Nov. 21, 1933. P. KOEHLY 1,935,801

CHARGE FORMING DEVICE

Filed Sept. 7, 1929 2 Sheets-Sheet 1

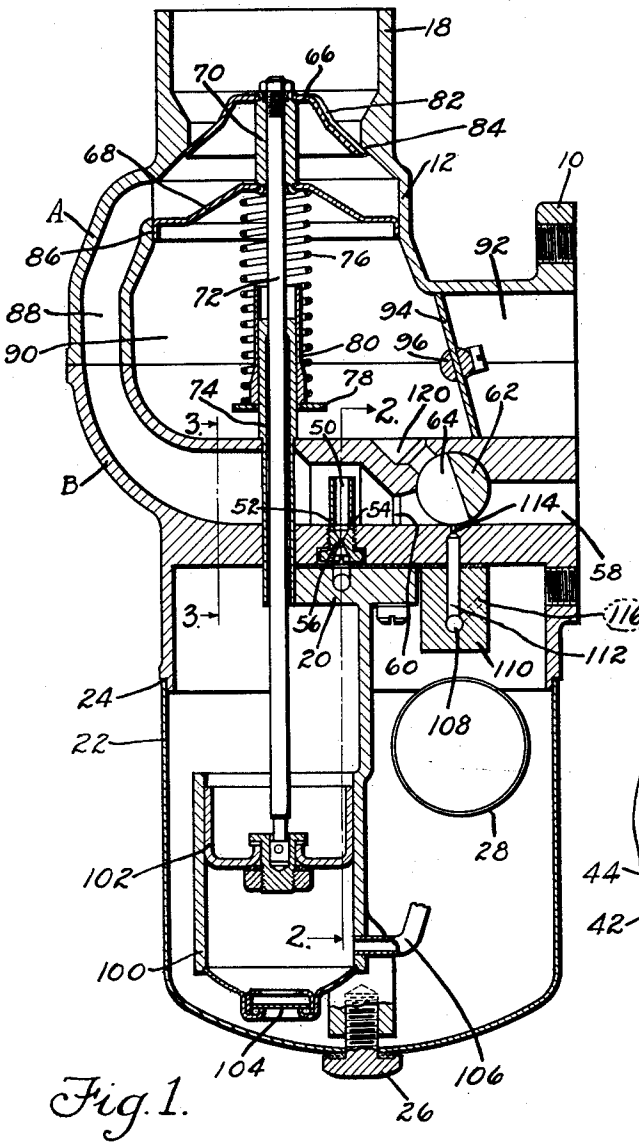


Fig. 1.

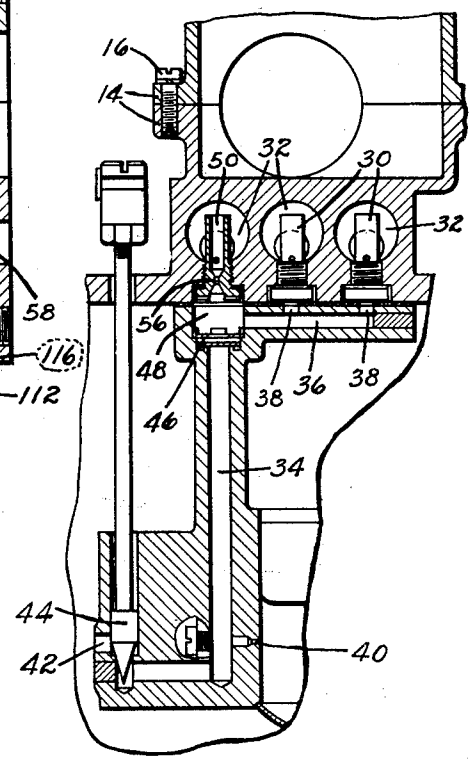


Fig. 2.

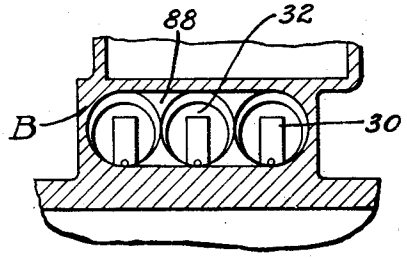


Fig. 3.

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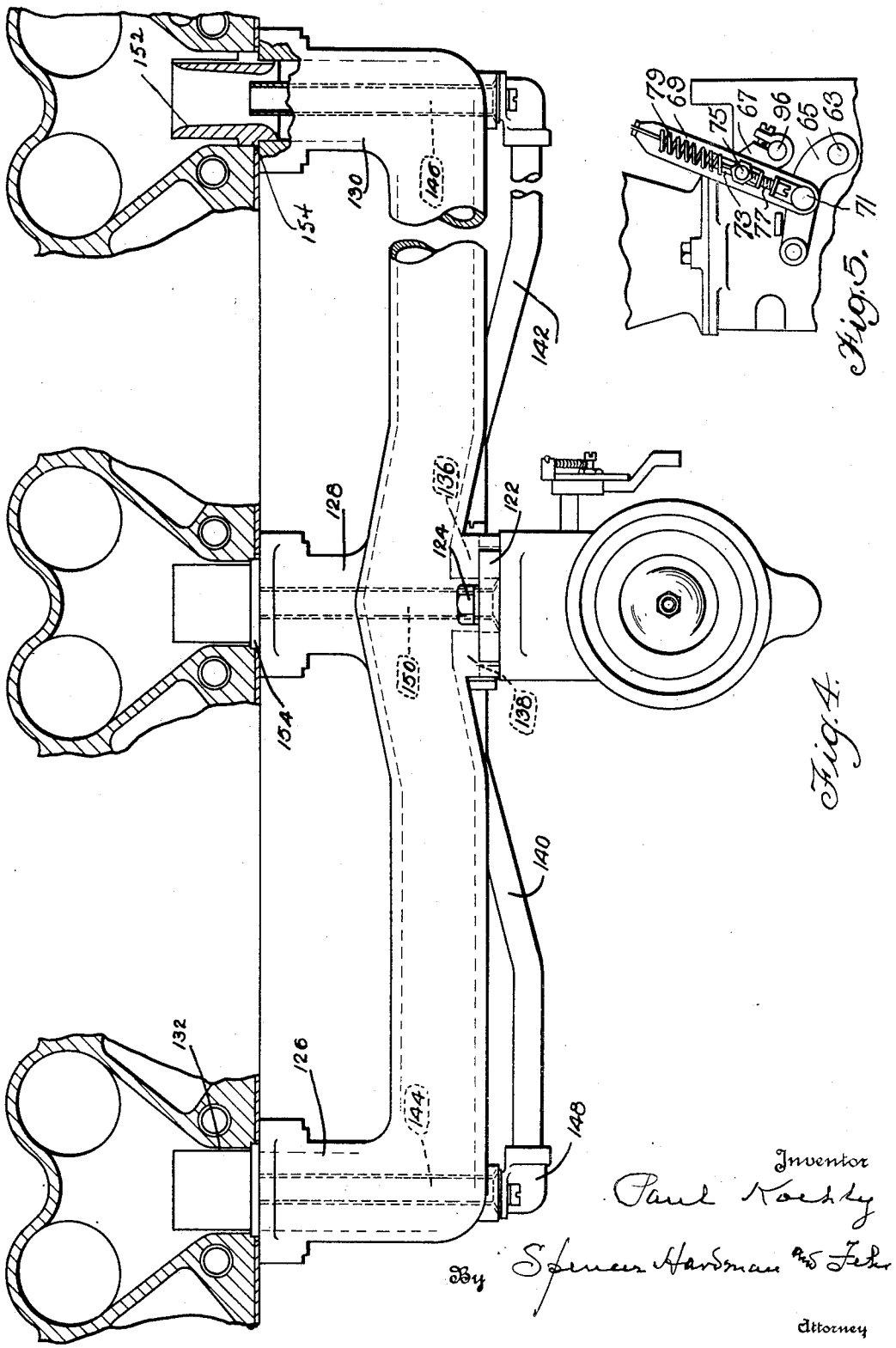


Fig. 4.

Fig. 5.

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UNITED STATES PATENT OFFICE

1,935,801

CHARGE FORMING DEVICE

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11 Claims. (Cl. 261—46)

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 the object of the present invention to provide a device of the character disclosed in the above application, which is simplified in construction and improved in operation, and most particularly one which is provided with means effective to improve its operation during the acceleration period immediately following any opening of the throttle.

It is a further object of this invention to provide means for controlling the admission of air, which is effective to increase the velocity of flow through the mixture passages during opening movements of the throttle.

A still further object of this invention is to provide means for controlling the suction at the fuel jets so that during operation with the throttle partly open as is the condition throughout the normal driving range, the suction at said jets is relatively low, whereby a relatively weak mixture is formed during such operations, while during operation with the throttle fully open and the engine running at high speed or at low speed under heavy load, the suction is relatively high by comparison with earlier devices of this general character to provide a mixture relatively high in fuel content during this operation.

These objects are accomplished according to the present invention by providing an air intake passage leading to the primary mixture passages, which communicates at its inlet end with the main intake passage at a point posterior to a suction operated valve therein so that substantially atmospheric pressure is maintained at the inlet ends of the primary mixture passages and the pressure differential in said passages between the inlet and outlet ends thereof is greater than in earlier devices of this character, as for instance, that shown in the above copending application.

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

In the drawings:

Fig. 1 is a vertical, longitudinal section through a carburetor unit of a charge forming device constructed in accordance with this invention.

Fig. 2 is a fragmentary, vertical section on the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary, vertical section on the line 3—3 of Fig. 1.

Fig. 4 is a plan view of the device, certain parts being shown in section and other parts being omitted for the sake of clarity.

Fig. 5 is a fragmentary elevation showing the operating mechanism for the throttle valves.

The device disclosed comprises a carburetor unit which is adapted to be connected to an air manifold in which secondary mixing chambers are formed, as clearly illustrated in the above mentioned application. The carburetor unit is provided with an attaching flange 10, adapted to be connected to a similar flange on the manifold in the well-known manner.

The carburetor unit comprises a main housing indicated in its entirety by the reference character 12 and comprising upper and lower sections A and B respectively, as indicated in Fig. 1. These sections are provided with projecting bosses 14 adapted to be secured together by machine screws 16 as indicated in Fig. 2. An air inlet coupling 18 is formed integrally with the section A of the main housing and is adapted to be connected with an air cleaner if desired. A casting 20 in which the passages supplying fuel to the nozzles are formed, is secured by screws to the bottom wall of the lower section B of the main housing and a sheet metal fuel bowl 22 is held tight against a shoulder 24 on the said section B by any suitable means, as for instance by a screw 26 screwed into the casting 20. Fuel is conducted from the 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 28, operating in the usual manner to maintain a substantially constant level of fuel therein.

Fuel flows from the bowl 22 to a plurality of primary fuel nozzles 30, one of which is located in each of the primary mixing chambers 32, the construction of which is briefly described hereinafter. The fuel conduit between the fuel bowl and the nozzles comprises the vertical fuel passage 34 communicating at its upper end with a

horizontal fuel canal 36, which connects with each of the nozzles 30 through an orifice 38. Fuel is admitted to the passage 34 at all engine speeds through a fixed metering orifice 40 and at high speeds additional fuel is admitted through an orifice 42 controlled by a valve 44, operated in the manner set forth in the above mentioned copending application. This operating means forms no part of this invention and is, therefore, not disclosed herein.

Fuel is lifted from the fuel bowl through the above described passages to the primary mixing chambers by the suction maintained therein. Opening movements of the throttle produce a reduction in mixing chamber suction and to prevent any return of the fuel to the fuel bowl which might cause a temporary fuel starving of the engine, a check valve 46 is provided in the chamber 48 at the junction of passages 34 and 36 and on reduction in the mixing chamber suction, seats on the bottom of the chamber 48.

Each primary fuel nozzle is provided with a main fuel outlet 50 at the top of the nozzle and a secondary fuel outlet comprising two orifices 52 and 54 in the vertical wall of the nozzle near the bottom of the mixing chamber. At relatively high speeds, the mixing chamber suction is sufficient to lift fuel from the main outlet as well as from orifices 52 and 54, but at idling or low speed operation under load, the suction is enough to lift fuel only to some point between the top of the nozzles and the orifices 52 and 54, fuel flowing from these orifices by action of gravity under such conditions. Each nozzle is provided with a restricted fuel metering orifice 56.

The primary mixing chambers comprise the enlarged anterior ends of the primary mixture passages 58 which are parallel to each other and relatively 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 in the manifold, more fully described in the above mentioned application. Restriction 60 separates the primary mixing chambers from the remainder of the mixture passages and reduces the velocity of flow past the fuel nozzles for a purpose more fully set forth in the above application.

A single throttle valve 62 extends across all of the primary mixture passages, controls the flow therethrough and is provided with grooves 64 which register with the mixture passages. This throttle is operated in the manner more fully described later.

According to this invention all of the air entering the carburetor flows through the inlet coupling 18 and is controlled by two air valves 66 and 68, secured in any desirable manner to a sleeve 70, fixedly mounted on the air valve stem 72 which is slidable within a guide sleeve 74 which is fixed in the lower section B of the main housing. The valve stem 72 supporting the valves 66 and 68 is normally held in its uppermost position, as shown in Fig. 1, by a spring 76, which is received between the valve 68 and a flange 78 projecting from a sleeve 80, which is slidable on the fixed sleeve 74 in the manner described in the above application. When it is desired to choke the carburetor to facilitate starting of the engine, the flange 78 is adapted to be lifted by means not shown herein but fully described in the earlier application, until the upper end of such sleeve engages the valve 68 to hold the valves in the position shown in Fig. 1. Sufficient air to carry the starting fuel from the nozzles to the engine is admitted through grooves 82, formed in the upper surface of the valve 66, as shown in Fig. 1.

The valve 66 cooperates with the seat 84, while the valve 68 has a periphery in the form of a very short cylinder as indicated at 86 and in the position shown in Fig. 1, is received in a portion of the air intake passage which is of cylindrical form. It will be obvious, therefore, that as the valve stem 72 moves downwardly, the valve 66 becomes unseated immediately to permit air to flow past said valve while the valve 68 has to make an appreciable movement before it passes below the cylindrical portion of the air intake passage to a position where a flow of air past the valve is permitted. Communicating with the main air intake passage at a point anterior to the valve 68 and posterior to the valve 66, when the latter is closed, is a primary air passage 88, formed in the wall of the main housing and communicating with all of the primary mixing chambers, as shown in Fig. 3. At the beginning of the downward movement of the valve stem 72 and during its movement until the valve 68 passes below the cylindrical portion of the air passage, all of the air which flows past the valve 66 enters the primary air passage 88 and is supplied to the primary mixing chambers. After the valve 68 passes beyond the cylindrical portion of the air intake passage, air flowing past the valve 66 flows partly through the primary air passage, as above described, and partly to a main air chamber 90, which communicates with a secondary air passage 92 supplying air to the secondary mixing chambers in the manner fully described in said above mentioned application. The flow of air through the passage 92 is controlled by a valve 94, secured to a rotatable shaft 96. The results brought about by this valve construction will be fully described later and such construction forms the gist of the present invention.

The operating connections for the throttle 62 and the valve 94 constitute no part of the present invention, but the construction and operation of this mechanism is briefly described hereinafter to facilitate understanding this invention. Secured to a spindle 63 projecting from the primary throttle valve 62 is an operating arm 65 which is adapted to be connected to some suitable operating connection extending to a point adjacent the drive of the vehicle. This arm is connected through a lost motion connection to an arm 67 secured to the shaft 96 to which valve 94 is secured. The lost motion connection need not be described in minute detail herein, as its specific construction is not material so far as the present invention is concerned. It includes, however, a link 69 pivoted to the arm 65 at 71 and provided with a slot 73 through which extends a pin 75 which projects from the arm 67 and is normally held in the lower end of the slot in contact with an adjusting screw 77 by the spring 79. Obviously this connection makes a certain movement of arm 65 before the arm 67 begins to move, this movement generally being such as to permit a vehicular speed of substantially 20 miles per hour on a level before the arm 67 or valve 94 begins to move. When the valve 94 is closed, there is substantially no suction communicated to the main air chamber 90 and there is no necessity of the valve 68 opening until the valve 94 is opened. Accordingly, the cylindrical portion of the air intake passage with which the valve 68 cooperates is made of such lengths that the valve will

open to permit the passage of air into the air chamber 90 at substantially the same time that the valve 94 begins to open and at all less wide open positions of the throttle, all of the air entering the carburetor flows through the primary air passage and into the primary mixing chambers.

Any opening movement of the air valves 66 and 68 must be retarded to prevent fluttering of the valves and to temporarily restrict the admission of air following an opening movement of the throttle to prevent leaning of the mixture during the acceleration period. To accomplish these results, a dashpot is provided comprising a cylinder 100 and a piston 102 secured in any desirable manner to the bottom of the valve stem 72 and slidably received within the cylinder. A check valve 104 is provided in a suitable valve cage in the bottom of the cylinder to admit fuel thereto on closing movements of the air valve and to prevent the escape of fuel therefrom as the air valve is opened. The specific construction of this dashpot is fully described in the above application and is not material so far as this invention is concerned, as a dashpot of any conventional form may be employed.

In order to provide a mixture of the proper fuel content during the acceleration period, a pump is provided of the type described in the above application. The above described dashpot forms the pump and connected in the cylinder wall near the bottom thereof so as to communicate with the interior of the cylinder is a fuel delivery passage 106 extending to a horizontal channel 108, formed in the block 110, secured to the bottom of the lower section B of the main housing in any desirable way. The channel 108 communicates with vertical channels 112 having restricted outlets 114 and which communicate with the primary mixture passages, as fully set forth in the earlier application. The specific construction of this pump forms no part of this invention and for a full disclosure thereof, reference may be had to the specification of the earlier application. The passages 116 supply air to the channel 108 from the top of the fuel bowl, forming an emulsion of fuel and air in the passage 108 which is delievered to the primary mixture passages, as set forth in said application.

It will be noted that passages 120 are provided connecting the secondary air passage with each of the primary mixture passages posterior to fuel nozzles therein. The admission of air through the passages 120 reduces the velocity of air passing the fuel nozzles as set forth fully in the above mentioned application. In Fig. 4 of the drawings, the manifold with which the carburetor unit is used, is disclosed.

This manifold is provided with an attaching flange 122 to which the carburetor unit is adapted to be secured by bolts 124 in the conventional manner. The manifold is provided with a single inlet with which the secondary air passage 92 is adapted to communicate and three outlet branches 126, 128 and 130, each of which communicates with one of the engine intake ports 132, the drawings illustrating a six-cylinder engine having three of these ports. The outlet branches of the manifold are each provided with an attaching flange 134 by means of which the manifold is adapted to be secured to the engine block in the conventional manner. Each of the ports 132 supplies two adjacent cylinders with combustible mixture as indicated in the drawings.

The primary mixture passages 58 communicate with conduits which convey the primary mixture to secondary mixing chambers formed in the discharge ends of the outlet branches of the manifold. These conduits comprise angular passages 136 and 138 which communicate with tubes 140 and 142, these tubes connecting with tubes 144 and 146 in the branches 126 and 130 respectively, through the medium of elbows indicated by the reference numeral 148. The middle passage 58 communicates directly with the discharge tube 150 secured in the middle outlet branch of the manifold 128.

Each secondary mixing chamber is formed within a Venturi tube 152 having a flange 154 on its periphery which is adapted to be clamped between the outlet branch of the manifold and the engine block when the manifold is in its operative position. The Venturi tubes form secondary mixing chambers into which the tubes 144, 146 and 150 discharge primary mixture which is adapted to be mixed with additional air when the valves controlling the flow of secondary air are opened in the manner fully described in various earlier applications, as for example, that of Fred E. Aseltine et al., Serial No. 288,683, filed June 27, 1928.

In order to explain the operation of the device which forms the present invention and the advantageous results produced thereby, certain difficulties which have been encountered in earlier devices of this character are referred to briefly hereinafter. It has been found difficult under some operating conditions to supply a mixture of proper proportions during the acceleration period because the velocity of flow through the primary mixture passages is insufficient to carry the relatively heavy primary mixture to the secondary mixing chambers, on opening of the throttle, as soon as the air entering the secondary passage reaches such chambers. The formation of too lean a mixture therein results, and makes it necessary to to provide means to retard the flow of secondary air to compensate for such action.

It has also been found difficult to form a mixture of proper proportions throughout the engine speed range. This is due to the fact that if the spring employed to control the opening of the main air valve is of sufficient strength to create the proper suction at the jets during operation at relatively low speeds with the throttles partly open, the mixture will be too rich at high speeds unless some compensating means be provided as has been done in earlier devices.

The present invention has been designed to eliminate these difficulties and accomplishes its purpose by the provision of the air inlet and double valve controlling it disclosed herein. Since all the air supplied to the primary mixture passages during speeds below that at which the valve 68 permits the passage of air thereby is supplied directly from the atmosphere instead of from the air chamber 90 in which the pressure is sub-atmospheric, the pressure differential which causes such air to flow is greater than in devices such as that shown in the earlier application. For this reason and because the valve 68 does not open until the valve 66 has made a considerable opening movement a lighter valve spring can be employed in this device than in a device of the type shown in the earlier application and tendency to form an over-rich mixture at high speeds is largely eliminated. This is possible because the spring 76 controlling the valves has been considerably compressed by the time the valve 68 begins to open, and the resistance to its opening will be sub-

stantially the same with the lighter spring as in earlier devices with a heavier spring.

It will be understood that the construction of the manifold employed with the carburetor unit shown herein is just the same as that disclosed in the earlier application.

It will be understood that the two valves 66 and 68 supported by a single valve stem and controlled by the single spring 76 constitutes a single valve mechanism which controls the flow of air through separate air passages leading to the primary and secondary mixing chambers.

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 plurality of primary mixing chambers which are adapted to deliver a primary mixture of fuel and air to a plurality of secondary mixing chambers located within the intake manifold, an air inlet adapted to supply air to all of said primary and secondary mixing chambers, a plurality of passages communicating with said inlet, one of which supplies air to all the primary mixing chambers and another of which supplies air to all the secondary mixing chambers, and a plurality of valves in said inlet rendering said passages successively effective.

2. A charge forming device for internal combustion engines comprising a primary mixing chamber, a secondary mixing chamber into which said primary mixing chamber is adapted to deliver a primary mixture of fuel and air, a single air inlet supplying air to both said mixing chambers, primary and secondary air passages connecting said inlet with the said primary and secondary mixing chambers respectively, valves controlling the admission of air to said air passages, and an additional secondary air valve in the secondary air passage.

3. A charge forming device for internal combustion engines comprising a primary mixing chamber, a secondary mixing chamber into which said primary mixing chamber is adapted to deliver a primary mixture of fuel and air, a single air inlet supplying air to both said mixing chambers, primary and secondary air passages connecting said inlet with the said primary and secondary mixing chambers respectively, automatically operable valves controlling the admission of air to both said air passages and an additional manually operable secondary air valve regulating the flow of air through the secondary air passage.

4. A charge forming device for internal combustion engines comprising a primary mixing chamber, a secondary mixing chamber into which said primary mixing chamber is adapted to deliver a primary mixture of fuel and air, a single air inlet supplying air to both said mixing chambers, primary and secondary air passages connecting said inlet with the said primary and secondary mixing chambers respectively, automatically operable valves adapted to open seriatim to admit air to the primary and secondary air passages successively, and a manually operable secondary air valve in the secondary air passage adapted to be opened substantially simultaneously with one of said automatic valves.

5. A charge forming device for internal combustion engines comprising a primary mixing chamber, a secondary mixing chamber into which said primary mixing chamber is adapted to deliver a primary mixture of fuel and air, a primary throttle regulating the flow of primary mixture into the secondary mixing chamber, primary and secondary air passages supplying air to said primary and secondary mixing chambers respectively, a single valve mechanism for controlling the admission of air through said primary and secondary air passages, means whereby said valve mechanism is effective to permit a flow of air only through said primary air passage until the primary throttle makes a predetermined movement and other means in said secondary passage operable to control the flow of air therethrough and operative so as to permit flow of air therethrough only after a predetermined movement of the primary throttle.

6. A charge forming device for internal combustion engines comprising a primary mixing chamber, a secondary mixing chamber into which said primary mixing chamber is adapted to deliver a primary mixture of fuel and air, a primary throttle regulating the flow of primary mixture into the secondary mixing chamber, primary and secondary air passages supplying air to said primary and secondary mixing chambers respectively, a common air inlet supplying air to both said air passages, a single valve mechanism controlling the admission of air through said inlet and the flow through both said air passages, said valve mechanism being so constructed as to permit a flow of air only through the primary air passage until the throttle makes a predetermined movement and other means in said secondary passage operable to control the flow of air therethrough and operative so as to permit flow of air therethrough only after a predetermined movement of the primary throttle.

7. A charge forming device for internal combustion engines comprising a primary mixing chamber, a secondary mixing chamber into which said primary mixing chamber is adapted to deliver a primary mixture of fuel and air, a primary throttle regulating the flow of primary mixture into the secondary mixing chamber, primary and secondary air passages supplying air to said primary and secondary mixing chambers respectively, a single valve mechanism for controlling the admission of air through both said air passages, means for effecting the operation of said valve mechanism to permit a flow of air through the primary air passage during the entire opening movement of the primary throttle and into the secondary air passage only after a predetermined opening of the primary throttle and other means in said secondary passage operable to control the flow of air therethrough and operative so as to permit flow of air therethrough only after a predetermined movement of the primary throttle.

8. A charge forming device for internal combustion engines comprising a primary mixing chamber, a secondary mixing chamber into which said primary mixing chamber is adapted to deliver a primary mixture of fuel and air, a primary throttle regulating the flow of primary mixture into the secondary mixing chamber, primary and secondary air passages supplying air to said primary and secondary mixing chambers respectively, a single valve mechanism for controlling the admission of air through both said air passages, a second valve in said secondary air passage, said single valve mechanism being so constructed that air is admitted to said secondary air passage only after the opening of said second valve.

9. A charge forming device for internal combustion engines comprising a primary mixing chamber, a secondary mixing chamber into which said primary mixing chamber is adapted to deliver a primary mixture of fuel and air, a primary throttle regulating the flow of primary mixture into the secondary mixing chamber, primary and secondary air passages supplying air to said primary and secondary mixing chambers respectively, a single suction operated valve mechanism for controlling the admission of air through both said passages, means whereby the primary throttle controls the suction effective on said valve mechanism up to a predetermined position of the throttle, and a second valve in the secondary air passage for regulating the suction effective on said valve mechanism after the throttle reaches a predetermined position, whereby the suction communicated to said valve mechanism is ineffective to move the valve mechanism to a position to admit air to said secondary air passage until the said second valve is opened.

10. A charge forming device for internal combustion engines comprising a main housing, a primary mixing chamber, a secondary mixing chamber into which said primary mixing chamber is adapted to deliver a primary mixture of fuel and air, a main air inlet for supplying air to both said mixing chambers, a secondary air passage adapted to receive the major part of the air admitted through said main air inlet, a primary air passage formed in the wall of the main housing and joining the secondary air passage adjacent the main air inlet, and a single valve mechanism for controlling the admission of air through both said primary and secondary air passages, said valve mechanism comprising two suction-operated downwardly opening mushroom-valves on a single stem.

11. A charge forming device for internal combustion engines comprising a main housing, a primary mixing chamber, a secondary mixing chamber into which said primary mixing chamber is adapted to deliver a primary mixture of fuel and air, a main air inlet for supplying air to both said mixing chambers, a secondary air passage adapted to receive the major part of the air admitted through said main air inlet, a primary air passage formed in the wall of the main housing and joining the secondary air passage adjacent the main air inlet and a plurality of suction operated downwardly opening mushroom valves on a single valve stem for controlling the admission of air through both said primary and secondary air passages.

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