April 5, 1932. W. H. TEETER ET AL 1,852,762

CHARGE FORMING DEVICE

Filed Sept. 27, 1928

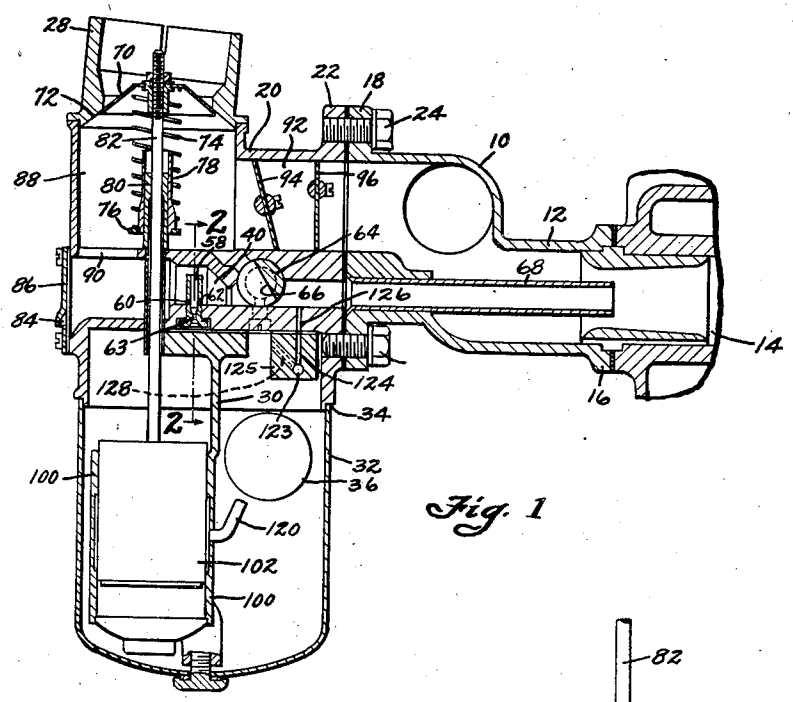

Fig. 1

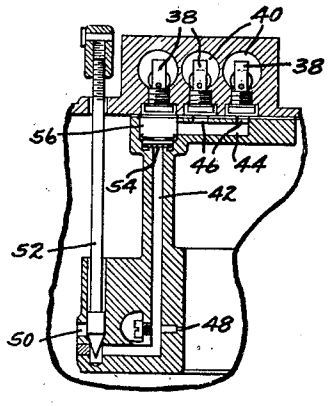

Fig. 2

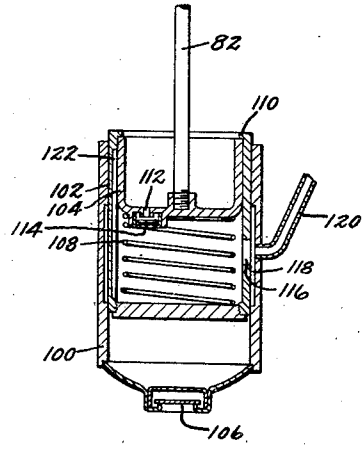

Fig. 3

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UNITED STATES PATENT OFFICE

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CHARGE FORMING DEVICE

Application filed September 27, 1928. Serial No. 308,846.

This invention relates to charge forming devices for internal combustion engines and more particularly to the type of charge forming device which comprises a plurality of primary mixing chambers, one for each intake port of the engine, which cooperate with a plurality of secondary mixing chambers located adjacent the engine intake ports and which receive primary fuel mixture from the primary mixing chambers while receiving air, when required, through the branches of an air manifold having a single inlet and adapted to supply air to all of the secondary mixing chambers. The quantity of mixture supplied the engine is controlled principally by a single air throttle and a common reservoir supplies fuel to all the primary mixing chambers.

Examples of charge forming devices of this character are disclosed in the copending application of Wilford H. Teeter, Serial No. 221,372, filed September 22, 1927, and that of Fred E. Aseltine, Carl Kindl and Wilford H. Teeter, Serial No. 288,683, filed June 27, 1928.

In the devices disclosed in these applications and in other devices of this character heretofore known, various mixture proportioning devices have been provided to secure the formation of a mixture having the desired proportions to most satisfactorily operate the engine under all operating conditions. These mixture proportioning devices have included pumps of various types, operated on opening movements of the throttle to supply additional fuel to the mixture passage for the purpose of enriching the mixture to the extent necessary to properly operate the engine during the acceleration period, and means for temporarily retarding the opening of the air valve on opening of the throttle to restrict the entry of air and assist the action of the pump. The pumps provided in these devices heretofore constructed and the means for retarding the opening of the air valve have not been altogether satisfactory because they have not proved uniform in their action and have not been always effective to supply the amount of fuel desired, under some conditions of operation supplying a mixture which is too rich and under other operating conditions operating to form a mixture which is too lean.

It has been found desirable to enrich the mixture to some extent on any opening movement of the throttle, to enrich said mixture to substantially the same degree on any rapid opening movement of said throttle, irrespective of the extent of the throttle movement and to enrich the mixture slightly throughout any very slow opening movement of said throttle. It is, accordingly, the general object of this invention to provide means for enriching the mixture during the acceleration period, which is simple in construction, positive and uniform in its action and which is effective to enrich in the manner referred to immediately above.

More specifically, it is the object of the invention to provide a fuel pump which is operative on very slow opening movements of the throttle to force additional fuel into the mixture passage throughout substantially the entire throttle movement, the amount of fuel varying in accordance with throttle movement, but which on relatively rapid opening of the throttle is effective to supply substantially the same amount of additional fuel, irrespective of the amount of throttle movement or its position at the beginning of such movement.

It is a further specific object of the invention to provide means for retarding the opening of the air valve on opening movements of the throttle which is effective to retard the valve throughout substantially the entire movement of the throttle when the latter is opened slowly, but is operative to retard the opening of said valve during only a part of the movement of said throttle when it is opened rapidly, and to retard the opening of the valve to substantially the same degree when the throttle is opened rapidly, irrespective of the amount of throttle movement, or its position at the beginning of such movement.

These objects are accomplished according to the present invention by the provision of a fuel pump in the form of a dash pot, the piston of which is connected with the main air

valve which is opened by suction on opening movements of the throttle. The cylinder of the dash pot comprises an outer fixed cylinder and an inner cylinder slidable therein and in which the dash pot piston slides. A by-pass is formed in the inner surface of the slidable cylinder which is normally closed by the dash pot piston, but which is opened after the said piston has made a slight downward movement, said slidable cylinder being held against any appreciable movement during the downward movement of the piston. During the downward movement of the piston fuel is pumped to the mixture passage and opening movement of the air valve is materially retarded, but as soon as the by-pass becomes effective, the pumping of fuel ceases and the valve is permitted to move substantially freely. After the piston comes to rest, the slidable cylinder moves slowly downward until it assumes the same position relative to the piston that it occupies originally and on the next opening movement of the throttle, the above described action is repeated. If the throttle is opened very slowly, the inner piston does not move appreciably relative to the dash pot piston and a small amount of fuel will be pumped throughout the opening movement of the throttle and the dash pot action will not be relieved as above described.

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 the present invention is clearly shown.

In the drawings:

Fig. 1 is a vertical longitudinal section through a charge forming device of this character showing one outlet branch of the manifold.

Fig. 2 is a section on line 2—2 of Fig. 1.

Fig. 3 is a detail section of the dash pot.

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 multi-cylinder engine. These outlet branches are each provided with an attaching flange 16 for securing the manifold to the engine block in the usual manner. Adjacent the inlet of the manifold is provided a flange 18 to which the main carburetor unit is adapted to be attached, as shown in Fig. 1.

The carburetor unit comprises a main housing 20 having an attaching flange 22 adapted to be secured to flange 18 by screws 24. An air inlet horn 28 is secured in position to register with an opening in the upper wall of housing 20, in any suitable way. A casting 30, having certain dash pot chambers and fuel passages formed therein, 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 by any suitable means. Fuel is conducted from a main source of supply to the fuel bowl through a conduit not shown herein 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 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 a vertical fuel passage 42 communicating at its upper end with a horizontal fuel canal 44 which connects with each of the nozzles 38 through orifices 46. Fuel is admitted from the fuel bowl to passage 42 at low speeds through a fixed metering orifice 48 and at high speeds additional fuel is admitted through an orifice 50 controlled by a valve 52 in the manner set forth in the above mentioned application.

Fuel is lifted from the fuel bowl through the above described fuel passages and nozzles 38 to the mixing chambers by the suction therein. Closing 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 were provided to prevent it. For this purpose a check valve 54 is provided in an enlarged chamber 56 at the junction of channels 42 and 44, and on reduction of mixing chamber suction seats on the bottom of its chamber, preventing downward flow of the 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 near the bottom of the vertical wall of the nozzle. At relatively high speeds the mixing chamber suction is enough to lift fuel from the main outlet as well as from holes 60 and 62. At idle or low speeds, however, the suction is sufficient to lift fuel only to some point between the top of the nozzle and orifices 60 and 62, fuel flowing from these orifices by action of gravity. Each nozzle is provided with a restricted fuel metering orifice 63. The primary mixture passages 38 are parallel to each other and close together as indicated in Fig. 2, and 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 copending application referred to.

A single throttle valve 64, which extends across all the primary mixture passages, controls the flow therethrough and is provided with grooves 66 which register with said mixture passages. This throttle is operated by means fully disclosed in the above copending

application and which forms no part of the present invention. The middle primary mixture passage connects with a tube 68, fixed in the manifold branch 12, which conveys the primary mixture to the secondary mixing chamber in that branch of the manifold.

Substantially all the air entering the carburetor flows through the air horn 28, controlled by a main air valve 70, normally held against a seat 72 by a spring 74 received between the valve and a flange 76 projecting from a sleeve 78 slidably mounted on a stationary guide sleeve 80, fixed in the housing 20 and serving as a guide sleeve for the stem 82 to which the air valve is secured.

When it is desired to choke the carburetor to start the engine, the flange is adapted to be lifted, by means not shown herein, until the upper end of sleeve 78 engages the valve to hold it against its seat. Sufficient air to carry the starting fuel from the nozzles to the intake ports is admitted through an elongated slot 84 formed in a plate 86 secured to the housing 20, as shown in Fig. 1.

The valve 70 admits air to a main air chamber 88 from which air flows to the primary mixture passages through an orifice 90 in the floor of the air chamber and to the secondary mixing chambers through a passage 92, which connects with the inlet of the manifold 10. A manually operable throttle 94 and a suction operated valve 96 control the flow of air through passage 92 and the operating connections for said valves are fully disclosed in the above mentioned application.

On opening of either or both throttle valves 64 and 94, the suction in the air chamber becomes sufficient to open the valve against the pressure of its spring to admit additional air and increase the quantity of mixture supplied to the engine. The opening of the valve must be retarded to some extent, however, to prevent admission of sufficient air to lean the mixture. To accomplish this result and to prevent fluttering of the air valve, a dash pot is provided which also constitutes a fuel pump to supply additional fuel to the mixture passage during the acceleration period.

The dash pot comprises a fixed outer cylinder 100 formed integral with the casting 30, an inner cylinder 102 which is slidable in the outer cylinder 100 and a piston 104 screwed on the lower end of the valve stem 82, or secured thereto in any desirable manner. Fuel is admitted to the outer cylinder through a port in the bottom controlled by a check valve 106 of the usual construction and the bottom of the inner cylinder is solid so that fuel can escape from the outer cylinder only by leakage between it and the inner cylinder 102. A spring 108 is provided between the piston 104 and the inner cylinder which normally retains the parts in the position shown in Fig. 3, with the upper end of the piston held against an inwardly projecting shoulder 110 on the upper end of the inner cylinder 102. An orifice 112 in the piston 104 permits the passage of fuel therethrough on upward movement of said piston to enable free movement thereof and to fill the inner cylinder 102 with fuel, while a check valve 114 prevents any flow of fuel through such orifice when the piston moves downwardly. An orifice 116 permits fuel to flow from the interior of the inner cylinder to a wide channel 118 formed in the inner wall of the fixed cylinder 100 and communicating with a fuel delivery conduit 120 operating to convey additional fuel to the primary mixture passages on descent of the piston 104 in the manner hereinafter set forth. As will be pointed out hereinafter, the inner cylinder is moved relative to the outer cylinder by the spring 108, being moved toward the bottom of the outer cylinder as the throttle is progressively opened and the channel 118 is of such width that the orifice will register with said channel in every possible position of the inner cylinder. A channel 122 is formed in the inner wall of the inner cylinder 102, the upper end of such channel being positioned a short distance below the shoulder 110. As the upper end of such channel is uncovered during the downward movement of the piston 104, the dash pot resistance is relieved and the delivery of fuel through the conduit 120 ceases.

The above described dash pot and pump operates substantially as follows. It may be assumed that all the parts are stationary and the parts of the dash pot occupy the position shown in Fig. 3. With the parts occupying this position, the throttle is opened relatively rapidly to increase the speed. The suction below the air valve 70 is increased and the air valve and piston 104 are moved downwardly. Since the fuel can escape from below the sliding cylinder 102 only by leakage which is very slow, the sliding cylinder is held substantially stationary as the throttle is opened, so that the piston 104 moves downward relative to the said cylinder 102 collapsing the spring 108, forcing fuel through the conduit 120 and resisting the air valve movement until the upper edge of the cylinder moves below the upper end of the channel 122. After the piston reaches this position and fuel is permitted to pass from below said piston through the channel 122, the delivery of fuel through conduit 120 ceases and the resistance of the dash pot to opening of the air valve is substantially eliminated. The spring 108 then forces the movable cylinder 102 slowly downwardly as the fuel below said cylinder escapes by leakage, until the resistance to fuel flow between the two cylinders is equal to the pressure of the spring 108, the parts of the dash pot, thus assuming their original positions relative to each other after any opening movement of the throttle.

It will be clear from the above that any

relatively rapid opening of the throttle will result in opposing the opening of the air valve to a definite degree and simultaneously pumping a definite amount of additional fuel into the mixture, the pumping action and the resisting of the air valve opening ceasing at the same time. It will also be clear that, since the parts of the dash pot and pump assume their original position after each operation of the throttle, the operation of said dash pot and pump is the same on any relatively rapid opening of the throttle, irrespective of the position of the throttle at the time the opening movement begins. The resistance of the dash pot prior to the opening of the channel 122 during downward movement of the piston 104 is determined by the size of the delivery conduit 120. This conduit should, therefore, be made quite small.

The delivery conduit 120 connects with a horizontal fuel channel 123 bored in the casting 125 and connecting with three passages 124 which communicate with three passages 126 in the main housing 20, each of which communicates with one of the primary mixture passages 40, as shown in Fig. 1. One or more air passages 128 admit air to the channel 123 which form an emulsion with the fuel in said channel, this emulsion being drawn through passages 124 and 126 on downward movement of the piston 104.

Air is admitted to the channel 123 to prevent the high suction in the mixture passages acting to draw fuel from the cylinder 100 independently of the pumping action of the piston 104. The suction in the mixture passages would be sufficient under all conditions of operation to lift fuel from the cylinder unless the fuel delivery passage were vented, while it is desirable to supply this additional fuel only on opening of the throttle. It is desirable to admit sufficient air to the channel 123 to reduce the suction effective on the delivery conduit 120, so that said suction is enough to lift fuel to a point slightly below the channel 123, but no higher.

A secondary mixing chamber is associated with each outlet branch of the manifold, one of such mixing chambers being shown herein. Each of these mixing chambers comprises a Venturi tube 130 clamped between the manifold and the engine block when the manifold is secured to the engine, and positioned so that the outlet of the primary mixture delivery conduit associated therewith terminates at the point of greatest suction therein. These Venturi tubes constitute no part of the present invention, but function in the manner set forth in the above copending applications.

It will be understood that the dash pot may be designed to control the movements of the air valve only and not act as a fuel pump. In such event, the dash pot would be constructed without the orifice 116 and channel 118. The operation of the dash pot would be exactly the same if so constructed, as it is when constructed as previously described. On slow opening movements of the throttle the spring 108 would not be collapsed and the dash pot would provide resistance to the opening of the air valve throughout practically the entire throttle movement, while on rapid openings of the throttle the spring 108 would be collapsed, the fuel within the inner cylinder permitted to escape and the resistance of the dash pot relieved, as previously described.

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 mixture passage, means for supplying fuel and air thereto, a throttle, an air valve regulating the supply of air to the mixture passage and means operative on any relatively rapid opening movement of the throttle to resist the opening of the air valve, said resisting means being so constructed that its total resistance is substantially the same, irrespective of the amount of movement of the throttle.

2. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve regulating the supply of air to the mixture passage and means operative on any relatively rapid opening movement of the throttle to resist the opening of the air valve, said resisting means being so constructed that its total resistance is substantially the same irrespective of the position of the throttle at the beginning of its opening movement.

3. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve regulating the supply of air to the mixture passage and means operative on any relatively rapid opening movement of the throttle to resist the opening of the air valve, said resisting means being so constructed that its total resistance is substantially the same irrespective of the position of the throttle at the beginning of its opening movement and of the amount of such movement.

4. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve regulating the supply of air to the mixture passage, means operative on any very slow opening movement of the throttle to resist the opening of the air valve throughout such throttle movement, and effective on relatively rapid opening movements of the throttle to resist the opening of the air valve during only a part

of its movement and to substantially the same degree irrespective of the amount of throttle movement.

5. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve regulating the supply of air to the mixture passage, and means operative on any very slow opening movement of the throttle to resist the opening of the air valve throughout such throttle movement, and operative on relatively rapid opening movements of the throttle to resist the opening of said air valve during only a part of the movement of the throttle.

6. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve regulating the supply of air to the mixture passage, and means operative on any very slow opening movement of the throttle to resist the opening of the air valve throughout such throttle movement, and operative on any relatively rapid opening of the throttle to resist the opening of said valve, said resisting means being so constructed that its total resistance is substantially the same irrespective of the amount of movement of the throttle.

7. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve regulating the supply of air to the mixture passage, means operative on opening movements of the throttle to supply additional fuel to the mixture passage and to simultaneously resist opening of the air valve and means operative on any relatively rapid opening of the throttle to render said last mentioned means ineffective after a predetermined movement of the throttle.

8. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve regulating the supply of air to the mixture passage, and means operative on any very slow opening movement of the throttle to resist the opening movement of the air valve and to supply additional fuel throughout such throttle movement, and means operative on any relatively rapid opening movement of the throttle for rendering said last mentioned means effective to resist the opening of the air valve during only a part of its opening movement and to supply only a limited quantity of fuel during a part of the movement of said valve.

9. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve controlling the supply of air to said mixture passage, and means operable on any rapid opening of the throttle to resist the opening of the air valve to substantially the same degree comprising a dash pot having an outer fixed cylinder, an inner cylinder movable relative thereto, and a piston slidable within the inner cylinder, said piston being adapted to move with the inner cylinder when the throttle is opened relatively slowly.

10. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve controlling the supply of air to said mixture passage, and means operable on any rapid opening of the throttle to resist the opening of the air valve to the same degree comprising a dash pot having an outer fixed cylinder, an inner cylinder movable relative thereto, a piston slidable within the inner cylinder and a by-pass in said inner cylinder rendered effective after a predetermined movement of said piston to render the dash pot ineffective.

11. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve controlling the supply of air to said mixture passage and means operable on any rapid opening of the throttle to resist the opening of the air valve to the same degree comprising a dash pot having an outer fixed cylinder, an inner cylinder movable relative thereto, a piston slidable within the inner cylinder, a by-pass in said inner cylinder rendered effective after a predetermined movement of said piston to render the dash pot ineffective and means for moving the inner cylinder relative to the piston on each movement of the throttle to restore the parts to their original positions whereby on each succeeding movement of the throttle the dash pot will produce the same effect.

12. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve controlling the supply of air to said mixture passage, and means operable on any rapid opening of the throttle to resist the opening of the air valve to a given degree and to simultaneously supply a given amount of additional fuel to said mixture passage, comprising a dash pot having relatively movable inner and outer cylinders, a piston slidable within said inner cylinder and a fuel delivery conduit communicating with the interior of said inner cylinder.

13. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve controlling the supply of air to said mixture passage, and means operable on any rapid opening of the throttle to resist the opening of the air valve to a given degree and to simultaneously supply a given amount of additional fuel to said

mixture passage, comprising a dash pot having relatively movable inner and outer cylinders, a piston slidable within said inner cylinder, means for moving said inner cylinder toward the bottom of the outer cylinder as the throttle valve is opened and a fuel delivery conduit communicating with the inner cylinder in any position of said cylinder.

14. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve controlling the supply of air to said mixture passage, means operable to simultaneously resist the opening of the air valve and supply additional fuel to the mixture passage on opening movements of the throttle comprising a dash pot having relatively movable inner and outer cylinders and a fuel delivery conduit communicating with said inner cylinder.

15. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve controlling the supply of air to said mixture passage, means operable to simultaneously resist the opening of the air valve and supply additional fuel to the mixture passage on opening movements of the throttle comprising a dash pot having relatively movable inner and outer cylinders, a fuel delivery conduit communicating with said inner cylinder and a by-pass for rendering said dash pot ineffective under certain operating conditions.

16. A charge forming device for multicylinder engines comprising a plurality of mixture passages, each of which is adapted to deliver mixture to a separate intake port, means for supplying fuel and air to said passages, a throttle controlling the flow through all said passages, a valve controlling the supply of air to all said passages, and means for resisting the opening of said valve to substantially the same degree and simultaneously supplying a given quantity of additional fuel to said passages on any relatively rapid opening movement of the throttle irrespective of the amount of such throttle movement.

17. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve regulating the supply of air to the mixture passage and a dashpot operative on any relatively rapid opening movement of the throttle to resist the opening of the air valve, said dash pot being so constructed that its total resistance is substantially the same irrespective of the amount of movement of the throttle.

18. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve regulating the supply of air to the mixture passage and a dashpot operative on any relatively rapid opening movement of the throttle to resist the opening of the air valve, said dash pot being so constructed that its total resistance is substantially the same irrespective of the position of the throttle at the beginning of its opening movement.

19. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve regulating the supply of air to the mixture passage and a dashpot operative on any relatively rapid opening movement of the throttle to resist the opening of the air valve, said dash pot being so constructed that its total resistance is substantially the same irrespective of the position of the throttle at the beginning of its opening movement and of the amount of such movement.

20. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve regulating the supply of air to the mixture passage, and means operative on any relatively rapid opening movement of the throttle to resist the opening of the air valve, said resisting means being so constructed that its total resistance is substantially the same (irrespective of the amount of opening movement of the throttle), and operative to simultaneously supply additional fuel to the mixture passage.

21. A charge forming device for internal combustion engines comprising a mixture passage, means for supplying fuel and air thereto, a throttle, an air valve regulating the supply of air to the mixture passage, and means operative on any relatively rapid opening movement of the throttle to resist the opening of the air valve, said resisting means being so constructed that its total resistance is substantially the same (irrespective of the position of the throttle at the beginning of its opening movement), and operative to simultaneously supply additional fuel to the mixture passage.

In testimony whereof we hereto affix our signatures.

WILFORD H. TEETER.
CARL H. KINDL.