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CHARGE FORMING DEVICE

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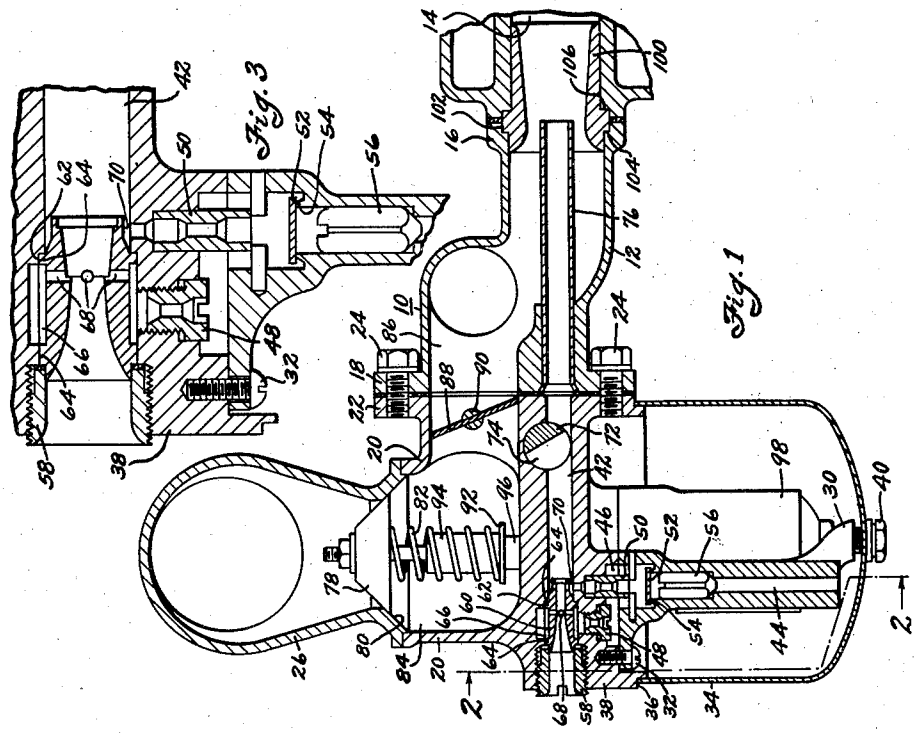


Fig. 1

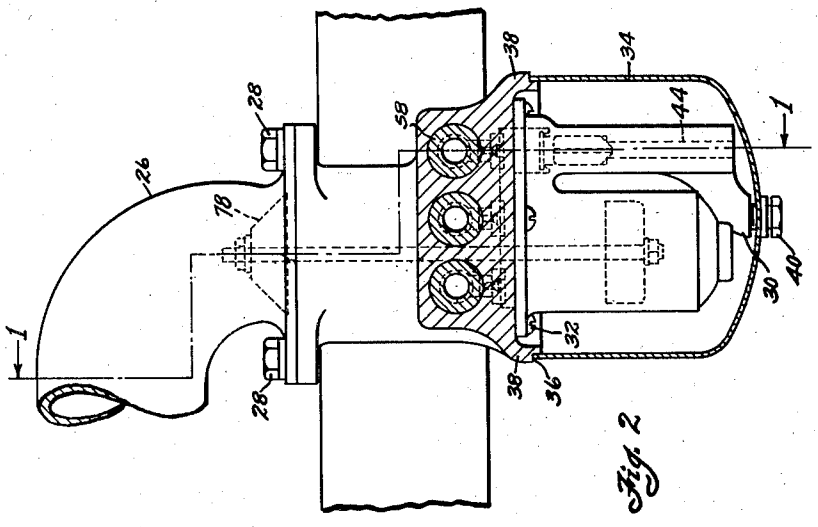


Fig. 2

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CHARGE FORMING DEVICE

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16 Claims. (Cl. 261—41)

This invention relates to a charge forming device for internal combustion engines and more particularly to the type of charge forming device comprising a plurality of primary fuel mixing chambers, one for each engine intake port and ccoperating respectively with the plurality of secondary mixing chambers each located adjacent an engine intake port and receiving fuel air mixture from a pipe connected with one of the primary mixing chambers and receiving air, when required, through one branch of an air manifold which supplies air to all of the secondary mixing chambers, the quantity of fluid flowing through the secondary mixing chambers being controlled primarily by a single main air throttle. The fuel is conveyed to the primary mixing chambers through the single fuel duct leading from a common float bowl.

Examples of charge forming device of this character are disclosed in the applications of W. H. Teeter, Serial No. 221,372, filed September 22, 1927, which matured to Patent 1,819,526 granted Aug. 18, 1931 and W. H. Teeter and F. E. Aseltine, Serial No. 221,371, filed September 22, 1927 which matured to Patent 1,819,495 granted Aug. 18, 1931.

In the devices disclosed in the above applications various means are provided to control the proportions of fuel and air in the mixture, and it is the principal object of the present invention to provide simplified and improved means for controlling the mixture proportions which shall be effective to form a mixture having such proportions of fuel and air as will most satisfactorily operate the engine under all possible operating conditions.

It is a further more specific object of this invention to provide novel means for controlling the flow of fuel in accordance with the engine speed whereby as the engine speed increases, the amount of fuel admitted to the mixing chambers is also increased automatically at the rate necessary to provide a mixture having the proper fuel content through the entire speed range of the engine.

It is a still further object of this invention to provide an increased flow of fuel as above described without the use of fuel valves or other moving parts which are subject to wear, or which may get out of proper adjustment during use.

The above applications disclose devices which present certain difficulties in obtaining a proper flow of fuel under all operating conditions because of the formation of a velocity head at the fuel nozzle. Attempts were made to prevent the formation of a velocity head in the primary mixing chambers of these earlier devices, but were only partially successful. At engine speeds lower than that corresponding substantially to a vehicular speed of 20–25 miles per hour, a slowly increasing velocity head is present at the jets, and by calibrating the jets somewhat smaller than would be required if the jets were subject only to static suction, a correct fuel flow is secured. The velocity head builds up so rapidly at speeds higher than that above referred to that some compensating means is required to prevent formation of a super-rich mixture. Moreover, at such higher speeds the primary mixture passages are of insufficient capacity to supply enough fuel mixture to meet the volumetric requirements of the engine. To compensate for the velocity effect and to supply the required quantity of mixture, the main air throttle is opened at the above mentioned engine speed. Air must be admitted in such quantity to meet the volumetric requirements of the engine as the main throttle opens so that the velocity through the primary mixture passages is rapidly reduced, resulting, first, in rapid reduction and then, in complete disappearance of the velocity effect. This necessitated the admission of additional fuel when the main throttle begins to open, which is controlled by a valve operated in connection with the throttle. In order to supply a fuel mixture of proper proportions, the moving parts must be accurately synchronized, which is almost impossible in view of wear, and liability to get out of proper adjustment resulting from use.

According to the present invention a fuel mixture of desired proportions is provided under all operating conditions by providing a plurality of fuel jets associated with each primary mixing chamber. One of these jets is subject to the velocity head and functions alone to admit all fuel up to a predetermined engine speed while at speeds higher than said predetermined speed the second fuel jet is brought into operation. The flow of fuel from this second fuel jet is effected, not by the aspirating action of a high velocity air current, or velocity head, but is due to the static suction within the primary mixing chamber. With this arrangement the flow of fuel at higher engine speeds is not dependent on the synchronization of a plurality of moving parts, but is dependent entirely upon the static suction within the primary mixture passages.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompany-

ing drawing, wherein a preferred form of embodiment of the present invention is clearly shown.

In the drawing:

Fig. 1 is a vertical longitudinal section through the carburetor unit and the middle outlet branch of the manifold taken on the line 1—1 of Fig. 2.

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

Fig. 3 is an enlarged detail section of the two fuel jets associated with each primary carburetor.

The device disclosed herein comprises a main air manifold indicated in its entirety by the reference numeral 10 and having three outlet branches, the middle branch 12 being shown herein. Each of these branches communicates with one of the intake ports 14 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 16 for securing the manifold to the engine block in the usual manner, and a flange 18, to which the carburetor unit may be attached, is provided adjacent the manifold inlet. The carburetor unit comprises the main housing 20 having an attaching flange 22, secured by screws 24 to the flange 18. An air inlet horn 26 is secured by screws 28 to the main housing and communicates with an opening in the top wall of said housing. A casting 30 having certain fuel passages and dash-pot cylinder formed therein is secured by screws 32 to the bottom of the main housing, and a sheet metal fuel bowl 34 is held tight against an annular shoulder 36 formed on a skirt 38 depending from the main housing, by a screw 40 screwed into the casting 30, a suitable gasket being provided to prevent leakage around the screw.

Fuel is conducted from a main source of supply to the fuel bowl and the flow is controlled by a float (not shown) in the usual manner in order to maintain a constant level of fuel in the bowl. To convey fuel from the bowl to a plurality of primary mixture passages 42, hereinafter more fully described, a passage 44 is provided in the casting 30. The passage 44 connects with a horizontal fuel canal at its upper end and said canal communicates with three pairs of calibrated low and high speed fuel jets or plugs 48 and 50 respectively, each of these pairs of jets being adapted to admit fuel to one of the mixture passages 42 as hereinafter more fully described.

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 the fuel bowl to drop enough to temporarily starve the engine unless means are provided to prevent this action. Such means comprises a check valve 52 positioned in an enlarged chamber at the upper end of the fuel passage 44 where said passage connects with the horizontal fuel channel 46. This valve is normally lifted above an annular rim 54, surrounding the outlet of the fuel passage 44, by the engine suction, but on reduction of this suction immediately seats on said rim preventing downward flow of fuel through the passage 44. 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 44, to regulate the flow of fuel to the jets 48 and 50 during operation at all speeds.

The primary mixture passages 42 to which the fuel jets 48 and 50 deliver fuel are bored horizontally through the central part of the main housing 20, are parallel to each other and are relatively close together as indicated in the drawing. Air is admitted to each of these mixture passages through air inlet bushings 58, one of which is screwed into the outer end of each passage. Immediately posterior to each of said bushings a small Venturi tube 60 is received in an enlargement 62 formed in the primary mixture passage. Each of these Venturi tubes is provided with two external ribs 64 arranged circumferentially of the tube and fitting tightly in 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.

The Venturi tube 60 is reduced in size at its inner end and is spaced from the wall of the primary mixture passage, as shown in Fig. 1, the space between the Venturi tube and the wall of the mixture passage being indicated by the reference numeral 70. The space 70 is substantially a dead air space in which the suction or vacuum is substantially the same as that maintained in the mixture passage between the inner end of the Venturi tube and the throttle which controls the flow through such mixture passage in the manner described hereinafter. Each main 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 the flow of such fuel is effected solely by the suction maintained within such space. It will be clear, therefore, that the suction within the Venturi tube 60, which is effective to cause the flow of fuel through the low speed jet 48 and the orifices 68 communicating therewith, is greater than that effective to cause a flow of fuel from the main fuel jet 50. For this reason each low speed jet 48 begins to supply fuel to its associated mixture passages as soon as the engine begins to operate, and continues to supply fuel at all engine speeds. The main or high speed jet, however, supplies no fuel to the mixture passage until a certain predetermined engine speed has been reached and is effective to supply fuel at all speeds higher than said predetermined speed. The low speed jets 48, therefore, are effective to supply fuel to the mixture passages at all speeds and under all operating conditions, supplying all of the fuel for idling and low speed operations and a part of the fuel at all other times, while the main or high speed jets are not effective to supply any fuel whatever until the engine is running at some predetermined speed, for instance at a speed corresponding substantially to a vehicular speed of 20 to 25 miles per hour.

Since the low speed jets terminate within the Venturi tube 60 the flow from said jets is not due to the suction within the mixture passages which causes a flow of air to take place through the Venturi tubes, but is effected by the considerably higher suction which is maintained within the Venturi tubes by the air velocity through the tubes, as well as to the aspirating action of the air current on the orifices 68. In other words, the flow of fuel from the low speed jets is not caused by what may be called the static suction of the mixture passages 42, but is controlled by the velocity head created at said jets by the Venturi tubes 60. The main fuel jets 50 how-

ever, which terminate in the dead air space 70 are not subject to the velocity head produced within the Venturi tubes and are shielded by the reduced inner end of said Venturi tubes so that there is no aspirating action on said jets by the ingoing air passing through the Venturi tubes. As hereinbefore indicated, a velocity head was created in the primary mixture passages of earlier forms of this device in spite of efforts to prevent. In the device herein disclosed, however, the inner diameter of the Venturi tubes is so small by comparison to the diameter of the primary mixture passages that the velocity of flow through said primary mixture passages should be insufficient at all speeds to create any appreciable velocity head within said passages. The flow from the high speed jets, therefore, is caused by the static suction of the mixture passages 42, which is substantially the same suction as is maintained in the space 70.

Means are provided to prevent a reverse flow of air from the passage 42 through the high speed fuel jet into the fuel column, the fuel being supplied through the low speed fuel jet before the high speed jet becomes effective. To this end the main fuel jet 50 is in the form of a tube of appreciable length having a diameter calibrated to the proper size and which extends down into the fuel in the enlarged chamber at the upper end of the fuel passage 44 to such a distance below the level of the fuel in said chamber that a column of fuel stands in the jets 50 at all times when the low speed fuel jets are functioning and before the jets 50 begin to function. The height of this column of fuel is sufficient to prevent the fuel therein being displaced by the difference in suction which is effective on the two fuel jets. In other words, this difference in suction is insufficient at any time while the low speed fuel jets are functioning alone to force the fuel out of the jets 50 so that a passage of air therethrough would be permitted.

The flow of the primary mixture through the passage 42 is controlled by a single throttle valve 72, which extends across all of said mixture passages and is provided with grooves 74 which register with said passages. The means for operating this throttle forms no part of the present invention, but is fully disclosed in the copending application previously referred to. Each primary mixture passage communicates with a pipe associated with each branch of the manifold for conveying the primary mixture to secondary mixing chambers hereinafter more fully described. The pipe 76 associated with the middle branch 12 of the manifold is disclosed herein and those which convey the primary mixture to the other branches of the manifold are fully shown and described in the above mentioned applications, such structure forming no part of the present invention.

All of the air which is mixed with the primary mixture in the secondary mixing chambers is admitted through the air horn 26, the flow being controlled by an air valve 78 normally held against a seat 80 by a spring 82. Air passing the valve flows first into an air chamber 84 and thence through the secondary air passage 86 connecting with the inlet end of the air manifold and provided with a throttle valve 88 secured to a shaft 90 journalled in the housing 20 and operated in a manner fully described in the above mentioned applications to regulate the flow of air to the secondary mixing chambers.

The spring 82 is received between the air valve and a flange 92 projecting from a sleeve 94 slidably on a guide sleeve 96, which guides the air valve stem in the manner described in the above mentioned applications. A choke mechanism, which is not shown herein, is adapted to be operated to lift the flange sufficiently to bring the sleeve 94 into engagement with the air valve to hold said valve closed in order to facilitate starting of the engine, and, if desired, to partially lift said sleeve to increase the tension of the spring 82, which tends to hold the air valve closed. To prevent sufficient opening of the air valve to cause leaning of the mixture and to prevent fluttering of said valve, a dash-pot 98 is provided which may be of the form shown in the copending cases referred to or may be of any conventional or desired design.

As above stated, the throttle operating mechanism forms no part of this invention and is not disclosed herein, but in order to facilitate understanding of the operation of the whole device, the mode of operation of the throttles 72 and 88 will now be very briefly described. During operation at all engine speeds up to that corresponding to a vehicular speed of 20–25 miles per hour on a level, it is desirable that the primary mixture passages supply all of the combustible mixture to the engine cylinders and at speeds higher than that it is desirable to admit air to the secondary mixing chambers through the passage 86 in order to supply a sufficient quantity of fuel mixture to the cylinders to secure the desired volumetric efficiency of the engine, and to secure this result the two throttles 72 and 88 are provided with a common operating mechanism so arranged that the primary throttle 72 is given a certain predetermined movement before the throttle 88 begins to open and after said throttle 88 begins to open both throttles are moved together to their wide open positions. The predetermined movement of the throttle 72 which takes place before the throttle 88 begins to open is sufficient to admit a large enough quantity of mixture to the engine to operate said engine at a speed corresponding to the vehicular speed above referred to.

There are three secondary mixing chambers of identical construction, each of which comprises a Venturi tube 100 secured in an outlet branch of the manifold in such position that its point of greatest depression or suction is immediately adjacent the outlet end of the primary mixture pipe associated with that particular manifold branch, as shown in Fig. 1. Each Venturi tube is provided with an external circumferential rib 102 which, when the device is assembled, is adapted to be clamped between shoulders 104 and 106 formed on the manifold and engine block respectively. These Venturi tubes cause air passing the ends of the primary mixture delivery pipes to move at high velocity under all operating conditions, creating in each pipe a high suction at all times.

While it is probably preferable to design the device so that the main jet is brought into operation substantially simultaneously with the beginning of the opening movement of the main air throttle, by varying the dimensions of the various parts the time the main jet is brought into operation may be varied if desired.

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 having in combination a mixing chamber, a plurality of jets supplying fuel to said mixing chamber, means admitting air to said mixing chamber, a throttle for controlling the flow from said mixing chamber, means for causing a current of air to flow at high velocity past one of said jets, and means to shield another of said jets from said current of air so as to maintain at said last named jet a suction which is less than that maintained at the first named jet, whereby said jets are caused to become effective seriatim.

2. A charge forming device for internal combustion engines comprising a mixture passage, a throttle therein, a Venturi tube admitting air thereto and having an abrupt enlargement therein, and a plurality of fuel jets arranged on the same side of the throttle, one of which communicates with the Venturi tube at the point of enlargement therein and the other of which communicates directly with the mixture passage.

3. A charge forming device for internal combustion engines comprising a mixture passage, a Venturi tube projecting into the mixture passage for admitting air thereto and having a reduced inner end spaced from the walls of the mixture passage, and a plurality of fuel jets one of which communicates with the Venturi tube and the other of which communicates with the space between the reduced end of the Venturi tube and the wall of the mixture passage.

4. A charge forming device for internal combustion engines comprising a mixing chamber, a Venturi tube admitting air to the mixing chamber, a relatively small fuel jet communicating with the Venturi tube and adapted to supply all the fuel to the mixing chamber at low engine speeds, and a relatively large fuel jet communicating directly with the mixing chamber and supplying fuel thereto at higher engine speeds, said last named jet being shielded from the action of the high velocity stream of air flowing through the Venturi tube.

5. A charge forming device for an internal combustion engine comprising a secondary mixing chamber, a primary mixture passage supplying fuel mixture thereto, a main air passage admitting air to said secondary mixing chamber, a plurality of fuel jets for supplying fuel to said primary mixture passage, means for making the static suction of the mixture passage effective on one of said jets to cause a flow of fuel therefrom, and means for creating a velocity head at the other of said jets.

6. A charge forming device for an internal combustion engine comprising a secondary mixing chamber, a primary mixture passage supplying fuel mixture thereto, a secondary air passage admitting air to said secondary mixing chamber, a normally closed valve controlling the flow of air through the secondary air passage and adapted to be opened at higher engine speeds, a plurality of jets for supplying fuel to said primary mixture passage and in uninterrupted communication with the fuel supply when the engine is running, and means for rendering one of said jets effective to supply fuel to said primary mixture passage at all engine speeds, and the other of said jets continuously effective during operation subsequent to the opening of said air valve.

7. A charge forming device for internal combustion engines having in combination a plurality of primary carburetors adapted to supply fuel air mixture to a plurality of secondary mixing chambers, one associated with each engine intake port, means for admitting air to the primary carburetors, a plurality of fuel jets associated with each primary carburetor, a common fuel supply passage leading to all of said jets and means for rendering the jets in each primary carburetor effective seriatim.

8. A charge forming device for internal combustion engines having in combination a plurality of primary carburetors adapted to supply fuel air mixture to a plurality of secondary mixing chambers, one associated with each engine intake port, an air passage for supplying air to all of said secondary carburetors, a valve normally closing said passage and adapted to open at higher engine speeds a plurality of fuel jets for supplying fuel to each primary carburetor, a common fuel supply passage communicating with all of said jets, means for admitting air to said primary carburetors, and means for rendering one of the jets in each primary carburetor effective to supply fuel thereto at all engine speeds and the other of said jets effective to supply fuel thereto subsequent to the opening of said air valve.

9. A charge forming device for internal combustion engines comprising a mixture passage, a plurality of fuel jets for supplying fuel to said mixture passage during normal engine operation, means admitting air to said mixture passage, means for maintaining a greater suction at one of said jets than the other whereby said jets are rendered effective seriatim to supply fuel continuously as long as the suction maintained at said jets is sufficient to cause a flow therefrom, a common fuel supply passage in uninterrupted communication with both of said jets when the engine is in operation and means for preventing a reverse flow of air from the mixture passage through one of said jets before the latter is effective to supply fuel to said passage.

10. A charge forming device for internal combustion engines comprising a Venturi passage, a throttle therein, a Venturi tube admitting air thereto and having an abrupt enlargement therein, a plurality of fuel jets arranged on the same side of the throttle, one of which communicates with the Venturi tube at the point of enlargement therein and the other of which communicates directly with the mixture passage, and means for shielding the last named jet from the action of the air current flowing through the Venturi tube.

11. A charge forming device for internal combustion engines comprising a secondary mixing chamber, a primary mixture passage supplying a primary fuel mixture thereto, a throttle regulating the flow of primary mixture, a secondary air passage admitting air to said secondary mixing chamber, a normally closed valve in said secondary air passage controlling the flow of air therethrough and adapted to be opened when the throttle has reached a predetermined position, a plurality of fuel jets in uninterrupted communication with the fuel supply when the engine is running adapted to supply fuel continuously to the primary mixture passage when rendered effective, and means for maintaining different degrees of suction at said jets whereby one of said jets is rendered effective to supply fuel to said primary mixture passage at all engine speeds and the other of said jets is rendered effective only during operation subsequent to the opening of the air valve.

12. A charge forming device for internal combustion engines comprising a mixture passage, a plurality of fuel jets supplying fuel to said mixture passage during normal engine operation, means admitting air to said mixture passage, means for maintaining a greater suction at one of said jets than the other whereby said jets are rendered continuously effective seriatim, a common fuel supply passage uninterruptedly communicating with both of said jets when the engine is running and means for preventing a reverse flow of air from the mixture passage through one of said jets before the latter is effective to supply fuel to said passage, said means comprising an enlarged chamber in the fuel delivery passage and a tube leading to one of said fuel jets and projecting into said enlarged chamber, whereby when the jet on which the greater suction is effective begins to function, the passage of air through said tube is prevented by fuel standing in the tube.

13. A charge forming device for internal combustion engines comprising a mixing chamber, high and low speed fuel jets supplying fuel to said mixing chamber, each of said jets being adapted to continue in operation as long as the suction effective thereon is enough to cause a flow therefrom, a throttle for controlling the flow of mixture therefrom, means for directing an aspirating current of air past the low speed jet and means for shielding the high speed jet from the action of said current of air whereby the low speed jet is rendered effective to supply fuel to the mixing chamber before fuel flows from the high speed jet.

14. A charge forming device for internal combustion engines having in combination, a mixing chamber, a plurality of jets supplying fuel to said mixing chamber, means admitting air to said mixing chamber, a throttle for controlling the flow from said mixing chamber, means for causing a current of air to flow at high velocity past one of said jets, and means to shield another of said jets from said current of air so as to maintain at said last named jet a suction which is substantially equal to the suction of the mixture passage, whereby the jets are caused to become effective seriatim.

15. A charge forming device for internal combustion engines comprising a mixing chamber, an air inlet therefor, a throttle to control the flow therefrom, a plurality of fuel jets of different capacity supplying fuel to said mixing chamber, means for causing a current of air to flow at high velocity past the jet of lesser capacity to create a velocity head at said jet, and means for shielding the jet of greater capacity from the action of said air current so as to produce a smaller suction at said last named jet, whereby the lesser and greater jets are rendered effective at low and high speeds respectively.

16. A charge forming device for internal combustion engines comprising a mixing chamber, an air inlet therefor, a throttle to control the flow therefrom, a plurality of fuel jets of different capacity supplying fuel to said mixing chamber, means for causing a current of air to flow at high velocity past the jet of lesser capacity to create a velocity head at said jet, and means for shielding the jet of greater capacity from the action of said current of air and communicating thereto the suction of the mixing chamber so as to maintain at said last named jet substantially the same suction as is maintained in the mixing chamber.

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