Sept. 18, 1934. O. B. MONOSMITH ET AL 1,974,286

CARBURETOR

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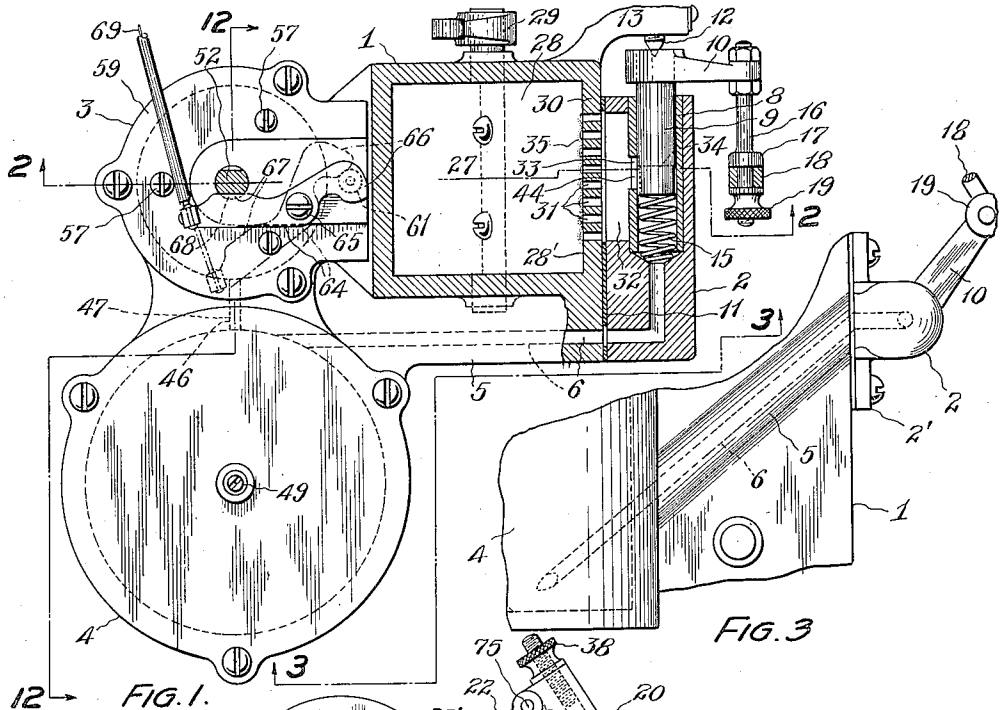


FIG. 1.

FIG. 3

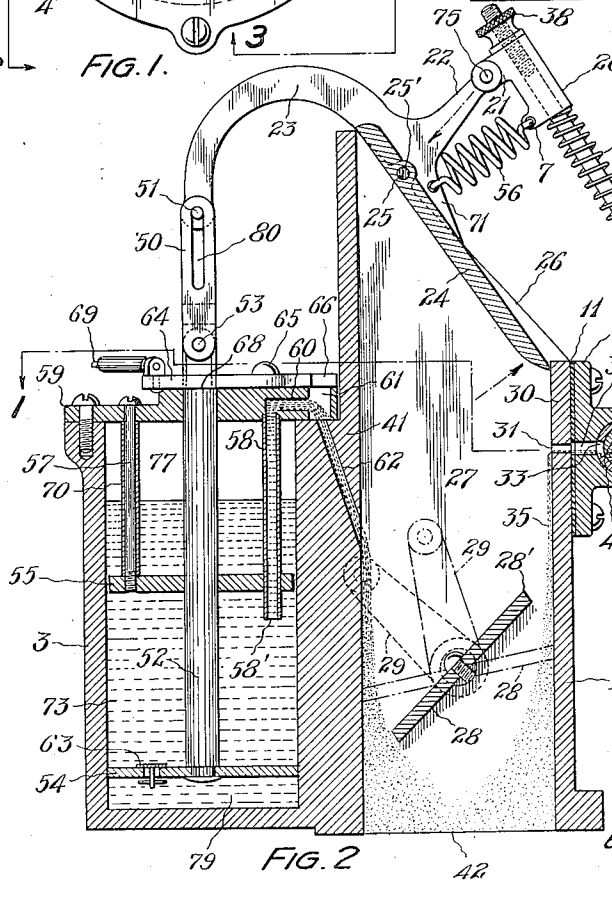


FIG. 2

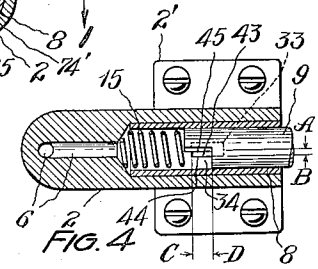


FIG. 4

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CARBURETOR

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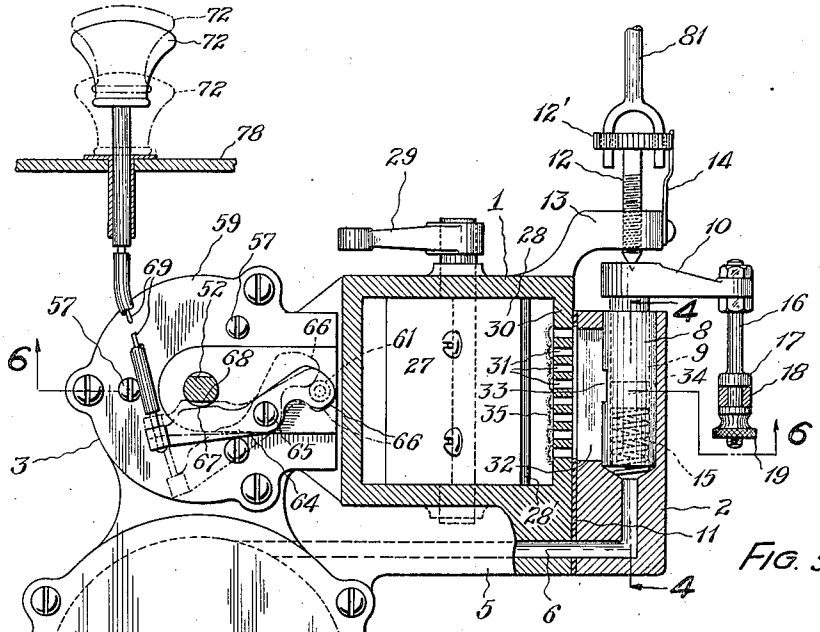


FIG. 5

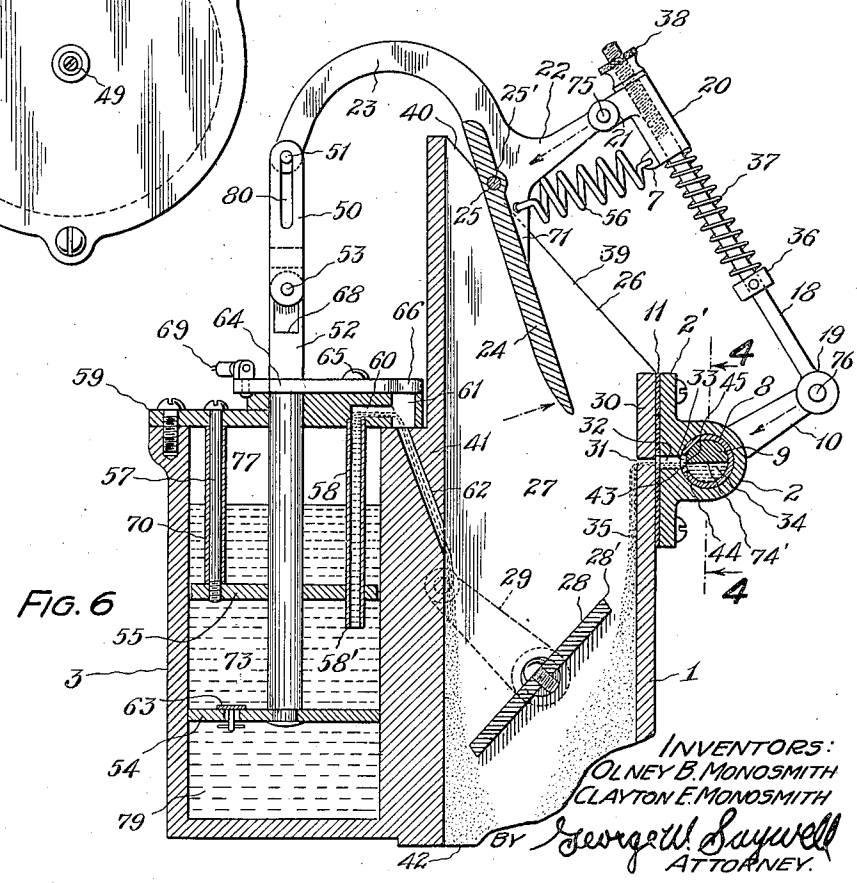


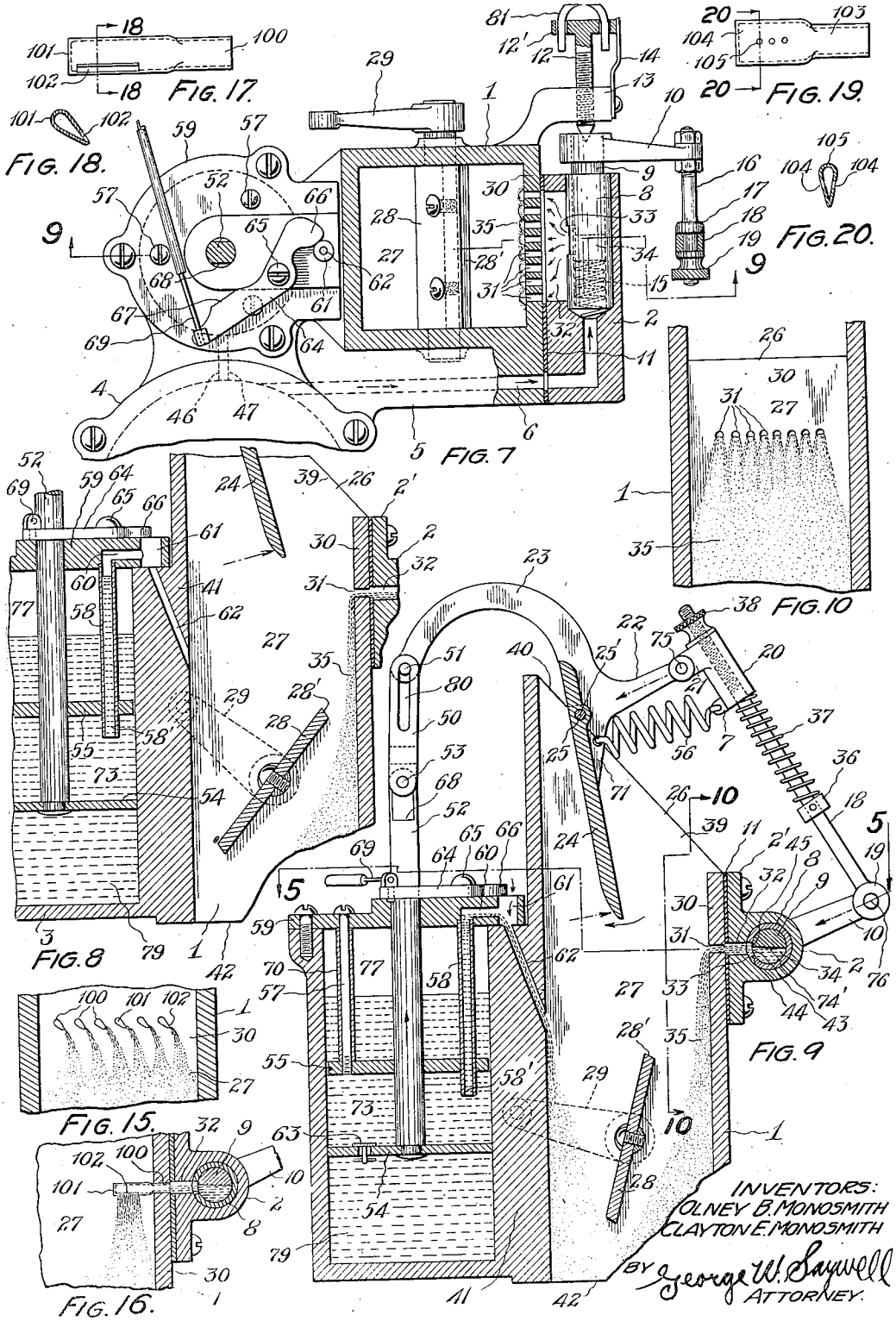
FIG. 6

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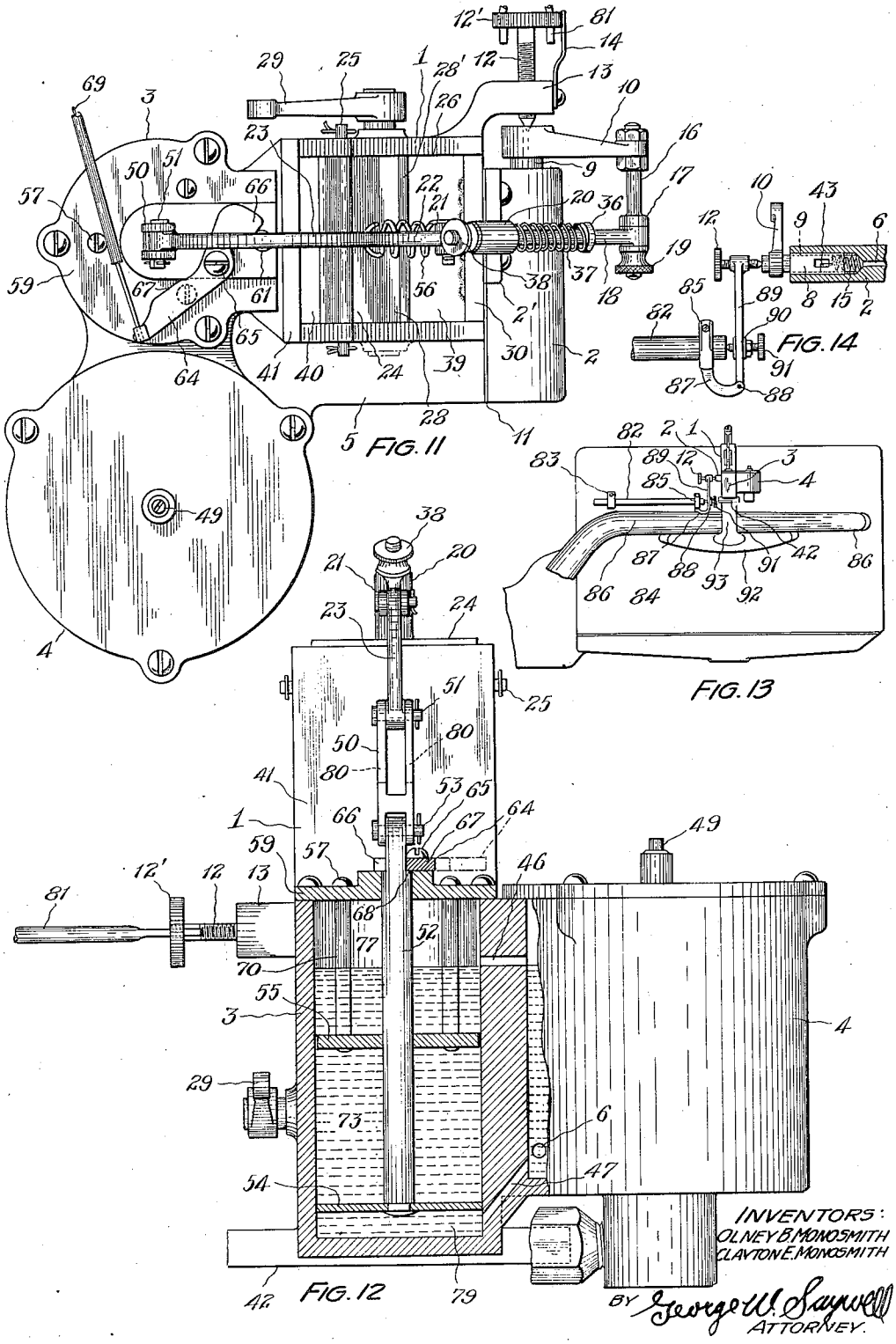


FIG. 11

FIG. 14

FIG. 13

FIG. 12

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UNITED STATES PATENT OFFICE

1,974,286

CARBURETOR

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Application November 6, 1930, Serial No. 493,750

17 Claims. (Cl. 261—50)

Our invention relates to carburetors for internal combustion engines, and particularly to the proportional-flow type of carburetor. These improvements are particularly applicable to the down-draft type of carburetor. Certain features of the invention are outstanding, as follows:

(1) The air valve of the carburetor is suction-controlled, the valve being spring-loaded, so as to permit the admission of air only when a certain predetermined minimum vacuum obtains in the carburetor casing. This vacuum is maintained, within narrow limits, to the full opening of the air valve, since the attachment of the spring is such that its range of movement is small.

(2) The fuel valve is of the two-movement type, these two movements being in different dimensions, the movements of the fuel valve in one dimension being automatically induced by, and proportionate to, the movements of the automatic air valve, the opening of the fuel valve during its movements in this dimension being, throughout the entire range of movements, in an amount having a constant ratio to the opening of the air valve. The movement of the fuel valve in the other dimension is manually-controlled and is adapted to change the constant ratio from one value to another and maintain the selected value throughout the entire range. The movement of the fuel valve in this last-mentioned dimension can be automatically controlled by means of a thermostat or aeronoid bellows or other suitable automatic controlling means, as hereinafter illustrated.

(3) The amount of vacuum in the carburetor casing into which the fuel enters is the same as that under which the air is admitted to the casing;

(4) We provide a dash-pot which supplies a very rich mixture for starting, and also additional finely atomized fuel for rapid acceleration. This dash-pot also prevents the air valve from fluttering, all of which functions will be hereinafter fully described.

(5) A spraying of the fuel is effected by feeding it from the two-movement fuel valve to the mixing chamber through a plurality of substantially horizontally aligned openings, these openings being of sufficient capacity to prevent any material resistance to the fuel flow. These multiple openings with relatively large capacity and low velocity of fuel flow prevent the fuel from spurting into the eddy currents on the low vacuum side of the throttle and also provide a relatively large area of contact for the fuel with the air stream in the mixing chamber, thus facilitating fine spraying. At very low engine speeds, the fuel flows down the casing wall within which the multiple openings are formed, in a thin film and is sprayed at the upper edge of the throttle.

(6) The automatically-operated air valve is pivoted intermediate its ends, thus providing an air inlet opening upon each side of the pivot, which construction tends to reduce the eddy currents around the air valve and results in a smoother air flow. The air valve is also pivoted off-center so as to render it subject to suction control.

(7) The throttle is hung in an inclined position with the upper edge adjacent the multiple fuel ports in the casing wall. Such a disposition of the throttle tends to prevent the fuel from getting into the eddy currents on the low vacuum side of the throttle and thus facilitates a smooth flow of the atomized fuel past the throttle.

The annexed drawings and the following description set forth in detail certain means embodying our invention, such means disclosing, however, but a few of the various forms in which the principle of the invention may be applied.

In said annexed drawings:

Figure 1 is a plan section of the carburetor, taken in the planes indicated by the line 1—1, Figure 2, the several parts of the carburetor being shown in the fully choked starting position, a dot-and-dash position of certain parts being shown during the fully closed or inactive position of the choking devices;

Figure 2 is a vertical section, taken in the planes indicated by the line 2—2, Figure 1;

Figure 3 is a fragmentary side elevation, taken in the planes indicated by the line 3—3, Figure 1, the view particularly showing the gasoline passage leading from the float chamber to the two-movement fuel valve;

Figure 4 is a fragmentary vertical section, taken in the plane indicated by the line 4—4, Figures 5 and 6, this view particularly showing the two-movement fuel valve;

Figure 5 is a plan section, similar to Figure 1, but showing the positions of the several parts when the air is partially choked, the choke button being shown also in fully choked position by dot-and-dash lines, and in normal running, or non-choking, position by dotted lines;

Figure 6 is a vertical section, similar to Figure 2, but showing the parts in the partially choked position illustrated in Figure 5, this Figure 6 being taken in the planes indicated by line 6—6, Figure 5;

Figure 7 is a fragmentary plan section, similar

to Figure 1, but showing the carburetor in unchoked running position;

Figure 8 is a fragmentary vertical section, showing the positions of the respective parts during normal operation, with the engine running at a substantially uniform rate of speed;

Figure 9 is a vertical section, taken in the planes indicated by the line 9—9, Figure 7, showing the respective positions at the time of acceleration;

Figure 10 is a fragmentary vertical section, taken in the plane indicated by the line 10—10, Figure 9, showing the flow of the gasoline into the mixing chamber through a plurality of substantially horizontally-aligned fuel ports;

Figure 11 is a complete plan view of the carburetor in running position;

Figure 12 is a vertical section, taken in the planes indicated by the line 12—12, Figure 1;

Figure 13 is a fragmentary side elevation of our improved carburetor, in combination with associated engine elements, and shows means for automatically actuating in one direction a fuel valve forming part of the improved carburetor, as will be hereinafter fully described;

Figure 14 is a view, upon an enlarged scale, of a portion of Figure 13, some valve parts being shown in vertical section;

Figures 15 and 16 are fragmentary sections, similar to Figures 9 and 10, respectively, of a modified construction for introducing the gasoline into the mixing chamber through a plurality of substantially horizontally-aligned inlets;

Figure 17 is an enlarged side elevation of the fuel inlet shown in Figure 15;

Figure 18 is a vertical section, taken in the plane indicated by the line 18—18, Figure 17; and

Figures 19 and 20 are views, similar to Figures 17 and 18, respectively, of a second modified form of one of a plurality of substantially horizontally-aligned fuel ports.

Referring to the annexed drawings in which the same parts are indicated by the same respective numbers in the several views, a main casing 1 is provided with a valve body portion 2 secured to the main casing 1 by means of integral ears 2', a gasket 11 being positioned between the casing 1 and the adjacent surface of the valve body 2. The casing 1 is also formed with an auxiliary casing member 3 serving as a dash-pot chamber, with a float chamber portion 4, and an exterior boss 5 lying between the float chamber 4 and the valve body 2 and formed with a gasoline passage 6 communicating with the float chamber 4 and discharging into a sleeve member 8 mounted in the valve body 2. Contained within this sleeve 8 is a rotatable pin 9 forming part of the fuel valve, which pin is fixed at one end to an arm 10 which serves automatically to actuate the fuel valve in a transverse plane in a manner hereinafter fully described. The longitudinal position of the valve pin 9 in the sleeve 8 is determined by a spring 15 positioned between an inside end wall of the valve body 2 within the sleeve 8 and one end of the pin 9, and by a manually-operated adjusting screw 12 threaded through a bracket 13 and adapted to bear upon the other end of the pin 9. The tendency of the spring 15 is to force the valve pin 9 as far as possible to the right, Figure 4, this movement being controlled by the setting of the adjusting screw 12, which is manipulated from the dash through the connecting arm 81, secured to the head member 12' of the screw 12, Figures 5 and 7. The setting of the screw 12 is maintained by a spring plate 14 which is secured at one end to the bracket 13 and bears at its other end upon the knurled head 12' of the adjusting screw 12, as plainly shown in Figures 5, 7 and 11.

The fuel valve can be automatically operated in a longitudinal direction, and we show means in Figures 13 and 14 to effect such operation. A rod 82 of copper or other material adaptable readily to thermal expansion is adjustably fixed adjacent one end in a bearing 83 mounted upon the engine case 84, and freely movable under longitudinal expansion through another bearing 85 supporting its end, this rod 82 being mounted closely adjacent and above the engine exhaust pipe 86. The bearing 85 is formed with an extension 87 having a pivot pin 88 upon which is mounted one end of a lever 89 which is formed with a hub member 90 intermediate its ends and provided with the adjusting screw 12 at its other end, this movable lever 89 replacing the fixed bracket 13 shown in Figures 1, 7 and 11, for instance, which bracket 13 serves as a support for the adjusting screw 12 when the longitudinal movement of the fuel valve member 9 is limited to manual control. The hub member 90 is intersected by an adjusting screw 91 which serves to adjust the position of the lever 89 with relation to the end of the copper rod 82. The lever 89 is so mounted that the amount of thermal expansion of the rod 82, induced by the heat from the exhaust pipe 86, will be compounded to produce a greater movement of the valve member 9, the latter, as hereinbefore explained, being longitudinally adjusted by any movement of the screw 12. The arrangement is such that a movement of the valve member 9 induced by an expansion of the copper rod 82 will reduce the size of the fuel valve opening 43 whereby a lean mixture will be fed to the mixing chamber 27. Thus when the engine is hot enough to cause the heat of the exhaust gases to expand the copper rod 82 enough to move the fuel valve member 9 to its steady-running position, fuel will be furnished through the port 43 in an amount sufficient to produce a normal mixture. It will be noted that these elements which illustrate the automatic longitudinal adjustment of the fuel valve member 9 present various means of adjustment for determining what should be the proper longitudinal movement of the valve member 9 induced by the thermal expansion. These various adjusting means comprise the lever 89 which is subject to a range of compounding movements, the adjusting screws 12 and 91, and the copper rod 82 which can be varied in its distance from, and its other relations to, the exhaust tube 86. In the illustrative showing of Figures 13 and 14, we suggest an intake manifold 92 and a mixture passage 93 thereto from the mixture outlet 42 of the casing 1.

One end of a rod 16 is mounted upon the outer end of the fuel valve control arm 10, this rod 16 being formed with an intermediate shoulder portion 17 and engaged by a thumb nut 19 at the other end. One end of a bar 18 is rotatably mounted upon the rod 16 between the shoulder 17 and the thumb nut 19, as plainly shown in Figures 6, 7 and 11. This bar 18 is connected to the air valve 24 which is pivoted in an unbalanced manner intermediate its ends upon the pin 25 and which controls the casing air opening 26. The details of this connection comprise an arm 22 formed integrally with the air valve 24 and rotatably secured to a boss 21 formed upon a sleeve 20 mounted upon the bar 18 and ad-

justed to position by a thumb nut 38 engaging the bar 18. A coiled spring 37 bears against the inside end of the sleeve 20, said spring also bearing against a stop member 36 secured to the bar 18, the spring 37 thus adapting the rod 18 to the thumb nut adjustment. The purpose of the adjustment provided for the bar 18 by the sleeve 20 and thumb nut 38 is to adjust the initial opening area of the two-movement fuel valve. The distance between the pivotal axes 25' and 75 is equal to the distance between the pivotal axes 74' and 76, and the plane containing the pivotal axes 25' and 74' is substantially parallel to the plane containing the pivotal axes 75 and 76, so that any opening or closing movement of the air valve 24 will result in a proportionate opening or closing movement of the fuel valve member 9. Normally the air valve 24 is controlled by the engine suction which is regulated by the movements of the throttle valve 28. The latter is operated from the dash in any usual manner through the medium of the connecting arm 29.

The air valve 24, by reason of its pivotal mounting intermediate its ends, divides the air opening 26 into two parts 39 and 40 when the air valve 24 is moved to an open position such as is illustrated in Figures 6, 9 and 11. The purpose of this construction will be hereinafter fully described. The air valve 24 is further integrally formed with a curved arm 23 the outer end of which depends toward the auxiliary dash-pot chamber 3 and is pivotally connected to one end of a yoke 50 by means of a pin 51, the other end of the yoke 50 being pivotally connected by a pin 53 to the top of a plunger rod 52 depending in the auxiliary dash-pot 3. The arms of the yoke 50 are formed with elongated slots 80 in which the ends of the pin 51 can slide. Secured to the bottom of the plunger rod 52 is a plunger head 54. Intermediate the bottom and top of the dash-pot chamber is fixed a partition member 55 which has a free fit with the inside face of the chamber 3, this partition member 55 being supported by a plurality of screws 57 depending from the dash-pot cover 59 and contained within cylindrical spacing members 70 mounted between the bottom of the cover member 59 and the top of the partition member 55. The tendency of the plunger head 54 is to seek its lowermost position in the casing 3 under the force of gravity.

A coil spring 56 is secured at one end to a web portion 71 of the arm 22 closely adjacent the pivotal axis 25' of the air valve 24 and secured at the other end to an ear 7 formed upon the sleeve 20. This spring 56 serves as a loading upon the air valve 24 and determines the minimum vacuum which must obtain in the mixing chamber 27 before the air valve 24 commences to open.

The line of pressure of the spring 56 in three planes is shown by the dot-and-dash-line arrows, Figures 2, 6 and 9. It will be particularly noted that one such line of pressure is exerted against the fuel valve seat upon that side where the valve feeds, which insures a tight seating at the valve cut-off edge 44, Figure 2. This line of pressure upon the cut-off edge 44 is exerted upon the long end of the rod 18, the spring 56 being secured to the sleeve 20 and the air valve 24 closely adjacent the plane containing the pivotal axes 25' and 75. In all positions of the fuel valve this pressure is just sufficient to keep the fuel port edge in tight contact with the opening in the fuel valve block 9 and thus insure perfect proportioning of the fuel. Of course, this will also insure proper take-up of the fuel valve parts at the cut-off edges 44 and 45, if any of these parts become worn, or loose for any other reason. Thus, any leakage of fuel through the fuel port, when the latter should be closed, is avoided, together with the uncertainty that would thereby be created as to the necessary correct position of the valve parts for the duty required of them.

The purpose of the dash-pot is to prevent the fluttering of the air valve; and also to supply additional fuel to the mixing chamber under certain conditions, viz., when starting a cold motor and when accelerating a motor. Two forces or conditions are utilized to accomplish this furnishing of additional fuel, viz., the movements of the plunger 54 and the vacuum of the chamber 27. Means are provided for using these forces in different combinations to accomplish these purposes. For this purpose of supplying additional fuel to the mixing chamber, a fuel passage 47, Figure 12, is formed in the casing wall and communicates at its two ends with the float chamber 4 adjacent the bottom of the latter, and with the portion 79 of the auxiliary chamber 3 beneath the lowermost position of the plunger head 54, respectively. Gasoline freely passes the plunger head 54 into a dash-pot chamber 73, when the plunger head 54 is moving downwardly, through the medium of an inwardly-opening valve 63, Figures 2, 6 and 9, and thence passes upwardly through a conduit 58, when the plunger head 54 moves upwardly, the upper end of this conduit 58 communicating with a horizontal passage 60 formed in the dash-pot chamber cover 59, which passage 60 communicates with a vertical hole 61 formed through the cover member 59. This hole 61 is open to the atmosphere at its upper end and at its lower end communicates with a fuel conduit 62 formed in the wall member 41 of the casing 1 and opening into the mixing chamber 27. The conduit 58 at its bottom end 58' dips somewhat below the fixed partition 55, in order that, if there is a slight pocket of air in the upper part of the fuel chamber 73, the conduit 58 will still dip into the fuel in this chamber 73 and thus will not feed air. The upper part of a chamber 77, which chamber is above the partition 55, is in communication with the upper part of the float chamber 4 through the medium of the wall passage 46, Figure 12, and the upper part of the float chamber 4 is also open to atmosphere through the port 49. The conditions under which a very rich mixture is fed from the dash-pot chamber 3 to the main casing 1, or under which additional air is obtained through the medium of the hole 61 and fed to the main casing 1, will be described in detail hereinafter.

Pivotally mounted intermediate its ends upon the dash-pot chamber cover 59 by means of a pin 65 is a lever 64 secured at one end to a cable 69 which in turn is connected in any desired manner with a choke button 72 on the vehicle dash 78, Figure 5. Said pivoted lever 64 is formed with a portion 67 which, in a certain position, is adapted to overlie a shoulder 68 formed on the plunger rod 52, if the latter is in its lowermost position, as plainly shown in Figures 1 and 12, this lever 64 being also formed with a portion 66 which is adapted, in certain positions, to cover the upper end of the air opening 61 formed in the cover 59 Both of these locking and covering positions of the lever 64 are assumed, when the choke button 72 is pulled outwardly to its fully operative position. If the choke button 72

is eased off somewhat, then the lever locking portion 67 moves off the rod shoulder 68, and, if the choke button is eased off entirely or closed, then the lever 64 is moved sufficiently so that the portion 66 uncovers the air opening 61. Thus, when the choke button 72 is in fully operative position, the rod 52 is restrained from moving upwardly by the locking portion 67 of the lever 64, and any fuel fed to the mixing chamber 27 from the auxiliary dash-pot chamber 3, due to the suction created in the mixing chamber 27 by the opening of the throttle 28, is not mixed with air, since the top of the opening 61 is closed However, when only a comparatively slight choking effect is desired, that will not necessitate holding the air valve 24 closed, then the rod 52 is released from the locking member 67 and the opening movement of the air valve 24 induced by the engine suction can operate upon the plunger rod 52 and plunger head 54. However, the auxiliary fuel that is forced into the mixing chamber 27 from the auxiliary chamber 3 through the conduits 58, 60 and 62 is not mixed with air, until the choke button 72 is completely closed so as to move the pivoted lever 64 over to a position in which the lever portion 66 moves off the top of the opening 61, as shown in Figures 7, 9 and 11.

The detailed construction and operation of the two-movement fuel valve will be hereinafter fully described but it will be here noted that the fuel that is furnished by this valve comes through the wall 30 of the casing 1 in a plurality of streams, there being formed in this wall 30 a multiplicity of horizontally-aligned ports 31 which tap a chamber 32 formed in the valve casing and into which the two-movement fuel valve discharges. These ports 31 furnish the fuel in a thin finely divided broad band or stream 35, such as illustrated in Figure 10. This fuel stream is mixed in the chamber 27 with the air entering through the air openings 39 and 40, the effect beng to finely atomize and vaporize the fuel and feed the same by the throttle valve 28 intimately mixed with the air, whence the mixture passes to the engine manifold through the carburetor mixture outlet 42.

In the modified form of construction shown in Figures 15 and 16, the multiplicity of horizontally-aligned fuel ports 31 is replaced by a multiplicity of fuel inlets in the form of nozzles 100 which are secured at one end in the casing wall 30, this nozzle 100 having a portion 101 projecting into the chamber 27 and being flattened, as plainly shown in Figure 18, and formed with a discharge slot 102 arranged at an angle to both the vertical and horizontal axes of the casing, and at the lower end of the upper side of the projecting nozzle portion 101. In this type of fuel inlet, the air stream passing downwardly through the chamber 27 causes a suction at the edge of the slots 102, thus inducing a more even and satisfactory feed of the gasoline, and insuring for some types of motor a better carburetor performance than is obtained by the type of fuel inlets 31 shown in Figures 9 and 10.

In the second modified form of fuel inlet shown in Figures 19 and 20, the axis of the projecting portion 104 of the nozzle 103 is substantially at right angles with the vertical axis of the chamber 27 and the two sides of the flattened nozzle portion 104 are formed with a plurality of substantially horizontally-aligned fuel ports 105, the line of ports upon the two sides of the nozzle portion 104 being substantially opposed one to the other, thus providing a further modified method of fuel feed which is more satisfactory for certain types of motors than the two types of fuel feed shown in Figures 9 and 15, respectively.

The fuel valve sleeve 8 is formed with a rectangular opening 33 forming a fuel aperture adapted to register more or less, in a manner hereinafter fully described, with a corresponding fuel opening 34 formed by cutting away substantially one-half of a portion of the pin 9 at one end, to form a valve part comprising a segment of a cylinder, in the manner plainly shown in Figures 2 and 4. The fuel port formed by the overlapping areas of the openings 33 and 34 is designated by the number 43, Figure 4, and the port edge of the opening 33 is indicated by the number 44 and the port edge of the opening 34 by the number 45, the distance between these port edges being indicated by the line A—B, Figure 4. The apertures 39 and 40 through which the air enters the mixing chamber 27 are rectangular, as plainly shown in Figures 5, 7, and 11, and, as mentioned above, the openings 33 and 34 form a rectangular fuel port 43 so that, due to the mechanical assemblage of the elements connecting the air valve and the fuel valve, hereinbefore described, any increment of air valve and fuel valve openings will admit corresponding proportional increments of air and fuel. Inasmuch as the fuel port 43 is rectangular, the area of said port 43 will vary in direct proportion as the distance between the port edges 44 and 45 varies, illustrated by the distance A—B, Figure 4. Furthermore, any manual adjustment of the valve pin 9 effected by the screw 12, or any automatic longitudinal adjustment of said pin, to vary the distance C—D, Figure 4, to change the constant ratio of the fuel and air, will be effective proportionally for all automatic movements of the fuel valve caused by the varying openings of the air valve 24 and the throttle 28 and the varying speeds of the motor. We have provided, then, two movements of the fuel valve, at an angle to each other, one movement feeding the fuel proportionately to the flow of air and the other movement varying this proportion. It will be noted that the suction-actuated automatic control of the fuel and air valves maintains a constant ratio between the effective areas of the fuel valve and air valve openings for all automatic movements; further, that the manual control of the fuel valve through the adjusting screw 12, or the longitudinal automatic control thereof, provides for changing this ratio of the effective areas of the fuel valve and air valve openings from one constant ratio value to another constant ratio value. It is evident, therefore, that any desirable range of fuel feed for motor operation, from idling to full throttle, may be chosen through the medium of the proper setting of the adjusting screw 12 and then, under the action of the throttle and the pull of the engine, the fuel valve through the medium of the air valve 24 will move through this chosen range of openings proportionately to the movements of the air valve.

It is evident from the foregoing description that the spring 56 being placed under suitable tension to provide the desired differential of pressure between atmosphere and the chamber 27, the movements of the air valve 24 induced by the movements of the throttle valve 28 and the speeds of the motor, will maintain this differential within the required limits, and the vacuum of the chamber 27 produced by this differential will be termed the "low vacuum", as distinguished from the "high vacuum" upon the manifold side of the throttle

valve 28. By the term "low vacuum", we refer to a vacuum that is, preferably, kept to less than a pound; whereas, the "high" vacuum may at times be as high as eight pounds. Spring 56 which controls the movements of air valve 24 will maintain the low vacuum within sufficiently close limits to prevent any material change in the relative flow of air to liquid fuel, due to variations in vacuum in chamber 27. During the design of the carburetor a suitable tension would be determined for the spring 56, according to the type of the carburetor, the service for which the same is designed, and the stresses to which the particular spring would adequately respond. The air and fuel both enter the same low vacuum in the mixing chamber 27, thus insuring the feeding of the fuel and air by the same suction. Correct proportioning of the fuel and air is comparatively easy of accomplishment in the low vacuum chamber 27. The mixing of the fuel and air takes place upon both sides of the throttle valve 28. The fuel enters the mixing chamber 27 in a condition to be effectively and quickly subjected to the action of the air, by reason of the multiplicity of fuel ports 31. Atomization of the fuel and an intimate intermixing of the same with the air immediately commences and is continued throughout the length of the mixing chamber 27, also in the high vacuum chamber and in the engine manifold. The wide walls of the mixing chamber 27 in which the fuel inlets 31 and the conduit 62 are formed permit ready and rapid flow of the fuel, with consequent atomization, from the low vacuum chamber by the throttle valve 28 into the high vacuum chamber, with little or no condensation of fuel upon the throttle valve 28.

In order that the turbulent flow of the fuel may be preserved throughout the entire range of operation, despite the fluctuations in vacuum encountered in practice, we load the air valve 24 by the spring 56 between certain upper and lower limits of vacuum, preferably a lower limit of about two ounces and an upper limit of about one pound below atmosphere, i. e., between the inside of chamber 27 and the atmosphere. The reasons for these practical limits are: If the suction in chamber 27 is much more than one pound, the power of the engine is limited at full load. If the suction is much less than two ounces, there is an undesired effect from fluctuating fuel levels and from the surface tension of the liquid fuel; also, the fuel flow may change from the turbulent to the streamline flow, which causes variations in the fuel flow disproportionate to the variations in the air flow. Although, as above stated practical operation presents certain fluctuations of the vacuum, still the tension of the spring 56 is determined for any one carburetor so as to provide a fixed vacuum in the chamber 27 at some point between two ounces and one pound, as deemed desirable, and in theory this vacuum is considered to be maintained constant, although in practice it actually varies, this variation being well within the above limits under usual operating conditions and not affecting the constant ratio between the effective areas of the fuel and air openings. In our improved type of carburetor, a considerable friction in the air and fuel valve mechanism, or a wider fluctuation in the differential pressure between chamber 27 and the air intake 26, has no effect on the relative flow of air to fuel either in theory or practice. However, due to the short movement of the spring 56 and its location, as described, the pressure range will not vary greatly but will be maintained nearly constant for all openings of the air valve 24, as hereinafter more fully described.

By reason of pivoting the air valve 24 intermediate its ends and thus subdividing the casing opening 26 into two air openings 39 and 40, one on either side of the pivotal pin 25, we reduce the eddy currents which otherwise would tend to be set up around the air valve, and which would pick up the fuel in an irregular fashion. The spring 56 is subject to a very short movement even if the air valve is subjected to its greatest possible opening movement. Also, spring 56 is secured closely adjacent the pivotal axis 25' so that there is a very small arc of spring movement. The result is that the pressure range is nearly constant for all openings of the air valve 24, and the spring tension does not vary as much as it would if it were subjected to a greater range of movement. The lines of pressure exerted by the spring 56 are indicated by the dot-dash line arrows shown in Figures 2, 6 and 9.

By reason of so hanging the throttle 28 that it is inclined, when in closed position, with the upper edge 28' adjacent the wall 30 within which the multiplicity of fuel ports 31 is formed, we tend to keep the fuel from getting into the eddy currents on the low vacuum side of the throttle, thus facilitating a smooth flow of the atomized fuel past the throttle, a condition which is not obtained when the throttle is hung with its upper edge upon the opposite side of the mixing chamber 27 to that which we have shown and described.

The planes in which the air valve 24 and the throttle valve 28 hang, when in their normal closed positions, converge adjacent the casing wall in which the multiplicity of aligned fuel ports 31 are formed.

We direct particular attention to the fact that our improved carburetor has a straight rectangular main passage 27, having rectangular inlet and outlet valves 24 and 28, respectively, and that the axes of these valves are parallel and that the planes of the valves are inclined toward each other, the bearing of the inlet valve being off-center so as to permit automatic suction control and the outlet valve being manually controlled.

The operation of our improved carburetor is substantially as follows:

Assuming that the automotive engine has been stopped, the carburetor parts will be in the respective positions shown in Figures 1 and 2, the throttle 28 being in the dot-and-dash position shown in Figure 2, and the lever 64 being in the dot-and-dash position shown in Figure 1. In starting with a cold engine, the valve rod 9 is manipulated to establish a ratio of fuel to air that feeds a comparatively rich mixture, the choke button is pulled out, probably to its extreme position, and the throttle valve is partially opened, these positions being shown in full lines in Figures 1 and 2. The result is that substantially undiluted fuel is drawn into the mixing chamber 27 from the fuel port 43 and from the auxiliary chamber 73. Of course, there will be such air as is necessary to create an explosive mixture, this air being derived by leakage around the air valve 24, when the engine is running and creating a suction in the carburetor casing. As soon as the engine has been sufficiently warmed by the rich mixture, the choke button 72 is pushed in somewhat, enough to release the shoulder 68 of the rod 52 from the portion 67 of the lever 64, and then the air valve 24 is free to open an

amount commensurate with the low vacuum of the chamber 27, and proper proportioned fuel and air is fed into the mixing chamber 27 through the air openings 39 and 40 and from the fuel port 43, substantially undiluted fuel being also pulled in from the chamber 73, no air being mixed with this fuel because the lever 64 is still in a position in which the portion 66 covers the air hole 61. The respective positions of the several carburetor parts at this stage of operations is shown in Figures 5 and 6.

The next stage of operations is to further shut off the choking effect, and this is done by pushing the choke button into the position shown in dotted lines in Figure 5, which results in so moving the lever 64 as to cause the portion 66 to move away from the opening 61. Also the valve rod 9 is manipulated to establish a steady-running ratio of fuel to air. Then, assuming first that the engine is accelerated by opening the throttle 28 the desired amount, the increased suction will cause the air valve 24 proportionately to open, which correspondingly lifts the plunger rod 52 and the plunger head 54, forcing gasoline into the conduit 58 and through the conduit 62 into the mixing chamber 27. This condition is shown in Figure 9, and it will be noted that properly proportioned air and fuel is being fed into the mixing chamber 27 through the air openings 39 and 40 and through the fuel port 43 and that fuel and air are being fed into the mixing chamber 27 from the conduit 62. During this operation a rich mixture of finely sprayed fuel and air will be drawn into the mixing chamber 27 through the conduit 62. As soon as this accelerating movement is completed, and assuming that the engine has been accelerated to that point where it is desired to run at a uniform rate for a period of time, the air valve 24 will be maintained in the position shown in Figure 9 and consequently the plunger head 54 will be maintained in its position shown in that figure and no more fuel will be forced into the mixing chamber 27 from the fuel chambers 73. The auxiliary chamber condition will then settle down to that shown in Figure 8 wherein it will be noted that the fuel level in the conduit 58 is somewhat above that of the fuel in the chamber 77, but that substantially no fuel is being taken into the mixing chamber 27 from the auxiliary casing 3. Under these conditions, substantially undiluted air is being fed through the hole 61 and the conduit 62 into the mixing chamber 27, to be incorporated with the properly proportioned mixture of air and fuel coming into the mixing chamber 27 from the air openings 39 and 40 and through the fuel port 43. This last-named condition is also shown in Figures 7 and 11. This condition obtains until some change is made in the position of the throttle 28 which will correspondingly affect the air valve 24 and consequently the plunger head 54.

It will be understood that when gasoline is forced by the upward movement of the plunger head 54 through the conduit 58, the chamber 79 in the casing 3 will receive a fresh supply from the float chamber 4 through the channel 47. When the plunger 54 is moved downwardly, the inwardly opening valve 63 permits fuel to be fed from the chamber 79 into the chamber 73 to keep the latter full of fuel. It will also be noted that the pressure upon the fuel in the upper chamber 77 is substantially atmospheric and therefore substantially equal to the pressure upon the top of the fuel in the float chamber 4, these two chambers 77 and 4 being in communication through the medium of the channel 46, and the float chamber 4 being open to atmospheric pressure through the port 49, Figure 12. In the event that for any reason air is trapped in the chamber 73 so as to result in a material layer of air in the top of said chamber, the dip portion 58' of the conduit 58 will still provide for the feeding of fuel instead of air by reason of its extension into the chamber 73 substantially below the partition 55, as plainly shown in Figures 2, 6, 8 and 9. The comparatively loose fit of the partition 55 in the casing 3 permits air to escape from the chamber 73 to the chamber 77 and also provides a flexibility of operation if the pressure upon the fuel in the chamber 73 becomes greater than would be normally accommodated by the passage of fuel upwardly through the conduit 58. This construction also keeps the chamber 73 full of fuel when the plunger 54 is locked, together with the air valve 24, by the portion 67 of the lever 64, and the suction in chamber 27 is drawing fuel up through conduit 58 and down through conduit 62.

The loose play provided between the plunger rod 52 and the air valve arm 23, by reason of the slot arrangement 80, permits the quick shutting off of the air valve 24 when the throttle 28 is entirely and suddenly shut off, without the necessity of the plunger head 54 immediately assuming its lowermost position. There is not a great amount of difference of time in the settling of the plunger head 54 under the influence of gravity and the time consumed by the complete closing of the air valve 24, but whatever differential of time is necessary for these two actions is accommodated by the described loose play arrangement between the plunger rod 52 and the air valve arm 23.

It will be noted that our improved carburetor construction provides a constant ratio of fuel and air, throughout the entire range of throttle and engine operation, this ratio being subject to change so as to provide any other desired constant ratio of fuel and air throughout the whole range of operations, provision being made for a desired idling or low-speed ratio. Furthermore, provision is made for a short range of movement of the spring controlling the suction-actuated air valve so as to provide nearly constant pressure range for all openings of said valve, and further provision for efficient atomization of the fuel and intermixing of air therewith. Also we have provided means for furnishing a temporary rich mixture for a cold motor or for quick acceleration.

One of the important advantages of our improved carburetor construction is the ability to clearly see the carbureting action. The casing is open at the top when the air valve 24 is opened and by looking down through the casing the character of the fuel feed can be clearly determined and the nature and extent of eddy currents, if any, definitely analyzed.

What we claim is:

1. A carburetor comprising a main casing having an air inlet, a fuel port, and a mixture outlet; a throttle valve mounted in said casing; a suction-actuated valve controlling said air inlet; a valve controlling said fuel port, said fuel valve being connected to said air valve and moved automatically by the movements of said air valve, the construction being such as to maintain a constant ratio, throughout the entire range of movement, between the area of the fuel port opening and the area of the air inlet opening; an auxiliary casing formed with a fuel port adjacent the bottom thereof; a plunger rod and plunger head within

said auxiliary casing; means forming a fuel conduit between the main and auxiliary casings, said plunger rod being connected to the air valve so as to move said plunger head toward said fuel conduit when the air valve is being opened.

2. A carburetor, as in claim 1, characterized in that the auxiliary casing is vertical and the connection between said plunger rod and said air valve permits loose play, so that the air valve can close quickly and the plunger head settle by gravity to its lowermost position in said auxiliary casing.

3. An accelerating auxiliary for carburetors comprising the combination with a main casing having an air inlet, a fuel port, a throttle valve, and a mixture outlet, air and fuel valves, said air valve being suction-actuated, and means for operating said valves to admit proportionate amounts of fuel and air; of an auxiliary casing formed with a fuel port adjacent the bottom thereof; means forming a fuel conduit between the main and auxiliary casings, an air port communicating with said fuel conduit, a fixed partition member in said auxiliary casing, said fuel conduit extending through said partition from bottom to top and extending upwardly in said auxiliary casing, a plunger rod connected at one end to said air valve, extending downwardly through said partition and having a head at the other end adapted to slide in said auxiliary casing, an inwardly-opening valve in said plunger head, and a spring secured to said air valve and tending to hold the latter in closed position.

4. An accelerating auxiliary for carburetors, as in claim 3, characterized in that said fuel conduit extends downwardly materially beyond said partition, and said partition member has a loose fit in the auxiliary casing so as to permit the escape of air trapped between said partition and said plunger head.

5. An accelerating auxiliary for carburetors, as in claim 3, characterized in that releasable locking means are provided for keeping the plunger rod from moving upwardly, and hence, the air valve from opening.

6. An accelerating auxiliary for carburetors, as in claim 3, characterized in that releasable locking means are provided for keeping the plunger rod from moving upwardly, and hence, the air valve from opening, said means being adapted also to close the air port which communicates with the fuel conduit.

7. An accelerating auxiliary for carburetors, as in claim 3, characterized in that movable releasable locking means are provided which are adapted to keep the plunger rod from moving upwardly, and hence, the air valve from opening, over a certain range of movement of the locking means, said means being adapted also to close the air port which communicates with the fuel conduit over the said range of movement and also over a subsequent range of movement.

8. An accelerating auxiliary for carburetors comprising the combination with a main casing having an air inlet, a fuel port, a mixing chamber, a throttle valve, and a mixture outlet, air and fuel valves, said air valve being suction-actuated, and means for operating said valves to admit proportionate amounts of fuel and air; of an auxiliary casing chamber, the wall between said main casing and said auxiliary chamber being formed with a fuel conduit adapted to discharge into the mixing chamber of said main casing, said auxiliary casing being formed with a fuel port adjacent the bottom thereof, a plunger head adapted to slide in said auxiliary chamber, a cover for said auxiliary chamber, a plunger rod secured to said plunger head and extended upwardly through said cover, an operating arm secured to said air valve, a yoke member secured at one end to said arm and at the other end to said plunger rod, the connection between the yoke and arm being such as to permit a limited amount of relative movement between them, a hole through said cover communicating with said fuel conduit, a fixed partition in said auxiliary chamber above said plunger head, means for supporting said partition, the latter engaging the walls of the auxiliary chamber with a loose fit, a spring secured to said air valve and tending to hold the latter in closed position, means forming a fuel conduit through said partition and upwardly in said auxiliary chamber to communicate with said aforesaid fuel conduit in said casing wall, a lever pivotally mounted on said cover and means for operating the same, said lever having a portion adapted in one position to close said cover hole and a portion adapted to lock said plunger rod in the retracted position of the latter, the plunger rod locking portion of said lever having a range of effective locking positions less in extent than the range of effective closing positions of the hole-closing portion of said lever.

9. An accelerating auxiliary for carburetors comprising the combination with a main casing having an air inlet, a fuel port, a throttle valve, and a mixture outlet, air and fuel valves, said air valve being suction-actuated, and means for operating said valves to admit proportionate amounts of fuel and air; of an auxiliary casing, means forming a conduit between the main and auxiliary casings, an air port communicating with said conduit; a fuel reservoir, and conduits communicating therewith and with said fuel port and said auxiliary casing, respectively; and a plunger rod and plunger head in said auxiliary casing, said rod being connected to the air valve so as to force fuel through said first-mentioned conduit and into said main casing when said air valve is opening, air being drawn through said air port and said conduit into said main casing when the air valve is being maintained at substantially a steady open position.

10. An accelerating auxiliary for carburetors comprising, in combination with a carburetor casing proper and air, fuel and throttle valves, and means for operating said valves; of an auxiliary casing formed with a fuel port, a fuel conduit connecting said two casings, a controlled air inlet for said fuel conduit, a plunger and a spaced partition member above the plunger and both located in said auxiliary casing, said conduit communicating with the space between said partition member and said plunger and extending materially below said partition member, said fuel port opening into the auxiliary casing space below said plunger, means for reciprocating said plunger to force fuel through said conduit, said plunger being formed with an inwardly opening valve, and means other than through said fuel conduit permitting the escape of air from the top of the space between said partition and said plunger.

11. A carburetor comprising a substantially vertical main casing having an air inlet at the top thereof and a mixture outlet at the lower portion thereof, an air valve pivotally mounted at an intermediate portion to the top of the casing in such manner as to divide the air inlet into two unequal parts, a throttle valve pivotally

mounted within the casing between the air inlet and mixture outlet, said casing having a plurality of small adjacent fuel ports between the inlet and the throttle valve and directly above and in that portion thereof with which a swinging edge of the throttle valve contacts, and said throttle valve being so mounted that said swinging edge opens upwardly.

12. A carburetor comprising a substantially vertical main casing substantially rectangular in cross section, said casing having its top open to form an air inlet and being provided with a mixture outlet at its lower portion, a rectangular air valve pivotally mounted at an intermediate portion to the top of the casing in such manner as to divide the inlet into two unequal parts, said casing having a plurality of small adjacent fuel portions in that side wall entirely bordering the larger air inlet opening, and a throttle valve pivoted at an intermediate portion to the casing below the level of the fuel ports in such manner that a swinging edge contacts with that casing side wall having the fuel ports and opens upwardly.

13. A carburetor comprising a substantially vertical main casing substantially rectangular in cross section, one side wall of said casing having a series of small adjacent fuel ports and said casing having an inlet at its top and a mixture outlet at its lower portion; a suction-operated air valve pivoted to the upper portion of the main casing; a throttle valve pivoted to the main casing below the level of the fuel ports, said valves being pivoted in such manner that each valve has two swinging edges, one of which when in closed position contacts with the casing side wall having the fuel ports; means for operating the throttle valve; a fuel valve operated by the air valve; an auxiliary fuel casing; a fuel conduit leading from the auxiliary casing to the main casing, said conduit terminating in that main casing wall opposite the main casing wall having the series of fuel ports and between swinging edges of the air and throttle valves, and an intermediate portion of said conduit being above the fuel level in the auxiliary casing, an air port in the auxiliary casing communicating with said intermediate portion of said fuel conduit; piston means in the auxiliary casing for forcing liquid fuel into said intermediate portion of the fuel conduit, said piston means being actuated by the air valve; and means adapted to close the air port communicating with the fuel conduit.

14. A carburetor comprising a casing having an air inlet, a fuel inlet, and a mixture outlet; a throttle valve mounted in said casing; a pivoted suction-actuated valve controlling said air inlet; a valve controlling said fuel inlet and means for actuating the same, said means being pivotally connected to the air inlet valve; and a spring tending to hold the air inlet valve closed and secured at one end to said air inlet valve and at the other end to the means connecting said air inlet and fuel inlet valves closely adjacent the plane containing the pivotal axis of said air valve and the pivotal axis of said connecting means, whereby said spring exerts pressure upon the fuel-feeding side of the fuel valve seat.

15. A carburetor comprising a casing having a straight rectangular passage, a rectangular air valve and a rectangular throttle valve, a fuel port discharging into the casing between said air and throttle valves and means for controlling said fuel port, said air and throttle valves having their axes parallel and, when in closed positions, both lying in inclined positions with their planes inclined toward each other, said planes converging toward the casing wall within which said fuel port is formed, and means for manually controlling said throttle valve, said air valve being pivoted off-center so as to permit suction control thereof.

16. A downdraft carburetor comprising a casing having an air inlet, a fuel port, and a mixture outlet; a throttle valve pivotally mounted in said casing; a suction-actuated and pivotally mounted valve controlling said air inlet; a valve controlling said fuel port; means for actuating said fuel port valve; a low vacuum casing chamber formed between said air inlet and said throttle valve, said fuel port feeding into said low vacuum chamber; a high vacuum chamber formed between said throttle valve and said mixture outlet, said throttle valve hanging in an inclined position, when closed, with its higher edge adjacent the casing wall in which the fuel port is located, whereby the fuel is fed past the throttle at the apex of the triangle formed on the high vacuum side of the throttle by the throttle and said casing wall, said air-controlling valve hanging in an inclined position when closed, the planes of said air and throttle valves when the latter are closed converging toward the casing wall within which the fuel port is formed.

17. A downdraft carburetor comprising a casing having an air inlet; a fuel port, and a mixture outlet; a throttle valve pivotally mounted in said casing; a valve controlling said air inlet and pivotally mounted intermediate its ends in unbalanced condition so as to form two openings in the air inlet and to permit suction control of the valve; a valve controlling said fuel port; means for actuating said fuel port valve; a low vacuum casing chamber formed between said air inlet and said throttle valve, said fuel port feeding into said lower vacuum chamber; a high vacuum chamber formed between said throttle valve and said mixture outlet, said throttle valve hanging in an inclined position, when closed, with its higher edge adjacent the casing wall in which the fuel port is located, whereby the fuel is fed past the throttle at the apex of the triangle formed on the high vacuum side of the throttle by the throttle and said casing wall, said air-controlling valve hanging in an inclined position when closed, the planes of said air and throttle valves when the latter are closed converging toward the casing wall within which the fuel port is formed.

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