fuel for acceleration into the mixture passages at a point adjacent the engine intake ports so that such additional fuel shall be supplied to the engine intake ports on opening of the throttle with no appreciable delay and equal distribution of this additional fuel shall be secured.

It is an additional object of the invention to provide means for forming a homogeneous mixture of this additional fuel with the normal mixture to prevent large particles of fuel in the liquid state being carried into the engine cylinders.

These objects are accomplished according to the present invention by the provision of a fuel pump comprising a pump piston connected to the throttle operating mechanism for direct operation thereby as the throttle is opened and provided with a fuel delivery conduit extending from the pump cylinder and having branches, one of which extends to each primary mixing chamber adjacent the engine intake ports. Means are provided to close the delivery conduit except during the pumping stroke of the pump piston to prevent the suction in the secondary mixing chambers drawing fuel from the delivery conduit, and to prevent any return of the fuel in the delivery conduit to the pump cylinder when stationary or during its non-pumping stroke.

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 attached to the engine cylinder head, a part of which is shown in section.

Fig. 2 is a side elevation looking toward the engine block.

Fig. 3 is a section on line 3—3 of Fig. 1.

Fig. 4 is a section on line 4—4 of Fig. 1.

Fig. 5 is a fragmentary section on line 5—5 of Fig. 3.

Fig. 6 is a detail view of the primary throttle valve.

Fig. 7 is a side elevation of the main carburetor unit looking from the right in Fig. 2.

Fig. 8 is a side elevation of the main carburetor unit looking from the left in Fig. 2.

Fig. 9 is a section through a secondary mixing chamber on the line 9—9 of Fig. 2.

Figs. 10 and 11 are detail sections at right angles to each other of the float valve mechanism and fuel inlet passage controlled thereby.

Fig. 12 is a section on line 12—12 of Fig. 3.

The device disclosed herein comprises a main air manifold indicated in its entirety by the reference character 10, and having three outlet branches 11, 12 and 13 each of which is adapted to communicate with one of the ports 14 of a multicylinder engine. Each port serves two adjacent cylinders through valve ports 14*a* and 14*b*, as clearly indicated in Fig. 1. The cylinder head is shown in three separate fragments 15, but it will be understood that it may be an integral structure. The branches 11, 12 and 13 are each provided with an attaching flange 16, for attaching the manifold to the engine block in the conventional manner. Adjacent the inlet of the manifold is provided a flange 17 to which may be secured the main carburetor unit as shown in Fig. 3.

The main carburetor unit comprises a main housing in the form of a single casting 18, attached by screws 19 to the flange 17. An air inlet horn 20, the flow of air through which is regulated in a manner later described, is secured in position over an opening in the upper wall of said housing by screws 22 which pass through flanges 23 and 24 on the horn and housing respectively. A casting 25 having certain dash-pot chambers and fuel passages, described in detail hereinafter, formed therein is secured by screws 26 to the lower wall of the main housing 18, a gasket being provided between the castings to make a tight joint, and a sheet metal fuel bowl 27 is held tight against a shoulder 28 on said main housing 18 by means of a screw 29 which is screwed into a post 30 depending from and integral with the casting 25.

A fuel line leading from a main source of supply (not shown) is adapted to communicate with a bore 32 formed in the wall of housing 18. The bore 32 connects with a bore 33 which communicates with a vertical bore 34 in the casting 25. A plug 35 is screwed into the lower end of bore 34 and is provided with lateral fuel outlets 36 admitting fuel to the fuel bowl 27. Cooperating with a valve seat 37 formed in said plug is a valve 38 controlled by a float 39 pivoted at 40 and operating in the usual manner to maintain a substantially constant fuel level in the bowl 27.

Fuel is conducted from the fuel bowl to a plurality of primary fuel nozzles 42 located in the primary mixing chambers 43 formed in the central part of the main housing which may be termed the distributor block. The construction of the distributor block and cooperating elements comprising the primary carburetors will be more fully described hereinafter. To permit the fuel to flow from the fuel bowl to the primary nozzles 42 the casting 25 is provided with a vertical fuel channel 44 which communicates at its upper end with a horizontal fuel canal 45 which connects with each of the nozzles 42 through holes 46. Fuel is admitted from the fuel bowl to the channel 44 at low speed through a metering orifice 47. All of the fuel flowing to the fuel nozzles 42 up to a certain predetermined engine speed, for example that corresponding to a vehicular speed of 20 miles per hour passes through the metering orifice 47. For higher speeds than said predetermined speed fuel is also admitted to the fuel channel 44 through an orifice 48 controlled by a fuel valve 49, operated in a manner fully described hereinafter, and thence through a horizontal channel 50, connecting with the lower end of channel 44.

Fuel is lifted from the fuel bowl through the nozzles 42 to the primary mixing chambers by the suction therein. When the throttle is moved toward closed position to reduce the engine speed there is a sudden reduction in suction on the vertical column of fuel between the fuel bowl and the nozzle which might permit this column of fuel to drop sufficiently to cause a temporary fuel starving of the engine unless means were provided to prevent the dropping of such column of fuel. To prevent this action a check valve 51 is received in an enlarged chamber 52 at the junction of channels 44 and 45 and on reduction of suction in the primary mixing chambers seats on the bottom of such chamber, preventing downward flow through the channel 44.

The metering orifice 47 is drilled in the casting 25 and the drill hole on the opposite side of the channel 44 is plugged by a screw 53.

Each primary fuel nozzle is shown herein as provided with a main fuel outlet in the top of the nozzle and a secondary fuel outlet comprising two holes 54 and 55 formed in the vertical wall of the nozzle and diametrically opposite each other as shown in Fig. 3. At higher speeds there is sufficient suction in the primary mixing chambers to cause fuel to flow from the main fuel outlet in the top of each primary nozzle, as well as from the holes 54 and 55. At idle or very low speed, however, there is insufficient suction to cause such a flow of fuel, the fuel at such time standing in the nozzle at a point between the top of the nozzle and the orifices 54 and

55, flowing from such orifices by action of gravity. Each fuel nozzle is provided with a restricted fuel metering orifice 56.

In the device disclosed herein the central portion of the main casting constitutes the distributor block and is indicated by the reference numeral 60 in Fig. 3. The distributor block has three primary mixture passages 61, 62, 63 formed therein, these passages being parallel to each other and close together as indicated in Figs. 4 and 5. Each of these passages registers with a corresponding passage formed in the manifold casting, the middle one of which is a straight passage in alignment with the primary mixture passage 62 and receiving a tube 70 which conveys primary mixture to the secondary mixing chamber formed in the middle outlet branch 12 of the manifold. The other two passages which register with the primary mixture passages 61 and 63 are of angular shape and at their outlet ends receive pipes 71 and 72, more fully described hereinafter which conveys the primary mixture to the secondary mixing chambers formed in the branches 11 and 13 of the manifold respectively. These passages which receive the primary mixture delivery pipes are of substantially the same construction as are the corresponding passages in the copending application 221,371 with one exception. In this device these passages are formed in the manifold while in the copending application such passages are formed in the main carburetor unit.

The inlet ends of the primary mixture passages where the fuel nozzles project into such passages are of larger diameter than the outlet ends thereof and between the inlet and outlet end of each passage its cross sectional area is constricted as indicated at 64, in order to reduce the velocity of the air passing the nozzle for a purpose later set forth. The flow of mixture through passages 61, 62 and 63 is controlled by a single throttle valve 65 extending across all of said passages at a point intermediate the above mentioned constriction and the outlet ends of said passages. The throttle is provided with grooves 66 which register with the primary mixture passages 61, 62 and 63 and is journalled in the walls of the main housing 18. Spindles 67, integral with the throttle project from each end of the throttle outside the walls of housing 18 and support certain valve operating devices more fully described hereinafter. A groove 68 is provided in the throttle which cooperates with the inner end of a screw 69 adjustable in the casting, to prevent longitudinal movement of the throttle.

As above stated the primary mixture delivery tube 70 associated with the middle branch of the manifold is secured in the manifold itself in alignment with the middle primary mixture passage 62. The pipes 71 and 72, however, which communicate with the mixture passages 61 and 63 are connected at their delivery ends to elbows 74 detachably secured to the manifold branches 11 and 13, the outlet ends of such elbows being in alignment with tubes 75 and 76, similar to the tube 70 and secured in the manifold branches 61 and 63 respectively in any desirable manner. Primary mixture is drawn by engine suction from the primary mixing chambers through the pipe connections above described, and tubes 70, 75 and 76 to the secondary mixing chambers in which said tubes terminate, and in which the primary mixture is mixed with additional air under certain operating conditions more specifically described later.

Substantially all the air entering the carburetor flows through the air horn 20, the flow therethrough being controlled by a main air valve 77, normally held against a seat 78 by a spring 79. Air flows past the valve 77 to a main air chamber 80 formed in the housing 18. An air conduit 81 controlled by a valve mechanism hereinafter described connects the air chamber with the main air manifold, while an orifice 82 in the floor of the air chamber permits a flow of air from the chamber 80 to the primary carburetors.

When the carburetor is choked to start the engine the air valve 77 is held against its seat by means presently described to completely close the main air inlet. To provide sufficient air to carry the starting fuel from the primary nozzles to the engine when the carburetor is choked as described, an air inlet 83 is provided. This inlet is an elongated slot formed in a plate 84 secured to the housing 18 as shown in Fig. 3.

The main air valve 77 is adjustably secured on a stem 86 slidably mounted in a guide sleeve 87 fixed in the main housing 18. Surrounding the guide sleeve 87 is a slidable sleeve 88, the lower end of which has a projecting disc 89 secured thereto, the disc providing a seat for the air valve spring 79. Means are provided for raising this sleeve to a position where the upper end thereof will engage the air valve to hold it against its seat to choke the carburetor. This means comprises an arm 90 secured to a rock shaft 91 rotatably mounted in the wall of the main housing 18. The arm at its inner end has two pins 92 and 93 secured therein between which the disc 90 is received. The shaft 91 projects through the wall of the casing and at its outer end is bent to form an arm 200 having a hole 201 therein in which some form of operating connection, extending from a point convenient to the operator may be attached. An adjustable stop screw 202 is received in a lug detachably secured to the air horn as indicated in Fig. 2. By adjustment of the stop screw the normal position of the sleeve 88 may be determined to regu-

late the tension of spring 79. Ordinarily the stop screw is so adjusted that the main air valve will open slightly during idling.

Owing to the relative sizes of the air inlet orifice 82 and the total area of the constrictions 84 in the primary mixture passages, the velocity of flow past the nozzles increases but little at idling or other engine operation at speeds lower than that corresponding to a vehicular speed of substantially 15–20 miles per hour on a level with the result that at speeds below that mentioned the velocity is insufficient to build up a velocity head at the nozzles which will cause sufficient flow therefrom to form a super-rich primary mixture, the mixture formed in the primary mixture passages at the above mentioned engine speeds being of properly combustible proportions and being conveyed to the engine cylinders without dilution by admixture with additional air. At higher engine speeds the capacity of the primary mixture passages is insufficient to supply a sufficient quantity of fuel mixture to satisfy the volumetric requirements of the engine, and the velocity head builds up so rapidly that the primary mixture would become super-rich if means were not provided to compensate therefor. To offset the effect of the velocity head and to supply a sufficient quantity of fuel mixture at speeds higher than that above referred to the air passage 81 leading from the chamber 80 to the main air manifold is opened as described hereinafter to admit additional air which is mixed with the primary mixture in the secondary mixing chambers.

Flow of air from the chamber 80 to the secondary mixing chambers is controlled by a manually operable butterfly throttle 94 fixed on a shaft 96 which is journalled in the wall of housing 18 and is operated simultaneously with the throttle 65 by operating connections hereinafter described.

The operating connections for the throttle valves will now be described. Fixed on the end of one of the throttle spindles 67 outside the housing 18 is an operating arm 98 having a hole in its free end to be connected to some suitable form of operating connection extending to a point convenient to the operator of the vehicle. This operating arm 98 is connected through a lost motion connection to an arm 99 secured by a split clamp to the end of shaft 94 outside the casing. An operating link 100 is pivotally connected to the arm 98, and a pin 101 projecting from the free end of arm 99 projects through a slot 102 in the link 100. A regulating screw 103 is threaded in lugs 104 projecting from the operating link and may be adjusted to regulate the length of the slot 102, the upper end of the said screw constituting the lower end of said slot. A tension spring 105 is connected at one end to the upper end of the link 100 and at its other end to the pin 101. The spring tends to hold the pin 101 against the upper end of slot 102. With both throttles closed the parts are in the position shown in Fig. 9, with the pin 101 in engagement with screw 103. As the operating arm 98 is rotated in a counter-clockwise direction to open the primary throttle valve 65 the link 100 moves downwardly to a position where the upper end of slot 102 strikes pin 101 before the operating arm 99 of the air throttle 94 is moved so that the primary throttle is partly opened before the air throttle begins to open. The screw 103 serves as a stop to limit the closing movement of the primary throttle and adjustment of said screw regulates the throttle opening at idling.

On opening movement of either throttle valve the suction below the air valve 77 is increased and the air valve is opened against the tension of its spring permitting an inrush of air to the secondary mixing chambers which will be sufficient to lean the mixture unless means are provided to retard the opening movement of said valve. By retarding the opening of the valve the leaning of the mixture as well as fluttering of the air valve may be prevented. It will be understood, of course, that opening of the air valve may be sufficiently retarded on opening of the throttle to enrich the mixture for acceleration, but in this particular embodiment of the invention opening of the air valve is not retarded to that extent.

A dash pot is provided for retarding the opening of the air valve as above described comprising a piston 106 secured to the lower end of the air valve stem 86 in any desirable manner, as by a nut 107, and adapted to slide in a cylinder 108 formed in the casting 25. This dash pot is of ordinary conventional form and need not be described in detail herein.

According to the present invention a fuel pump is provided which is operated by the throttle on opening movement thereof to supply additional fuel to enrich the mixture for acceleration. This pump comprises a cylinder 110 cast integral with the dash pot cylinder 108 as shown in Fig. 4, and having its lower end closed by a removable plug 111. A pump piston 112 has a sliding fit within the cylinder and is connected to the primary throttle for operation therewith by means of a rod 113 connected at its lower end, in any desirable manner, to the piston 112, and at its upper end pivotally connected to a link 114, the upper end of which is pivotally connected between the arms 115, comprising the bifurcated free end of a lever 116, the other end of which is secured to one of the spindles 67 projecting from the primary throttle by any suitable means such as a set screw 117.

The plug 111 is provided with a passage 118 connecting the interior of cylinder 110 with the fuel bowl and serving to admit fuel to the cylinder on the upward stroke of the pump piston 112. The passage 118 has an enlargement 119 at its upper end forming a valve chamber in which a check valve 120, operating to close the passage 118 on downward movement of the piston 112, is received. A reduced portion 122 of the plug 111, having a central bore 123 therein projects downwardly from the main body of the plug and the bore is closed by a cap 124 screwed on the end of the reduced portion 122. A restricted orifice 125 connects the bore 123 with the interior of the cylinder 110 and a fuel delivery conduit 126 is secured in the wall of the reduced portion 122 and communicates with the said bore 123.

Flow of fuel from the pump cylinder 110 to the bore 123 and the delivery conduit 126 is controlled by a valve 127 received within the bore and connected by a wire 128 to a small piston 129 which slides within a recess 130 formed in the piston 112. A spring 131 surrounds the wire between the bottom of the piston 129 and the plug 111, said spring tending at all times to lift the piston 129 and close the valve 126. The function of the valve 127 will be more specifically pointed out hereinafter.

The pump delivery conduit 126 extends through that part of the main housing which constitutes the top of the float bowl and immediately above the bowl said conduit connects with a header 132 from which extend three separate delivery conduits 133, 134 and 135 which connect with the three outlet branches of the manifold 11, 12 and 13 respectively. To facilitate assembling any well known form of coupling means, such as a union may be provided in each conduit 133, 134 and 135 if desired. The delivery ends of the conduits 133, 134 and 135 are bent upwardly as indicated in Fig. 3, and said delivery ends extend obliquely through the attaching flanges 16 and through Venturi tubes 136 which form the secondary mixing chambers, terminating flush with the inner surface of said venturis and at a point substantially adjacent the point of greatest suction therein. The pump delivery conduits could, obviously, extend into the Venturi tubes 136 rather than terminate with the wall, but these tubes projecting into the Venturi tubes would tend to produce some disturbance in the air flow adjacent the delivery end of the primary mixture tubes which might affect the operation of said tubes to some extent. For this reason the construction disclosed herein is deemed more desirable, because by terminating the tubes 133, 134 and 135 flush with the inner surface of the Venturi tubes 136 the tubes do not disturb the flow of air through the secondary mixing chambers.

It will be clear that the suction and the rate of flow through the Venturi tubes at the point where the conduits 133, 134 and 135 terminate is at all times high and when the main air throttle is open the velocity of flow through the Venturi tubes is particularly great. Owing to the presence of a high vacuum and high air velocity at the outlets of the pump delivery conduits the fuel issuing therefrom will be partly vaporized and the unvaporized particles which remain will be thoroughly mixed with the mixture passing said outlets.

Owing to the large size of the air passage 81, which is necessary to supply the necessary quantity of fuel mixture to meet the engine demands at full open throttle, and the resulting increase in the quantity of air admitted per degree of opening of throttle 94, the effect of velocity head on the jets is more than offset and the mixture would become too lean subsequent to the opening of throttle 94 unless means were provided to supply additional fuel. This means comprises the valve 49 previously referred to which is opened subsequent to the opening of throttle 94 by mechanism which will now be described. This mechanism includes an arm 137 pivoted on a pin 138 projecting from the housing 18 as shown in Fig. 8. Projecting from the opposite end of the arm 137 is a pin 139 which is received in a slot in an enlarged head 140 screwed on the upper end of the valve 49 and held in adjusted position by a lock nut 141. A cam 142 is adjustably secured by a set screw 143 to one of the spindles 67, projecting from the primary throttle and engages a roller 144 rotatable on a pin 145 projecting from the lever 137 to open the valve 49 as the throttle opens. A considerable portion of the cam is concentric relative to its operating shaft so that it is ineffective to open the fuel valve until a certain predetermined engine speed is reached, for example a speed corresponding to a vehicular speed of substantially 20 miles per hour on a level. By employing a cam of different shape or by changing the adjustment of the cam or the head 140, the engine speed at which the valve begins to open and the rate of opening movement of the valve relative to the movement of the throttle may be varied.

The secondary mixing chambers comprise the Venturi tubes 136 previously referred to. There are three of these venturis which are identical in construction and are positioned in the branches 11, 12 and 13 of the manifold in such relation to the tubes 70, 75 and 76 that the point of greatest depression or suction in each venturi is immediately adjacent the outlet end of the tube associated therewith. Each venturi is provided with an

annular rib 150 which fits when the manifold is attached to the engine block, in the intake port and in a recess 151 in the associated branch of the manifold, being clamped between shoulders 152 and 153 on the manifold and engine block respectively. The Venturi tubes cause the air passing the tubes 70, 75 and 76 to assume high velocity creating in each tube a high suction at all times.

The operation of the above described pump mechanism is substantially as follows: On any rapid opening of the primary throttle and consequent rapid downward movement of the piston 112 the pressure effective on the piston 129 and valve 127, which normally is closed, is enough to open the valve substantially simultaneously with the beginning of the movement of piston 112. The valve 127 is closed as soon as the piston 112 comes to rest at the end of any pumping stroke and is held closed by the spring 131 during any upward movement of piston 112, so that the fuel in the delivery conduits cannot run back to the pump cylinder after a pumping operation. Moreover the closing of this valve prevents the suction in the secondary mixing chambers acting to draw fuel from the delivery conduits when the pump piston is stationary or moving upwardly. Therefore the delivery conduits are always kept full of fuel by means of valve 127, and said valve being opened, as above described, substantially as soon as any rapid downward movement of the pump piston begins, the pump is available to force additional fuel into the secondary mixing chambers substantially with the beginning of any rapid opening movement of the primary throttle, and, since the secondary mixing chambers are partly within the engine intake ports, this additional fuel is carried into the engine cylinders without any perceptible delay.

On a very slow opening of the throttle the injection of additional fuel into the mixture is not desirable and the valve 127 operates to render the pump ineffective during such throttle movement. There is certain leakage of fuel past the pistons 112 and 129, so that when the piston 112 moves downward very slowly this leakage is enough to prevent the building up of sufficient pressure on piston 129 and valve 127 to collapse the spring 131 and open said valve. The valve therefore remains closed during slow opening of the throttle, rendering the pump ineffective. It will be clear from the above that the valve 127 performs two functions, that just described and, in addition, operates to maintain the delivery conduits full of fuel at all times, so that the pump is operative to supply additional fuel to the engine cylinders substantially simultaneously with the beginning of any rapid opening of the throttle. The pump continues to supply additional fuel throughout the entire opening movement of the throttle.

While the form of embodiment of the present invention as herein described, 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 secondary mixing chamber, a primary mixture passage adapted to deliver a primary mixture of fuel and air thereto, air and fuel inlets therefor, a throttle, and means for supplying additional liquid fuel to the secondary mixing chamber on opening movements of the throttle.

2. A charge forming device for internal combustion engines comprising, a secondary mixing chamber, a primary mixture passage adapted to deliver a combustible primary mixture of fuel and air thereto, air and fuel inlets therefor, a throttle, means for supplying additional liquid fuel to the secondary mixing chamber, and common means for operating said throttle and the mixture enriching means.

3. 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, air and fuel inlets therefor, a throttle, means for enriching the mixture flowing through the secondary mixing chamber comprising a fuel pump adapted to inject liquid fuel into the secondary mixing chamber.

4. 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, air and fuel inlets therefor, a throttle, means to inject liquid fuel into the secondary mixing chamber and fuel injecting means for operating said means on opening movements of the throttle.

5. 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 secondary throttle controlling the flow of air to the secondary mixing chamber, a primary throttle controlling the flow through the primary mixture passages, a fuel pump for supplying additional fuel to the mixture passage, and a common operating means for both said throttle valves and said fuel pump.

6. 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 sec-

ondary throttle controlling the flow of air to the secondary mixing chamber, a primary throttle controlling the flow of mixture through said primary mixture passage, a fuel pump for supplying additional fuel to the primary mixture, means for operating the primary throttle, means for operating the secondary throttle during a part of the opening movement of said primary throttle, and means for operating the fuel pump during all of the opening movement of the primary throttle.

7. A charge forming device for internal combustion engines comprising, a mixture passage adapted to supply a combustible mixture to the intake port of the engine, means for supplying fuel and air thereto, a throttle controlling the flow through the mixture passage, and means for supplying additional fuel at a point adjacent the engine intake port on opening movement of the throttle.

8. A charge forming device for internal combustion engines comprising, a mixture passage adapted to supply a combustible mixture to the intake port of the engine, means for supplying fuel and air thereto, a throttle controlling the flow through the mixture passage, means within the mixture passage for increasing the velocity of flow therethrough and means for supplying additional fuel to said mixture passage at the point where the velocity of flow is increased, whereby said additional fuel is more readily atomized.

9. A charge forming device for internal combustion engines comprising, a mixture passage adapted to supply a combustible mixture to the intake port of the engine, means for supplying fuel and air thereto, a throttle controlling the flow through the mixture passage, means within the mixture passage for increasing the velocity of flow therethrough, means for supplying additional fuel to said mixture passage at the point where the velocity of flow is increased, and means for rendering said last mentioned means effective on opening movements of the throttle.

10. A charge forming device for multicylinder internal combustion engines comprising, a plurality of secondary mixing chambers, a plurality of primary mixture passages adapted to deliver a primary mixture to said secondary mixing chambers, means for supplying fuel and air to said primary mixture passages, a throttle, and means for supplying additional fuel to all of said secondary mixing chambers simultaneously on opening movements of the throttle.

11. A charge forming device for multicylinder internal combustion engines comprising, a plurality of secondary mixing chambers, a plurality of primary mixture passages adapted to deliver a primary mixture to said secondary mixing chambers, means for supplying fuel and air to said primary mixture passages, a throttle, a fuel pump, a branched delivery conduit extending from said pump to all of said secondary mixing chambers and means for operating said pump on opening movements of the throttle.

12. A charge forming device for internal combustion engines comprising, a mixture passage, means for supplying fuel and air thereto, a fuel pump for supplying additional fuel to said mixture passage, and means rendering said pump effective when the pump is operated rapidly, but rendering said pump ineffective when operated slowly, said means comprising a valve operated by the pump piston on relatively rapid opening movements of the throttle.

13. A charge forming device for internal combustion engines comprising, a primary mixture passage, means for supplying fuel and air thereto, a secondary mixing chamber into which said mixture passage delivers, a fuel pump for supplying additional fuel to the secondary mixing chamber, a delivery conduit for conveying fuel from the pump to said secondary mixing chamber and means for maintaining said delivery conduit full of fuel at all times.

14. A charge forming device for internal combustion engines comprising, a mixture passage adapted to supply a combustible mixture to the intake port of the engine, means for supplying fuel and air thereto, a throttle controlling the flow through the mixture passage, a Venturi tube in the mixture passage for increasing the velocity of flow therethrough, and means for supplying additional fuel to said mixture passage within the Venturi tube on opening movements of the throttle.

15. A charge forming device for internal combustion engines comprising a mixture passage for supplying a combustible mixture to the engine intake ports, means for supplying fuel and air thereto at a point relatively remote from the intake port to form a mixture for normal operation, a pump having a delivery conduit communicating with said mixture passage at a point adjacent the intake port for supplying additional fuel thereto during the acceleration period, and means for maintaining the delivery conduit substantially full of fuel under all operating conditions.

16. A charge forming device for internal combustion engines comprising a primary mixture passage, means for supplying air and fuel thereto, a secondary mixing chamber located adjacent the engine intake port, means admitting air to said secondary mixing chamber to mix with the primary mixture therein, a throttle, and a fuel pump operative on opening movements of the throttle for supplying additional fuel to the secondary mixing chamber to enrich the mix-

ture supplied the engine during the acceleration period.

17. A charge forming device for internal combustion engines comprising a main air manifold communicating with the engine intake ports, a plurality of secondary mixing chambers formed therein adjacent said ports, an air inlet supplying air to said manifold, a plurality of primary mixture passages adapted to deliver a primary mixture of air and fuel to said secondary mixing chambers, a throttle, and means operated on opening movements of the throttle for supplying additional fuel to all of said secondary mixing chambers simultaneously, to enrich the mixture during the acceleration period.

18. A charge forming device for internal combustion engines comprising a secondary mixing chamber located adjacent to the engine intake port, a primary mixing chamber connected by a primary mixture passage with the secondary mixing chamber and located relatively remote from said secondary mixing chamber, means for supplying fuel and air to the primary mixing chamber, a throttle and means for supplying additional fuel directly to the secondary mixing chamber on opening movements of the throttle, whereby a relatively rich mixture is supplied to the secondary mixing chamber substantially immediately on opening of the throttle.

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 said secondary mixing chamber, means supplying fuel and air to said passage, a primary throttle in said passage, and means operated by said primary throttle for supplying additional fuel to the secondary mixing chambers.

20. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto and a pump for supplying additional fuel thereto during the acceleration period, said pump comprising a piston, a cylinder having a fuel delivery outlet, a spring closed valve normally closing said outlet, and means operated by the pump piston for opening said valve on the pumping stroke of said piston.

21. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto and a pump for supplying additional fuel thereto during the acceleration period, said pump comprising a piston, a cylinder having a fuel delivery outlet, a valve for closing said outlet, means operated by the pump piston for opening said valve and means for closing the valve whenever the pump piston comes to rest.

22. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto and a pump for supplying additional fuel thereto during the acceleration period, said pump comprising a piston, a cylinder having a fuel delivery outlet, a valve for closing said outlet, means for opening said valve adapted to be operated by the pressure of the pump piston thereon, and means for holding said valve closed with sufficient force to prevent the opening of the valve on slow movements of the piston when the pressure on the valve opening means is low.

23. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto and a pump for supplying additional fuel thereto during the acceleration period, said pump comprising a piston having a recess therein, a cylinder in which the piston is slidable and provided with a fuel delivery outlet, a valve for closing said outlet, and a piston slidable in said recess and connected to said valve, whereby the valve is operated thereby.

24. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto and a pump for supplying additional fuel thereto during the acceleration period, said pump comprising a piston having a recess therein, a cylinder in which the piston is slidable and provided with a fuel delivery outlet, a valve for closing said outlet, and a piston slidable in said recess and connected to said valve, sufficient clearance being provided between the last named piston and the recess to permit slow movements of the pump piston without corresponding movement of the valve operating piston under certain operating conditions.

25. A charge forming device for internal combustion engines comprising, a mixture passage, means for supplying fuel and air thereto, a fuel pump for supplying additional fuel to said mixture passage, and means rendering said pump effective when the pump is operated rapidly, but rendering said pump ineffective when operated slowly, said means comprising a valve operated by the pump piston only on relatively rapid opening movements of the throttle.

26. The combination with a throttle-controlled carburetor comprising a mixing chamber, of an accelerating device comprising a cylinder and a plunger operating therein, means for supplying fuel to said cylinder, a fuel delivery passage from said cylinder to the mixing chamber, means for actuating a pressure stroke of said plunger concurrently with the opening of the throttle and for simultaneously connecting said fuel supply means and delivery passage, and means for automatically effecting a retarded closing of said discharge passage upon completion of throttle-opening movement.

27. The combination with a throttle-con-

trolled carburetor comprising a mixing chamber, of an accelerating device comprising a fuel pump having a discharge connection to the mixing chamber, a valve controlling such connection and means for actuating said pump and valve from the throttle, the means for actuating said valve being variably responsive to the throttle according to the rapidity of movement of the latter.

28. The combination with a throttle-controlled carburetor comprising a mixing chamber, of an accelerating device, comprising a fuel pump discharging into said mixing chamber, means actuated in common with said throttle upon its opening travel for actuating said pump, to deliver a charge of fuel therefrom to the mixing chamber and for establishing a subsequent abnormal fuel flow to the mixing chamber responsive to reduced pressure in said chamber, and means effective in the open position of the throttle for gradually and automatically cutting off such flow.

29. The combination with a throttle-controlled carburetor comprising a mixing chamber, of an accelerating device comprising a fuel pump discharging into the mixing chamber, a valve controlling the discharge from said pump, means actuated by said throttle in its opening travel for actuating said pump to force a charge of fuel into the mixing chamber and for opening said valve to establish a subsequent flow responsive to reduced pressure in the mixing chamber, and means effective in the open position of the throttle for gradually and automatically closing said valve.

30. The combination with a throttle-controlled carburetor including a mixing chamber and means comprising a normal fuel supply for said mixing chamber, means for increasing the fuel supply during certain operating conditions, and mechanisms for operating the last named means in conjunction with the throttle, said operating mechanism including a dash pot for varying the effectiveness of said last named means to increase the flow of fuel according to the rapidity of operation of said operating mechanism.

In testimony whereof I hereto affix my signature.

FRED E. ASELTINE.

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## CERTIFICATE OF CORRECTION.

Patent No. 1,911,135. May 23, 1933.

FRED E. ASELTINE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, line 108, claim 4, strike out the words "fuel injecting" and insert the same before "means" second occurrence, in line 109, of said claim; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 24th day of July, A. D. 1934.

Bryan M. Battey

(Seal) Acting Commissioner of Patents.