Feb. 14, 1933. F. E. ASELTINE 1,897,103

CHARGE FORMING DEVICE

Filed July 3, 1929

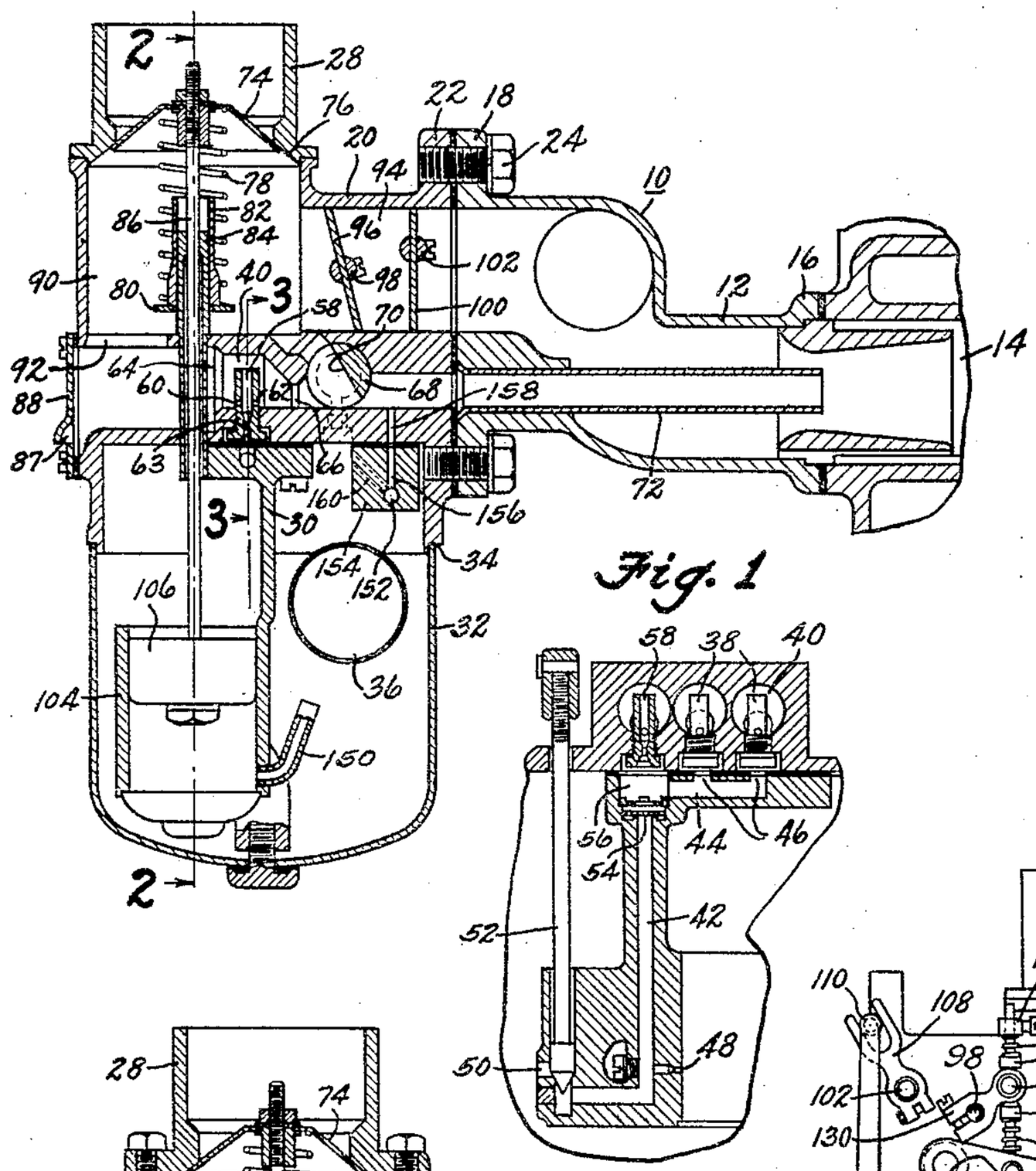

Fig. 1

Fig. 3

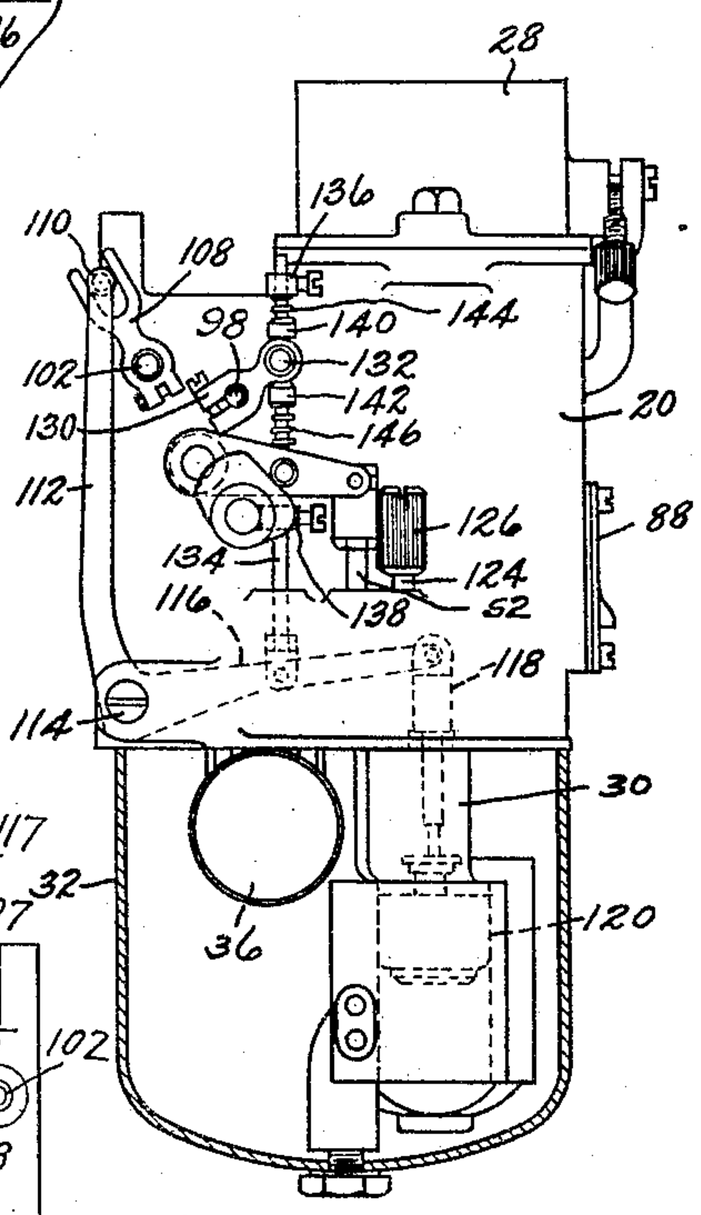

Fig. 4

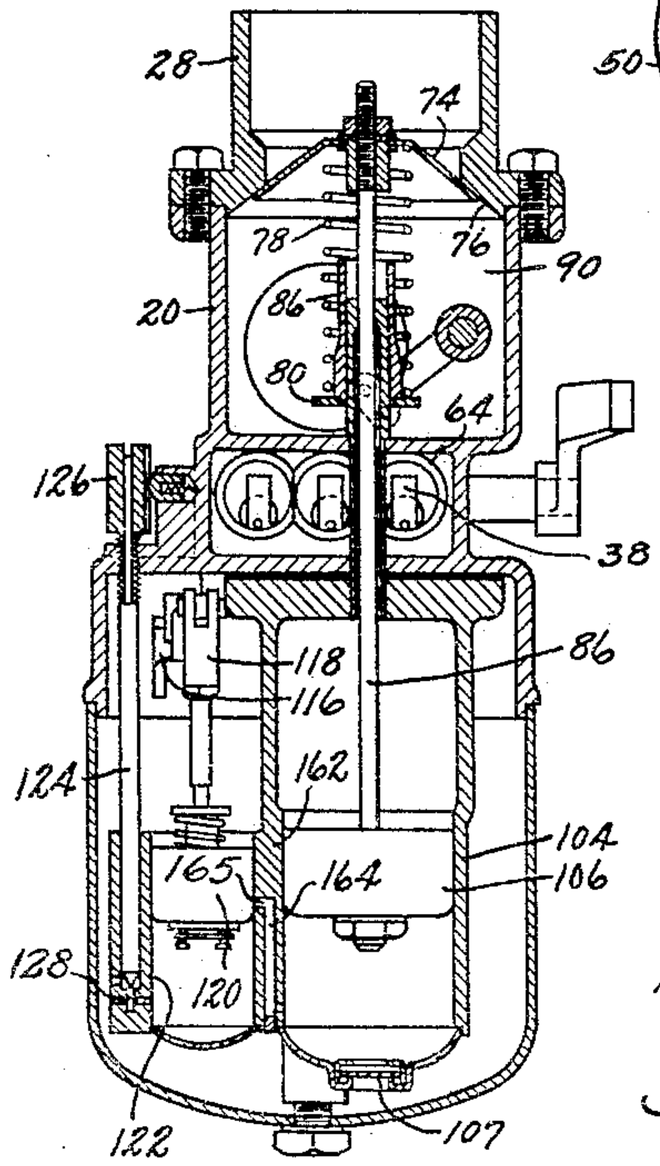

Fig. 2

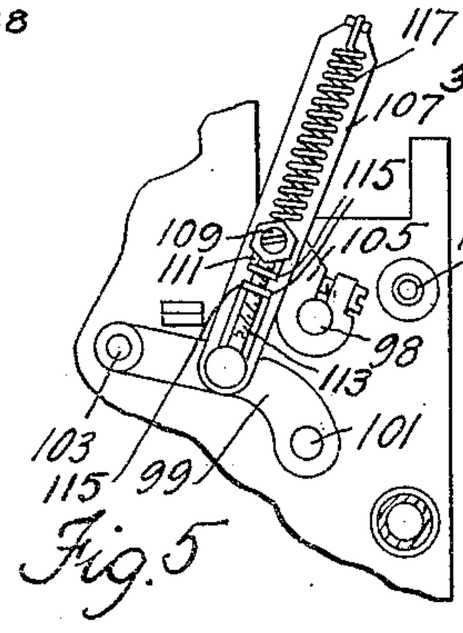

Fig. 5

Inventor

Fred E. Aseltine

By Spencer, Hardman and Fehr

His Attorneys

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UNITED STATES PATENT OFFICE

FRED E. ASELTINE, OF DAYTON, OHIO, ASSIGNOR TO DELCO PRODUCTS CORPORATION, OF DAYTON, OHIO, A CORPORATION OF DELAWARE

CHARGE FORMING DEVICE

Application filed July 3, 1929. Serial No. 375,633.

This invention relates to charge forming devices for internal combustion engines, and more particularly to devices of this character which comprise a plurality of primary carburetors which deliver a primary mixture of fuel and air to a plurality of secondary mixing chambers located adjacent the engine intake ports, and in which the primary mixture is mixed with additional air under certain operating conditions.

A device of this character is disclosed in the copending application of Fred E. Aseltine, Wilford H. Teeter and Carl H. Kindl, Serial No. 288,683, filed June 10, 1928, to which reference may be had for a full disclosure of the device shown herein.

It is one object of the present invention to improve the operation of devices of this character during the acceleration period and more particularly to provide means for enriching the mixture during the acceleration period having means associated therewith to prevent too great enrichment of the mixture during acceleration at relatively high engine speeds.

It is another object of this invention to prevent "ratcheting" of the air valve, that is a tendency for said valve to move toward closed positions as a result of the effect of engine pulsations when the engine is operating at low speed under heavy load with a relatively wide open throttle.

In certain earlier devices of this character means have been provided for enriching the mixture on opening movements of the throttle which include means for retarding the opening of the air valve under such operating conditions. It has been found in certain of these devices that the valve is retarded to so great an extent that when the throttle is opened at relatively high engine speed, the mixture enrichment is sufficient to cause "loading" of the engine. It has been found in devices of this character when a dash pot is employed to resist the opening movement of the air, the valve will gradually move toward closed position if the engine is operating very slowly under heavy load with relatively wide open throttle. This action is apparently due to engine pulsations, the effect of which is not noticeable during operation under other conditions. According to the present invention means are provided for partially relieving the resistance of the air valve dashpot when the throttle is opened at high speed, said means being automatically rendered effective by the auxiliary air valve during its opening movement accompanying the throttle movement and effective to eliminate too much enrichment of the mixture on opening of the throttle as well as the tendency for the air valve to close in the manner above described.

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

In the drawing:

Fig. 1 is a vertical, longitudinal section through a charge forming device constructed in accordance with the present invention and the intake port with which it is associated.

Figs. 2 and 3 are transverse, vertical sections on the lines 2—2 and 3—3 respectively.

Fig. 4 is a left-hand side elevation of the device, certain parts being shown in section.

Fig. 5 is a detail view of the throttle operating mechanism.

The device disclosed comprises a main air manifold 10, having three outlet branches, the middle branch 12 being shown herein. Each of these branches communicates with one of the intake ports 14 of a multicylinder engine. The outlet branches are each provided with an attaching flange 16 for securing the manifold to the engine block in the usual manner, and a flange 18 to which the carburetor unit is secured.

The carburetor unit comprises a main housing 20, having an attaching flange 22, adapted to be secured to the flange 18 by screws 24. An air inlet coupling 28 is secured in position to register with an opening in the upper wall of the housing 20, in any suitable way and may be connected with an air cleaner if desired. A casting 30, in which the passages supplying fuel to the nozzles are formed, is secured by screws to the lower wall

of housing 20, and a sheet metal fuel bowl 32 is held tight against an annular shoulder 34 on the housing 20 by any suitable means. Fuel is conducted from a main source of supply to the fuel bowl through a conduit (not shown) and the flow of fuel to the bowl is controlled by a float 36, operating in the usual manner to maintain a substantially constant level of fuel therein.

Fuel flows from the bowl 32 to a plurality of primary fuel nozzles 38, one of which is located in each of the primary mixing chambers 40, the construction of which is briefly described hereinafter. The fuel conduit between the fuel bowl and the nozzles comprises the vertical fuel passage 42 communicating at its upper end with the horizontal fuel canal 44, which connects with each of the nozzles 38 through an orifice 46. Fuel is admitted from the fuel bowl to the passage 42 at all engine speeds, through a fixed metering orifice 48 and at high speeds additional fuel is admitted through an orifice 50 controlled by a valve 52 operated in the manner set forth in the above mentioned application. This operating means forms no part of the present invention and need not be described further herein.

Fuel is lifted from the fuel bowl through the above described fuel passages and nozzles 38 to the primary mixing chambers by the suction therein. Opening movements of the throttle cause a reduction in mixing chamber suction which might permit the fuel column to drop sufficiently to cause a temporary fuel starving of the engine unless means are provided to prevent this action. For this purpose a check valve 54 is provided in an enlarged chamber 56 at the junction of the channels 42 and 44, and on reduction of mixing chamber suction, seats on the bottom of the chamber, preventing downward flow of fuel.

Each primary fuel nozzle is provided with a main fuel outlet 58 in the top of the nozzle and a secondary fuel outlet comprising two orifices 60 and 62 in the vertical wall of the nozzle near the bottom of tne mixing chamber. At relatively high speeds, the mixing chamber suction is sufficient to lift fuel from the main outlet as well as from orifices 60 and 62. At idling, or low speed operation under load, however, the suction is enough to lift fuel only to some point between the top of the nozzle and the orifices 60 and 62, fuel flowing from these orifices by the action of gravity under such operating conditions. Each nozzle is provided with a restricted fuel metering orifice 63. The primary mixing chambers comprise the enlarged anterior ends of the primary mixture passages 64, which are parallel to each other and close together, as indicated in Fig. 2. When the carburetor is attached to the manifold, these passages register with conduits which convey the primary mixture to the secondary mixing chambers, as fully disclosed in the application above referred to. Restrictions 66 separate the primary mixing chambers from the remainder of the mixture passages to reduce the velocity of flow past the fuel nozzles for a purpose fully set forth in the above mentioned copending application.

A single throttle valve 68, which extends across all the primary mixture passages, controls the flow therethrough and is provided with grooves 70, which register with said mixture passages. This throttle is operated in a manner hereinafter more fully described. The middle primary mixture passage communicates with a tube 72 fixed in the manifold branch 12. This tube constitutes one of the primary mixture conduits above referred to and conveys the primary mixture to the secondary mixing chamber located in the middle branch of the manifold.

Nearly all of the air entering the carburetor flows through the inlet coupling 28 and is controlled by the main air valve 74, normally held against a seat 76 by a spring 78, received between the valve and a flange 80, projecting from a sleeve 82, slidably mounted on a stationary guide sleeve 84, fixed in the housing 20, and serving also as a guide for the stem 86 to which the air valve is secured. When it is desired to choke the carburetor to facilitate starting of the engine, the flange 80 is adapted to be lifted by means not shown herein, but fully described in the above application, until the upper end of the sleeve 82 engages the air valve to hold it closed. Sufficient air to carry the starting fuel from the nozzles to the intake ports is admitted through an elongated slot 87, formed in a plate 88, secured to the housing 20, as shown in Fig. 1.

The valve 74 admits air to the air chamber 90, from which air flows to the primary mixture passages through an orifice 92 in the bottom of the air chamber and to the secondary mixing chambers through a passage 94, which connects with the inlet of the manifold 10. The flow of air through this passage is controlled by a manually operable throttle 96, secured to a shaft 98, rotatably mounted in the main housing and by a suction operated valve 100, secured to a shaft 102, also rotatably mounted in the main housing.

The operating connections for the throttle valves comprise an arm 99 fixed to a spindle 101 projecting from the primary throttle and provided with an orifice 103 in which some suitable operating connection is adapted to be attached. This operating arm is connected by a lost motion connection to an arm 105 secured by a suitable split clamp to the end of shaft 98, which projects outside the housing. An operating link 107 is pivotally connected to the arm 98 and a pin 109 projecting from the free end of arm 105 projects through

a slot 111 in the link 107. A regulating screw 113 is threaded in lugs 115 projecting from the link 107 and may be adjusted to regulate the length of slot 111. A tension spring 117 is connected at one end to the upper end of the link 107 and at its other end to pin 109, the spring tending to hold the pin against the upper end of the slot.

With both throttles closed, the parts are in the position shown in Fig. 1 with the pin 109 in engagement with the screw 113. As the arm 99 is rotated in a counterclockwise direction to open the primary throttle valve, the link 107 moves downwardly to a position where the upper end of slot 111 engages pin 109 before the operating arm 105 of the air throttle is moved, to permit a partial opening of the primary throttle independently of the air throttle. The degree of this opening may be adjusted by suitably adjusting the screw 113, but the parts are generally so adjusted that the primary throttle is opened without accompanying movement of the air throttle until the engine is running at a speed approximating a vehicular speed of twenty—twenty-five miles per hour on a level.

On opening of one or both of the throttle valves, the suction in the air chamber 90 is increased and the valve 74 is opened to admit additional air and increase the quantity of mixture supplied to the engine. The opening of this valve is retarded to prevent fluttering of the valve and to restrict the admission of air so as to enrich the mixture to some extent whenever the throttles are opened. For this purpose a dashpot is provided comprising a cylinder 104 which receives fuel from the reservoir 32, and a piston 106, secured to the lower end of the valve stem 86 by any suitable means. A check valve 107′ is provided in the bottom of the dash pot cylinder to admit fuel thereto on closing movements of the valve and to prevent escape of fuel therefrom as the valve is opened. The specific construction of this dashpot is not material so far as this invention is concerned, and may be any conventional form of liquid dash pot which will properly retard the opening of the air valve.

As hereinbefore stated, the valve 100 which for convenience may be termed an auxiliary air valve is opened primarily by engine suction, after the valve 96 begins to open. Its opening movements are controlled by a dashpot, and to this end an arm 108, having a forked end as shown in Fig. 4, is secured on one end of the shaft 102 in any desirable way. Engaging the forked end of this arm is a pin 110, projecting from an arm 112 forming part of a bell-crank lever, which is pivoted on the housing at 114, and is provided with another arm 116 pivotally connected at its free end to the upper end of a rod 118, in any desirable manner. The rod 118 has mounted on its lower end a piston 120, which is slidable within the cylinder 122. The specific manner of mounting the piston on the rod 118 is not material so far as the present invention is concerned, but is fully described in the above mentioned application. As the valve 100 is opened by engine suction, its movement is resisted by the dashpot, which comprises the piston 120 and cylinder 122, and the resistance of this dashpot to the motion of said valve may be regulated by means of a manually adjustable valve 124, provided with a knurled head 126, by which it may be turned. Adjustment of this valve will regulate the area of the fuel passage 128, which permits escape of fuel from the cylinder 122.

While the valve 100 is primarily operated by engine suction, the movement of the valve 98 also tends to move said valve 100. For this purpose an arm 130 is secured in any desirable manner to the end of shaft 96 and a pin 132, pivoted in the end of the arm has a hole therein in which is received a rod 134, which is pivotally connected at its lower end to the arm 116 of the above mentioned bell-crank lever. Adjustably secured to the rod 134 at points above and below pin 132, are collars 136 and 138 respectively, and between these collars and movable collars 140 and 142 are helical springs 144 and 146, which normally hold the collars 140 and 142 in engagement with the pin 132. Obviously, any movement of the arm 130 will compress one or the other of springs 144 and 146 and will tend to move the bell-crank lever, thus tending to move the valve 100 toward either open or closed position, as fully described in the above mentioned copending application.

In addition to the enrichment of the mixture secured by restricting the flow of air past the main air valve, the air valve dashpot may also be constructed to operate as a fuel pump. For this purpose a pump delivery conduit 150 may communicate with the bottom of the dashpot cylinder and extend to a horizontal passage 152 formed in a distributor block 154, secured to the lower face of the main housing. The channel 152 communicates with three vertical channels 156, which in turn communicate with channels 158 in the wall of the main housing. Passages 160 admit air to the channel 152 to form an emulsion of fuel and air therein which is drawn into the primary mixture passage through the passages 158, in the manner fully described in the above mentioned application. This pump may or may not be employed with the present invention.

In order to restrict the admission of air sufficiently during opening of the throttle at low speed to create sufficient suction at the jets to provide a mixture of the desired richness, it has been found necessary to provide a dashpot which will so retard the opening of the valve 74 that the suction produced at

the jets during opening movements of the throttle at high speed is too great and results in the formation of too rich a mixture under these conditions to properly operate the engine. In order to overcome this difficulty, means are provided according to this invention to vary the resistance which the dashpot offers to the opening of the valve when the throttle is opened from different positions. Specifically, the resistance of the dashpot is reduced under the operating conditions described and this is effected automatically by the dashpot controlling the movement of the valve 100. It will be noted on examination of Fig. 2 that the cylinders 104 and 122 are close together and separated by a wall 162. A passage 164 is formed in this wall and communicates with the bottom of the cylinder 104 as indicated by the numeral 163, and with the cylinder 122 about two-thirds of the distance from the bottom of said cylinder or at whatever point gives the desired result as indicated by the numeral 165. Under normal conditions, the upper end of the passage 164 closed by the piston 120, and said piston remains in position to close this passage during all opening movements of the throttle until the throttle is moved to a relatively wide open position, when the piston 120 which is operated by the valve 100 passes below the upper end of the passage 164 and permits a flow of fuel from the space below the piston 106 so that the resistance to movement of this piston is much reduced after the upper end of the passage 164 is uncovered as described. It will be clear, therefore, that when the throttle is opened to increase the speed when the motor is already running at relatively high speed and less enrichment of the mixture is needed, the resistance to opening of the air valve is much reduced, resulting in the admission of more air for a corresponding movement of the throttle and an increase in quantity of mixture supplied the engine without a corresponding increase in the proportion of the fuel therein.

As indicated hereinbefore, it has been found in earlier devices of this character that when the engine is running slowly under heavy load with relatively wide open throttle, the air valve is gradually moved toward closed position by the effect of engine pulsations. This is due to the fact that such pulsations reciprocate the valve to a certain extent and due to the resistance of the dashpot to opening movement while the closing movement is comparatively free, the closing movement during such reciprocations is greater than the opening with the result that the valve is gradually moved toward its seat, so that the mixture slowly becomes too rich. By providing the by-pass constructed according to this invention to partially eliminate the resistance of the dash pot when the throttle is opened relatively wide, this objectionable action of the air valve is prevented. The by-pass 164 therefore effects two very desirable results. It not only prevents too much enrichment of the mixture on acceleration at relatively high speeds, but eliminates the undesirable "ratcheting" of the air valve as described above.

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, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve controlling the admission of air thereto, means controlling the operation of said valve, an air passage, and pressure operated means in said passage for regulating the effect of said valve controlling means.

2. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve controlling the admission of air thereto, means for resisting the opening movement of said valve, an air passage, and pressure operated means in said passage for regulating the resistance offered by said resisting means to the movement of said valve.

3. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve controlling the admission of air thereto, a dash pot for resisting opening movement of the valve, an air passage, and pressure operated means in said passage for regulating the resistance offered by the dash pot.

4. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve controlling the admission of air thereto, an auxiliary air valve, and means controlled by said auxiliary air valve for regulating the operation of said main air valve.

5. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve controlling the admission of air thereto, an auxiliary air valve, means controlling the operation of said main air valve, and means controlled by said auxiliary air valve for regulating the operation of said controlling means.

6. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve controlling the admission of air thereto, an auxiliary air valve, means resisting the opening movement of the main air valve, and means controlled by said auxiliary air valve for regulating the resistance of said resisting means.

7. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve controlling the admission of air thereto, an auxiliary air valve, means normally retarding the opening movement of the main air valve and means controlled by said auxiliary air valve for rendering said retarding means ineffective on opening of the throttle under certain operating conditions.

8. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve controlling the admission of air thereto, an auxiliary air valve, means normally retarding the opening movement of the main air valve and means controlled by said auxiliary air valve for rendering said retarding means ineffective after a predetermined opening movement of the throttle.

9. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve controlling the admission of air thereto, means controlling the operation of said valve, and means operated by the blast of the entering air for regulating the effect of said valve controlling means.

10. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve controlling the admission of air thereto, means controlling the operation of said valve, an auxiliary air passage, and means located in said auxiliary air passage and operated by the blast of air passing through said auxiliary passage for regulating the effect of said valve controlling means.

11. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve controlling the admission of air thereto, a dash pot for retarding the opening movement of said valve, an auxiliary air passage, and means located in said auxiliary air passage and operated by the blast of air passing through said auxiliary air passage for reducing the resistance of the dash pot to movement of said valve.

12. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve controlling the admission of air thereto, a dash pot for retarding the opening movement of said valve, an auxiliary air passage, and means located in said auxiliary air passage and operated by the blast of air passing through said auxiliary air passage when the throttle is opened to a predetermined position for reducing the resistance of the dash pot to movement of said valve.

13. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve controlling the admission of air thereto, means for retarding the opening of the air valve whereby the mixture is enriched for acceleration and the said valve tends to move toward closed position because of the action of engine pulsations during operation under certain predetermined conditions, and means for modifying the action of the retarding means when the engine is operating under said conditions, whereby the effect of engine pulsations is eliminated and the mixture is prevented from becoming too rich at high engine speeds.

14. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve controlling the admission of air thereto, a dash pot for retarding the opening of the air valve whereby the mixture is enriched for acceleration and the said valve tends to move toward closed position because of the action of engine pulsations during operation under certain predetermined conditions, and means for reducing the resistance of the dash pot when the engine is operating under said conditions whereby the effect of engine pulsations is eliminated and the mixture is prevented from becoming too rich at high engine speeds.

15. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve, an auxiliary air valve, dash pots controlling the motion of both said air valves, and a passage connecting the cylinders of said dash pots and permitting a flow of liquid from one cylinder to the other under certain operating conditions.

16. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve, an auxiliary air valve, dash

pots controlling the motion of both said air valves, and a passage permitting escape of fuel from the dash pot controlling the main air valve, and adapted to be controlled by the piston of the dash pot governing the auxiliary valve.

17. A charge forming device for internal combustion engines comprising a mixing chamber, fuel and air inlets therefor, a throttle controlling the flow of mixture therefrom, a main air valve, an auxiliary air valve, dash pots controlling the motion of both said air valves, and a passage permitting escape of fuel from the main air valve dash pot, said passage being normally closed by the piston of the dash pot governing the auxiliary valves and adapted to be opened after a predetermined movement of said auxiliary valve.

18. A charge forming device for internal combustion engines comprising a plurality of secondary mixing chambers, a plurality of primary carburetors adapted to supply a primary mixture thereto, means for supplying fuel and air to said carburetors, a main air valve controlling admission of air to all of said carburetors, an auxiliary air valve regulating the flow of air to all of said secondary mixing chambers, means controlling the operation of said main air valve and means operated by said auxiliary air valve for regulating the effectiveness of said controlling means.

19. A charge forming device for internal combustion engines comprising a fuel reservoir, a mixing chamber, a fuel inlet therefor, a passage admitting air to said mixing chamber, a suction operated valve in said passage, a dash pot for controlling the opening movement of said valve comprising a cylinder and piston slidable therein and an additional suction operated piston for controlling the effectiveness of said dash pot.

20. A charge forming device for internal combustion engines comprising a fuel reservoir, a mixing chamber, a fuel inlet therefor, a passage admitting air to said mixing chamber, a suction operated valve in said passage, a dash pot for controlling the opening movement of said valve comprising a cylinder and piston slidable therein, an auxiliary cylinder communicating with the dash pot cylinder, a port in said auxiliary cylinder communicating with said fuel reservoir and adapted to control the effectiveness of the dash pot and a piston in the auxiliary cylinder for controlling the port.

21. A charge forming device for internal combustion engines comprising a fuel reservoir, a mixing chamber, a fuel inlet therefor, a suction operated valve controlling admission of air to said mixing chamber, a dash pot for resisting opening movements of said valve comprising a cylinder and a piston slidable therein, an auxiliary cylinder communicating with the dash pot cylinder, a piston in said auxiliary cylinder normally held in position to render the dash pot effective, but adapted to be moved to a position to render the dash pot ineffective when there is any relatively great increase in suction on the air valve.

22. A charge forming device for internal combustion engines comprising a fuel reservoir, a mixing chamber, a fuel inlet therefor, a suction operated valve controlling admission of air to said mixing chamber, a dash pot for resisting opening movements of said valve comprising a cylinder and a piston slidable therein, an auxiliary cylinder communicating with the dash pot cylinder, a piston in said auxiliary cylinder, a port in said auxiliary cylinder communicating with the fuel reservoir and adapted to control the resisting effect of the dash pot, and means normally holding the last named piston in position to close the port to render the dash pot effective.

23. A charge forming device for internal combustion engines comprising a fuel reservoir, a mixing chamber, a fuel inlet therefor, a suction operated valve controlling admission of air to said mixing chamber, a dash pot for resisting opening movements of said valve comprising a cylinder and a piston slidable therein, an auxiliary cylinder communicating with the dash pot cylinder, a piston in said auxiliary cylinder, a port in said auxiliary cylinder communicating with the fuel reservoir and adapted to control the resisting effect of the dash pot, resilient means normally holding the piston in said auxiliary cylinder in position to close the port and render the dash pot effective to resist normal opening movements of the air valve, said resilient means being adapted to yield to permit movement of the last named piston to position to open the port and render the dash pot ineffective when the suction on the air valve is sufficient to overcome the pressure of said resilient means on the piston.

In testimony whereof I hereto affix my signature.

FRED E. ASELTINE.