Oct. 18, 1932. F. E. ASELTINE 1,882,722

CHARGE FORMING DEVICE

Filed July 18, 1928 3 Sheets-Sheet 1

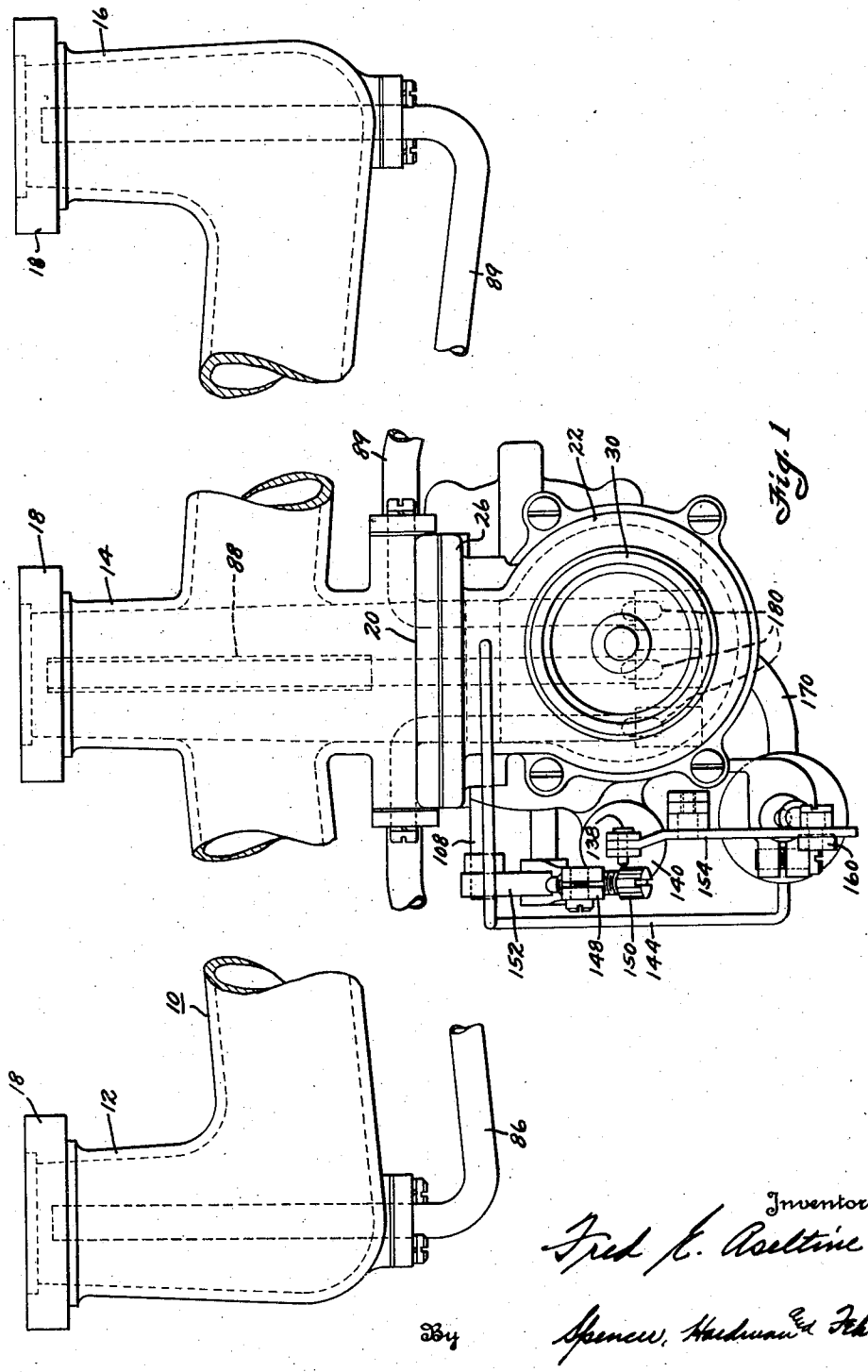


Fig. 1

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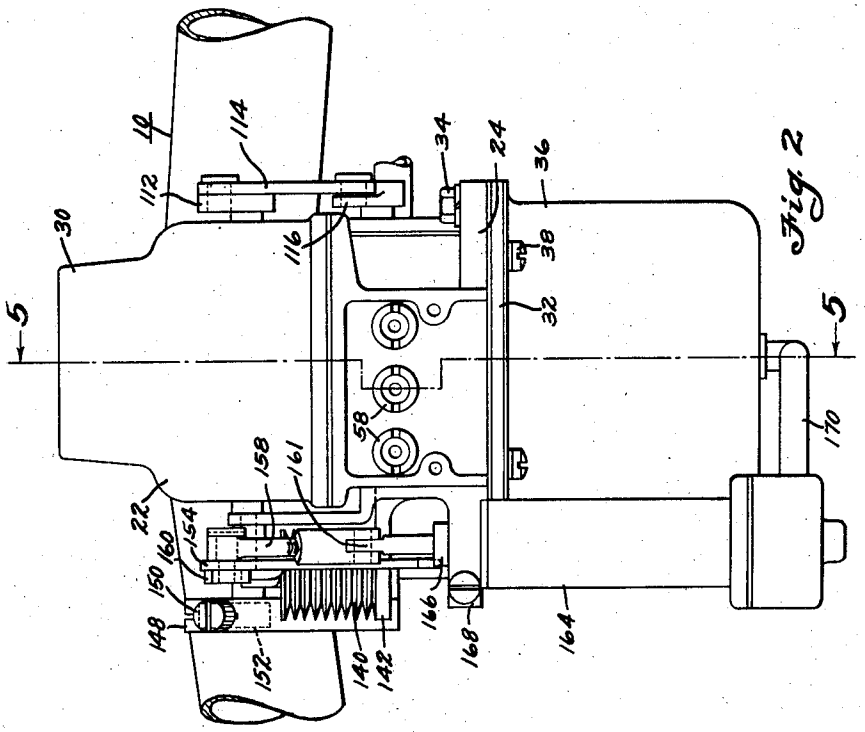


Fig. 2

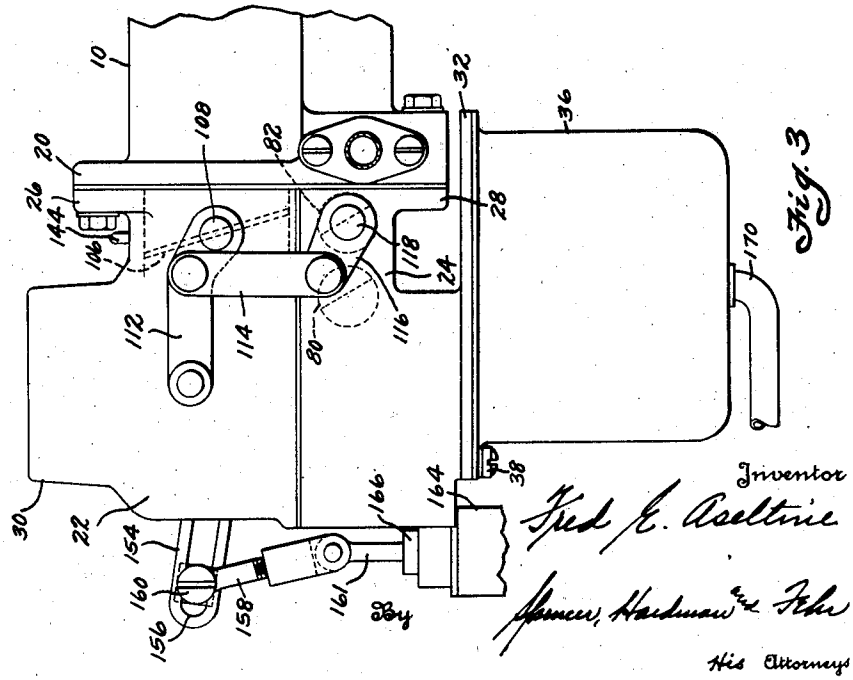


Fig. 3

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CHARGE FORMING DEVICE

Filed July 18, 1928 3 Sheets-Sheet 3

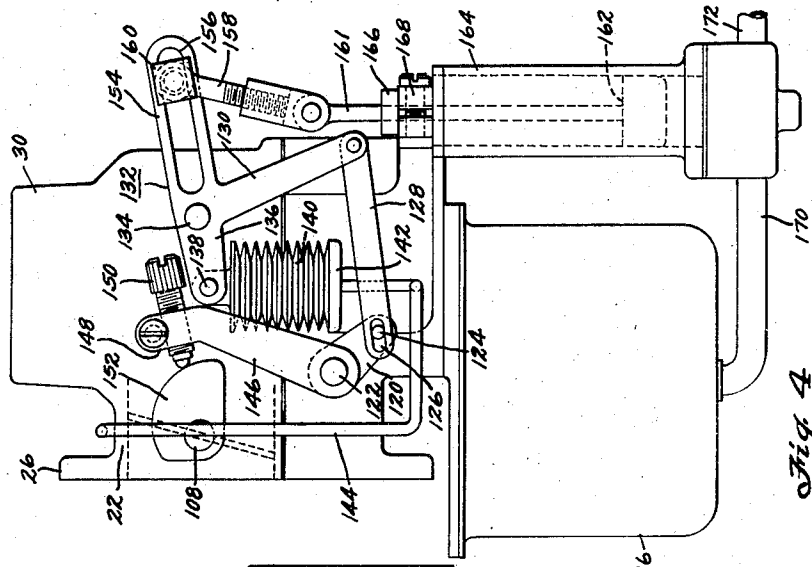


Fig. 4

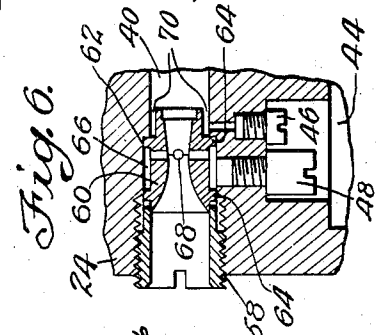


Fig. 6.

Fig. 5

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UNITED STATES PATENT OFFICE

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CHARGE FORMING DEVICE

Application filed July 18, 1928. Serial No. 293,628.

This invention relates to charge forming devices for multi-cylinder engines and more particularly to that type of charge forming device comprising a plurality of primary mixing chambers one for each intake port of the engine which co-operates respectively with a plurality of secondary mixing chambers each located adjacent an engine intake port and receiving primary mixture from a pipe connected with one of the primary mixing chambers, and also receiving air, when required, through one branch of an air manifold which supplies air to all of said secondary carburetors. Liquid fuel is supplied to all of said primary carburetors from a common fuel bowl, the fuel bowl being controlled by a float in the usual manner.

Examples of charge forming devices of this character are disclosed in the following copending applications, Wilford H. Teeter, Serial No. 221,372, filed September 22, 1927, which matured to Patent 1,819,526 granted Aug. 18, 1931, Fred E. Aseltine and Wilford H. Teeter, Serial No. 221,371, filed September 22, 1927, which matured to Patent 1,819,495 granted Aug. 18, 1931, and Fred E. Aseltine, Serial No. 288,684, filed June 27, 1928.

In each of these devices the primary mixture is conveyed to the secondary mixing chambers adjacent the intake ports where it is mixed with additional air. Throttling of the engine is effected by a single primary throttle which controls all the primary carburetors and a single main throttle which controls the admission of air to the secondary carburetors. Various mixture proportioning devices are provided to form a mixture of the desired proportions under all operating conditions.

Charge forming devices of this character have not been always entirely satisfactory during operation under certain conditions. For instance, it has been found difficult to construct a device which will supply a mixture which is rich enough during the accelerating period to give the necessary power and effect smooth and rapid acceleration without supplying a mixture which is too rich during normal operation.

It is the principal object of this invention to provide a charge forming device which is effective to supply the proper quantity of a combustible mixture having the desired proportions of fuel and air which will most satisfactorily operate the engine under all operating conditions. More specifically, it is an object of this invention to provide improved means for controlling the mixture proportions so that during normal operation of the engine at all speeds other than very low speeds, a mixture of such proportions as to give most economical fuel consumption is provided, while during the acceleration period and during operation at very low speeds a richer mixture is supplied to provide the power necessary for satisfactory acceleration, and to secure proper operation of the engine at low speeds.

According to the present invention the above objects are accomplished by the provision of an auxiliary primary throttle controlling the flow through the primary mixture passages, said throttle being operated by engine suction, controlled in part by the manually operable throttle operating mechanism and operating a pump to supply additional fuel during the acceleration period. This auxiliary throttle is so constructed that on opening movement of either or both of the manually operated throttles to accelerate the engine, the immediate decrease in suction above said throttles causes the auxiliary throttle to open to the same extent as the manually operable primary throttle so as not to restrict the primary mixture passages beyond the limit determined by said manually operable throttle during the accelerating period. The auxiliary throttle also operates a pump to supply additional fuel to aid in the formation of a mixture rich enough for satisfactory acceleration. As the engine speeds up after opening of the throttle, the suction increases and operates to move the auxiliary throttle toward closed position, the degree of such movement being controlled by a cam positioned by the manually operable primary throttle. This partial closing of the auxiliary throttle reduces the quantity of primary mixture supplied to the engine after

the acceleration period resulting in economy in fuel consumption.

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 constructed in accordance with the present invention.

Fig. 2 is a front elevation of this device.

Fig. 3 is a side elevation view from the right in Fig. 1.

Fig. 4 is a side elevation viewed from the left in Fig. 1.

Fig. 5 is a vertical section on the line 5—5 of Fig. 2.

Fig. 6 is an enlarged detail section.

The device disclosed herein comprises a main air manifold indicated in its entirety by the reference numeral 10 and having three outlet branches 12, 14, and 16, and each of these branches communicates with one of the intake ports of an internal combustion engine, each of which serves two adjacent cylinders, as disclosed in the copending applications above referred to.

Each of the manifold branches is provided with an attaching flange 18 for securing the manifold to the engine block in the usual manner. A flange 20, to which the carburetor unit may be attached, is provided adjacent the manifold inlet. The carburetor unit comprises an upper housing 22 secured to a lower casting 24 in any desirable manner. The housing 22 and casting 24, when secured together, form a unitary structure which is adapted to be secured to the attaching flange 20. To this end the housing 22 is provided with a flange 26 and the casting 24 with a similar flange 28, these flanges being secured by machine screws to the flange 20, as indicated in Fig. 5. An air inlet horn 30 projects upwardly from the casting 24 and communicates with an opening admitting air to the interior of the housing. A casting 32 having certain fuel passages formed therein is secured by screws 34 to the bottom of the casting 24 and a sheet metal fuel bowl 36 is supported by said casting 32, being secured thereto by screws 38, as shown in Fig. 5.

Fuel is conducted from a main source of supply to the fuel bowl 36 and the flow is controlled by a float (not shown) in the usual manner, in order to maintain a substantially constant level of fuel in the bowl. To convey fuel from the bowl to a plurality of primary mixture passages 40, hereinafter more fully described, a passage 42 is provided in the casting 32. This fuel passage communicates at its upper end with a horizontal fuel canal 44, which communicates with three pairs of calibrated high and low speed fuel jets 46 and 48 respectively, each of these pairs of jets being adapted to admit fuel to one of the passages 40, as fully described in applicant's copending application Serial No. 288,684 filed June 27, 1928.

Fuel is lifted from the fuel bowl to the primary mixture passages by the suction therein. When the throttle is moved toward closed position to reduce the engine speed, this suction may be reduced sufficiently to allow the fuel column between the jets and fuel bowl to drop enough to temporarily starve the engine unless means are provided to prevent this action. This means comprises a check valve 50 positioned in an enlarged chamber 52 at the upper end of the fuel passage 42 where said passage connects with the horizontal fuel channel 44. This valve is normally lifted above a rib 54 projecting upwardly from the bottom of the chamber 52 and surrounding the outlet of the fuel passage 42 by the engine suction, but on reduction of this suction immediately seats on said rib preventing downward flow of fuel through the passage 42. A two stage metering valve 56 of the type disclosed in the above mentioned applications and operating in the same manner is provided in the passage 42 to regulate the flow of fuel to the jets 46 and 48 during engine operation at all speeds.

The primary mixture passages 40, to which the fuel jets deliver fuel, are bored horizontally through the central part of the casting 24, are parallel to each other and are relatively close together, as indicated in the drawings. Air is admitted to the mixture passages through air inlet bushings 58, one of which is screwed into the anterior end of each mixture passage. Immediately posterior to each of these bushings a small Venturi tube 60 is received in an enlargement 62 formed in the primary mixture passage. Each of these tubes is provided with two external ribs 64 arranged circumferentially of the tube and fitting tightly into the enlargement 62. These ribs, form between them a fuel channel 66 with which the low speed jet communicates and a series of orifices 68 are provided in the wall of the Venturi tube to connect the interior of such tube with the channel 66.

Each Venturi tube 60 is reduced in size at its inner end and is spaced from the wall of the mixture passage, as shown in Fig. 5, the space between said Venturi tube and the wall being indicated by the reference numeral 70. The space 70 is substantially a dead air space in which the suction is substantially the same as that maintained in the mixture passage between the Venturi tube and the throttle. Each high speed fuel jet terminates flush with the wall of the mixture passage with which it is associated at a point opposite the reduced inner end of the Venturi tube, so that fuel flows from the jet into the space 70 and is effected solely by the suction

maintained within said space. It will be clear that the suction effective on the low speed jet 48 is greater than the suction effective on the high speed jet 46 and for this reason the low speed jet begins to supply fuel as soon as the engine begins to operate while the high speed jet supplies no fuel until a certain predetermined engine speed is reached. The low speed jets are effective to supply fuel at all speeds and under all operating conditions, supplying all of the fuel for idling and low speed operation under load and a part of the fuel at all other times, while the high speed jets are ineffective until the engine is running at some predetermined speed, for instance, that corresponding substantially to a vehicular speed of 20–25 miles per hour.

Since the low speed jets terminate within the Venturi tube 60 the flow of fuel therefrom is not caused by the suction of the mixture passage but is effected by the considerably higher suction maintained within the Venturi tubes by reason of the air velocity through said tubes, and to the aspirating action of the air current on the orifices 68 as well. In other words, the flow of fuel from the low speed jets is controlled primarily by the velocity head created at said jets by the action of the Venturi tubes 60. The main fuel jets 46, however, which terminate in the space 70 are not subject to the velocity head produced within the Venturi tubes and are shielded from the air current passing through the mixture chambers by the reduced inner end of the Venturi tubes so that there is no aspirating action on said jets by the ingoing current of air. The flow of the fuel from the high speed jets, therefore, is not influenced by the action of the Venturi tubes, but, as previously stated, is due solely to the suction in the space 70, which is substantially the same as the suction of the mixing chamber 40. Owing to the small diameter of the Venturi tubes relative to the diameter of the mixture passages, the velocity of flow through said passages will never be great enough to create any material velocity effect. The suction in the mixing chambers and space 70, therefore, is substantially a static suction. The above described mixture passages and fuel jets therefor, are more fully described in applicant's copending application Serial No. 288,684 filed June 27, 1928.

According to the present invention the flow of primary mixture through the mixture passages 40 is controlled by two primary throttle valves 80 and 82, the valve 82 being manually operated and the valve 80 being an auxiliary valve which is automatically operated in a manner set forth in detail hereinafter. Each of these throttles is journalled in the casting 24 and each is provided with a plurality of grooves 84, which register with the mixture passages. The means for operating these throttle valves will be fully described hereinafter. Each primary mixture passage 40 communicates with a pipe adapted to convey the primary mixture to one of the branches of the manifold 10. There are three of these pipes numbered 86, 88, and 89, associated with the manifold branches 12, 14, and 16 respectively. The pipes 86 and 89, which convey the primary mixture to the end branches 12 and 16 of the manifold, are of substantially the same construction as those disclosed in the copending application above mentioned. The pipe 88, which conveys primary mixture to the middle branch 14 of the manifold, is received in the wall of said manifold, as indicated in Fig. 5, and communicates directly with the central primary mixture passage. As these pipe connections constitute no part of the present invention and are fully shown and described in the application above referred to, they will not be described in detail herein.

All of the air which is mixed with the primary mixture in the secondary mixing chambers is admitted through the air horn 30, the flow being controlled by an air valve 90 normally held against a seat 92 by a spring 94 received between the lower face of the valve and the flange 96 secured to the lower end of a sliding sleeve 98 slidably mounted on a fixed sleeve 100. The parts normally occupy the position shown in Fig. 5 with the flange seated on top of the casting 24. Air passing the valve 90 flows first into a main air chamber 102 and thence through the secondary air passage 104 communicating with the inlet end of the air manifold 10 and provided with a throttle valve 106, secured to a shaft 108, journalled in the housing 22, and operated in a manner fully described hereinafter to regulate the flow of air to the secondary mixing chambers.

The air valve 90 is secured to a stem 110, which extends through the fixed sleeve 100 into the fuel bowl and is provided with a dash pot to control the movements of said valve. This dash pot constitutes no part of this invention and is not illustrated in this application, but is fully shown and described in the applications above referred to.

The flange 96 is adapted to be lifted by a choke mechanism, which is not illustrated, to bring the sliding sleeve 98 into engagement with the lower face of the air valve 90 to hold said valve closed in order to facilitate starting of the engine. Further, the choke mechanism may be partially operated to lift the sleeve 98 in order to increase the tension of the spring 94 which tends to close the air valve. By increasing the tension of the spring, as described, the mixture proportions can be, to a certain extent, regulated.

The mechanism controlling the operation of the throttles 82 and 106 constitutes one feature of the present invention, and this mechanism will now be described. The shaft

108 of the main air throttle is provided with an operating arm 112 secured to said shaft in any desirable manner and adapted to be connected to some suitable form of operating connection extending to a point convenient to the operator of the vehicle. Pivotally connected to the arm 112 is a link 114 which is pivotally connected to an operating arm 116 secured in any desirable manner to a spindle 118 projecting from one end of the primary throttle 82 and integral therewith. By means of these operating connections, the main air throttle and the primary throttle 82 are adapted to be moved simultaneously toward their open and closed positions, but the throttle 82 is so related to the throttle 106 that when the latter is completely closed throttle 82 is slightly open to permit the passage of sufficient mixture for idling and low speed operation. It will be noted that the present construction is somewhat different from the throttle operating mechanism of the devices disclosed in the above mentioned applications. According to the present invention the two throttles are so connected that they operate together at all times and neither can operate independently of the other, while in the earlier cases, the operating connections were so constructed that the primary throttle was opened to a predetermined position before the main air throttle was given any movement.

The auxiliary throttle 80 is automatically operated, but its operation is controlled by the manually operable throttles 82 and 106. The operating mechanism for the throttle 80 comprises an operating arm 120 secured in any desirable manner to a spindle 122 integral with and projecting from one end of the said throttle 80, as shown in Fig. 4. The arm 120 is provided at its free end with a pin 124 engaging a slot 126 in the end of a link 128 which is pivotally connected at its opposite end with one arm 130 of a three armed lever, indicated in its entirety by the number 132, and pivotally mounted on a pin 134 projecting from the housing 22. The arm 136 of said three armed lever is pivotally connected at 138 to the upper end of sylphon 140, the lower end of which is secured to a projecting plate 142 extending outwardly from the casting 24. A suction pipe 144 connects with the passage 104 at a point immediately in advance of the main air throttle, and the other end of such pipe is connected in a hole in the plate 142 and communicates the engine suction to the interior of the sylphon bellows 140, so that the bellows is contracted and expanded in accordance with the variations in suction on the engine side of the air throttle. As the bellows is contracted and expanded, the lever 132 is operated to move the auxiliary throttle 80 to such positions as may be determined by the engine suction.

Also secured to spindle 122 is an arm 146 having its upper end bifurcated to form a split clamp, as shown at 148. A stop screw 150 is threaded into the split clamp and the end of said screw is adapted to engage a cam 152 secured to the shaft 108 of the main air throttle outside of the housing 22. The engagement of stop screw 150 with said cam determines the limit of the closing movement of the auxiliary throttle 80 for any position of the main air throttle and holds said throttle 80 partially open at all times when the air throttle is closed for a purpose fully set forth later.

The three-armed lever 132 is provided with a third arm 154 which operates a fuel pump. At this end the arm 154 is provided with an elongated slot 156 in which the upper end of a turnbuckle 158 may be variably positioned by means of a set screw 160. The lower end of the turnbuckle is connected to a piston rod 161 having a piston 162 on its lower end which is adapted to slide in a cylinder 164 provided with a reduced upper end 166 which is supported in a split clamp 168 projecting from the casting 24. The pump cylinder 164 is adapted to be supplied with fuel from the main fuel chamber 36 by means of a conduit 170 and is provided with a delivery conduit 172 adapted to deliver fuel at any desired point in the mixture passage. The above described pump is a purely conventional form of pump and its specific construction forms no part of the present invention. Illustration of the specific construction of the pump is, therefore, unnecessary. By variably positioning the upper end of the turnbuckle in the slot 156, the movement of the pump piston and the amount of fuel pumped into the mixture passages on any given throttle movement may be regulated as desired. Since the fuel pump is connected to the lever 130, as above described, the pin and slot connection between arm 120 and link 128 allows slight movements of the pump piston and throttle 80 independently of each other.

A passage 180 connects the air chamber 102 with each primary mixture passage. There are three of these passages 180, as shown in Fig. 5, and such passages terminate adjacent the primary throttle 82, being so positioned that they are progressively closed by said throttle as the latter is moved toward open position, and when the throttle 82 is fully open, all of said passages 180 are closed.

The above described mechanism operates as follows: It is necessary to provide a comparatively rich mixture to secure proper engine acceleration when the throttle 82 is opened to increase the vehicular speed and also during engine operation at low speeds before the air throttle is opened. The fuel jets are designed to supply sufficient fuel to form a mixture of proper proportions for low speed operation and sufficiently rich to give satisfactory acceleration, when augmented by the above described pump which operates to

inject additional fuel into the mixture upon any expansion of the sylphon. The mixture would be too rich during normal engine operation at intermediate speeds subsequent to opening of the air throttle and the auxiliary throttle 80 is designed to prevent the formation of too rich a mixture during normal operating conditions at such intermediate speeds.

During operation at low speeds the auxiliary throttle 80 has no effect on the proportioning of the mixture because the cam 152, when the throttle 106 is closed holds the throttle 80 open to a considerable degree, and at such low speeds the throttle 82 constitutes the sole means for controlling the quantity of primary mixture. After a predetermined movement of the throttle 106 the cam 152 reaches a position where the throttle 80 is permitted to move nearer to closed position, the position occupied by throttle 82 and for all opening movements of the throttles after throttle 106 reaches the position referred to, the device operates in the following manner.

Whenever the throttles 82 and 106 are opened, the suction on the engine side of the throttle 106 is reduced permitting expansion of the sylphon 140 and a resulting opening movement of the throttle 80, if the cam 152 is not holding the said throttle open as above described. The throttle 80 will then assume substantially the same position as the throttle 82. Since the throttle 80 does not restrict the primary mixture passages to a greater degree than does throttle 82, it does not interfere with proper engine acceleration and since the fuel pump is operated on expansion of the bellows, additional fuel is forced into the mixture to aid in providing proper acceleration. During the acceleration period the speed of the engine increases with a corresponding increase in the suction on the engine side of the throttle 106 so that at the end of the acceleration period a higher suction is effective to partially contract the bellows, which will move the throttle 80 slightly toward its closed position. This partial closing of the throttle 80 partially restricts the primary mixture passages and reduces the amount of rich mixture supplied to the secondary mixing chambers. The amount of air admitted to the said mixing chambers is not reduced so that the mixture reaching the engine ports is a leaner mixture than was supplied during the acceleration period and during aspiration at low speed when the automatic throttle 80 was ineffective to control the volume of primary mixture supplied to the secondary mixing chambers. The above described closing movement of the throttle 80 is limited by engagement of the stop screw 150 with the cam 152 on the shaft 108.

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 primary mixture passage, means for supplying fuel and air thereto, a manually operated throttle, a secondary mixing chamber into which said mixture passage delivers, an automatically operated throttle for controlling said mixture passage and manually operable means for determining the limit of movement of said automatically operated throttle under certain operating conditions.

2. 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 throttle for controlling said mixture passage and manual and automatic means for operating said throttle.

3. 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 primary throttle for restricting said mixture passage, and other means for also restricting the mixture passage and adapted to be moved automatically after an opening movement of the throttle, to a position to restrict the passage to a greater extent than said passage is restricted by the throttle.

4. 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 manually operable throttle for restricting the mixture passage and automatic means for restricting said mixture passage after an opening movement of the throttle, to a greater extent then said passage is restricted by the throttle.

5. 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 manually operable throttle for restricting the mixture passage, means for restricting said mixture passage after an opening movement of the throttle to a greater degree than the restriction by the throttle and pressure responsive devices operable in accordance with engine suction for operating said restricting means.

6. 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 throttle for controlling said mixture passage, means for operating said throttle auto-

matically, an air throttle for controlling admission of air to the secondary mixing chamber, and means operated by said air throttle for controlling the operation of said automatically operable throttle.

7. 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, an automatically operable throttle for controlling said mixture passage, an air throttle for controlling admission of air to the secondary mixing chamber, and means operated by said air throttle for rendering said automatically operable throttle ineffective while said air throttle is closed.

8. 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 manually operable primary throttle, an automatically operable primary throttle, both of which are adapted to control said mixture passage, and means controlled by engine suction for moving the automatically operated throttle toward closed position on increase of suction in the mixture passage.

9. 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 manually operable primary throttle constituting the sole means for controlling the primary mixture passage at very low speeds, and an automatically operable throttle for modifying the effect of said manually operable throttle at higher speeds.

10. 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 plurality of primary throttles controlling the primary mixture passage, an air throttle controlling admission of air to said secondary mixing chamber and means operated by said air throttle for rendering one of said primary throttles ineffective under certain operating conditions.

11. 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 manually operable primary throttle for controlling said mixture passage and adapted to be opened for acceleration, an automatic primary throttle, and pressure responsive devices for operating said automatic throttle, said devices being constructed to open said throttle as the manually operable throttle is opened and to partially close said throttle immediately after the acceleration period.

12. 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 plurality of primary throttles controlling said mixture passage, pressure responsive devices for operating one of said throttles and a fuel pump operated by said pressure responsive devices for supplying additional fuel during opening movement of the throttles.

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 plurality of primary throttles controlling said mixture passage, pressure responsive devices for operating one of said throttles, a fuel pump operated by said pressure responsive devices for supplying additional fuel for acceleration, and means permitting independent movement of the pump and throttle relative to each other.

14. A charge forming device for mutli-cylinder internal combustion engines comprising a plurality of secondary mixing chambers, a plurality of primary mixing chambers supplying fuel mixture thereto, means supplying fuel and air to said primary mixing chambers, a plurality of primary throttles controlling the flow from said primary mixing chambers, an air throttle controlling admission of air to all of said secondary mixing chambers, common operating means for said air throttle and one of said primary throttles, and means operated by said air throttle for controlling the operation of the other of said primary throttles.

15. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, a throttle operated by fluid pressure for controlling the flow of mixture through the primary mixture passage, and means operated by the air throttle for limiting the closing movement of the fluid pressure operated throttle.

16. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, a throttle operated by fluid pressure for controlling the flow of mixture through the primary

mixture passage, means operated by the air throttle for limiting the closing movement of the fluid pressure operated throttle and means for varying the closed position of the fluid pressure operated throttle independently of the air throttle.

17. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, a throttle operated by fluid pressure controlling the flow of mixture through the primary mixture passage, a stop operated by the air throttle for limiting the closing movement of the automatically operated throttle, an arm movable with said last named throttle and adapted to cooperate with said stop.

18. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, an automatically operated throttle controlling the flow of mixture through the primary mixture passage, a cam operated by the air throttle for limiting the closing movement of the automatically operated throttle, and an arm operated by said automatically operated throttle and adapted to cooperate with said cam.

19. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, an automatically operated throttle controlling the flow of mixture through the primary mixture passage, a cam operated by the air throttle for limiting the closing movement of the automatically operated throttle, an arm operated by said automatically operated throttle, and an adjustable stop member carried by said arm and adapted to engage said cam.

20. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, a primary throttle operated by engine suction for controlling the flow through the primary mixture passage, and means operated by the air throttle for controlling the closing movement of said suction operated throttle.

21. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, a primary throttle operated by engine suction for controlling the flow through the primary mixture passage, a stop member operated by the air throttle for variably controlling the closing movement of the suction operated throttle and means operated by the latter for cooperating with the stop member.

22. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, a primary throttle operated by engine suction for controlling the flow through the primary mixture passage, a cam operated by the air throttle for variably controlling the closing movement of the suction operated throttle, an arm operated by the suction operated throttle, and an adjustable stop member carried by said arm and adapted to engage said cam.

23. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, an automatically operated throttle controlling the flow of mixture through the primary mixture passage, a second primary throttle controlling the primary mixture passage and operated by the air throttle and means also operated by the air throttle for limiting the closing movement of the automatically operated throttle.

24. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, an automatically operated throttle controlling the flow of mixture through the primary mixture passage, a second primary throttle positively connected to the air throttle for operation therewith, and means also operated by the air throttle for controlling

the closing movement of the automatically operated throttle.

25. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, two primary throttles controlling the primary mixture passage, one of which is suction operated, and means operated by the air throttle for variably controlling the closing movement of the suction operated throttle.

26. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, a suction operated primary throttle controlling the primary mixture passage and operated in accordance with suction variations in the air passage posterior to the throttle, and a manually operated throttle also controlling the primary mixture passage.

27. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, a suction operated primary throttle controlling the primary mixture passage and operated in accordance with suction variations in the air passage posterior to the throttle, and means operated by the air throttle for variably controlling the closing movements of said suction operated throttle.

28. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, a suction operated primary throttle controlling the primary mixture passage and operated in accordance with suction variations in the air passage posterior to the throttle, a second primary throttle operated by the air throttle and means also operated by said air throttle for variably controlling the suction operated throttle.

29. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, a primary throttle controlling the primary mixture passage, and pressure responsive means operated by suction in the air passage posterior to the air throttle for operating said primary throttle.

30. 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, an air passage supplying air to the secondary mixing chamber, an air throttle controlling admission of air through said air passage, a primary throttle controlling the primary mixture passage, pressure responsive means operated by suction in the air passage posterior to the air throttle for operating said primary throttle and a lost motion connection between the primary throttle and the pressure responsive means.

31. 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 throttle for controlling the primary mixture passage, a pressure responsive device for operating the throttle, a secondary air passage supplying air to the secondary air chamber, an air throttle in said air passage controlling the flow of air therethrough, and means for communicating the suction posterior to the said air throttle to the pressure responsive device.

32. A charge forming device for internal combustion engines comprising an intake passage, means for suppling fuel and air thereto, manual and suction operated throttle valves in said intake passage for controlling the flow of fuel mixture therethrough, a pressure responsive device for operating said suction operated valve and means for communicating the suction in the intake passage posterior to the valves to said pressure responsive device.

33. A charge forming device for internal combustion engines comprising an intake passage, means for supplying fuel and air thereto, manual and suction operated throttle valves in said intake passage for controlling the flow of fuel mixture therethrough, a pressure responsive device for operating said suction operated valve and adapted to close the valve on increase of manifold vacuum, and means for communicating the suction in the intake passage posterior to the valves to said pressure responsive device.

In testimony whereof I hereto affix my signature.

FRED E. ASELTINE.