Oct. 7, 1930. E. A. ROCKWELL 1,777,735

CARBURETOR

Filed April 2, 1919 2 Sheets-Sheet 1

Fig. 1.

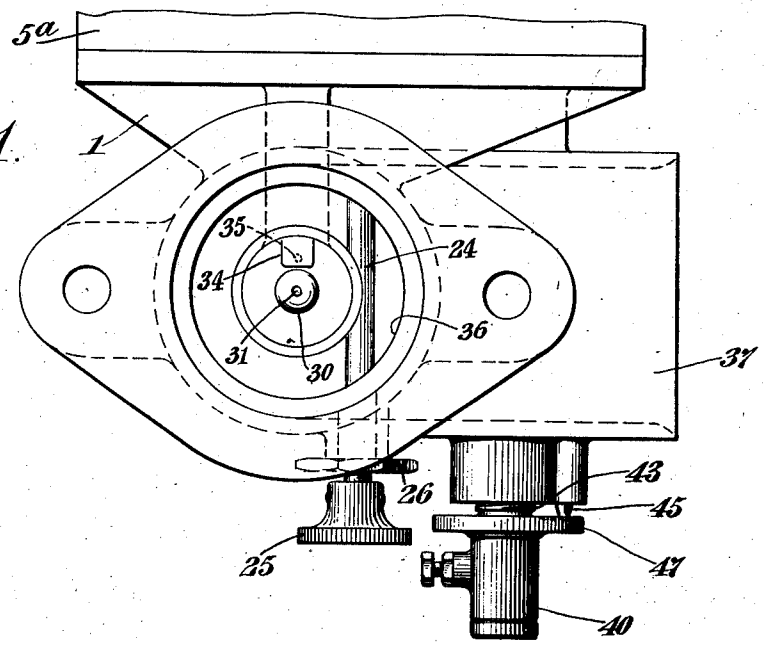

Fig. 2.

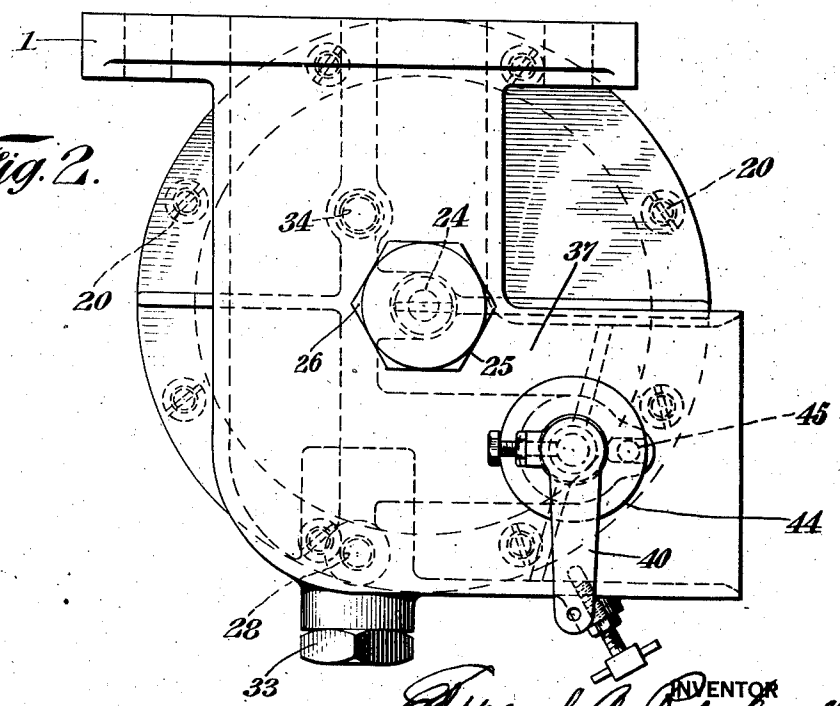

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Fig. 3.

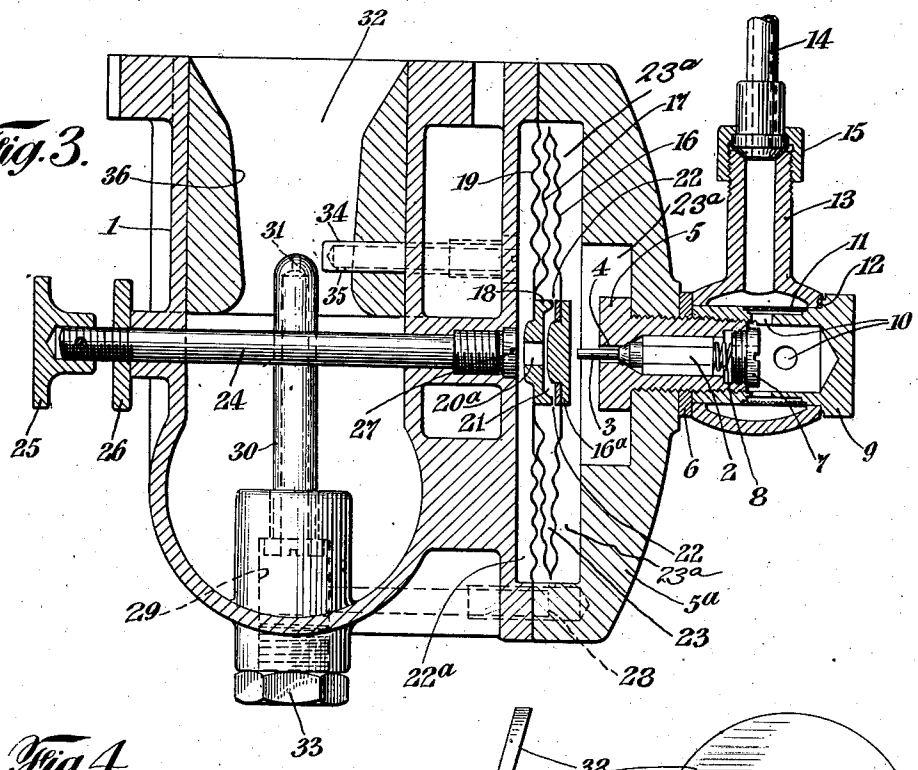
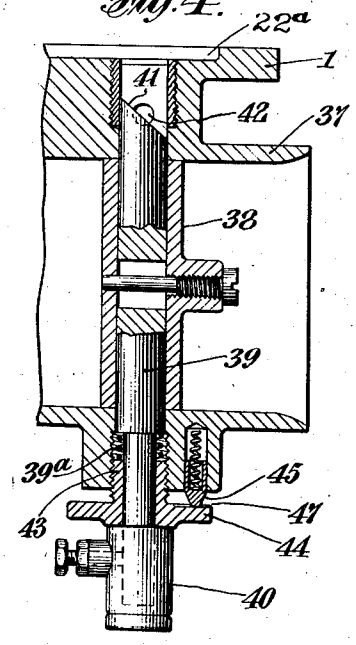


Fig. 4.



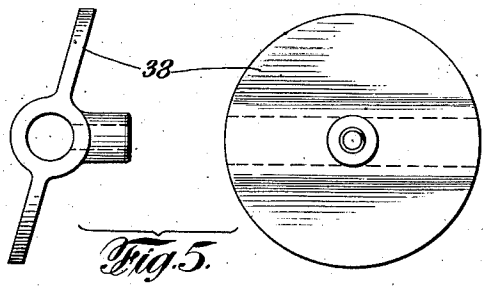


Fig. 5.

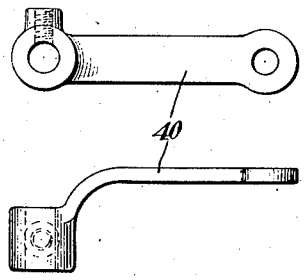


Fig. 6.

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UNITED STATES PATENT OFFICE

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CARBURETOR

Application filed April 2, 1919. Serial No. 286,963.

My invention relates particularly to an apparatus used for intermingling air and fuel supplied to an internal combustion engine and is designed for use in connection with internal combustion engines of different types.

The object of my invention is to provide a carburetor in which the feed of the fuel and air in the desired ratio is independent of variations in the level of the liquid fuel contained in the supply tank, and variations in the engine speed and barometric changes.

A further object of my invention is to provide a carburetor which will feed in any position, and which is not dependent upon the buoyancy of any parts contained therein, and in which the force of gravity is not a factor affecting the operation of the apparatus.

Another object of my invention is to provide an apparatus which is practically entirely free from lever-and-link connections, but which is constructed with fixed or flexible parts so that the apparatus cannot readily become inoperative through accidental dislocation of the parts.

The ultimate object of my invention may thus be understood to be, by reason of the above mentioned adaptation to operate with uniform ratio of fuel and air in the mixture supplied to the engine independently of changes of level of the fuel in the supply tank and variations in engine speed and barometric pressures at different altitudes, to provide a carburetor particularly adapted for use on aeroplanes.

While my invention is capable of embodiment in many different forms, for the purpose of illustration I have chosen only one form illustrated in the accompanying drawings, in which:

Figure 1 is a plan view of a carburetor made in accordance with my invention;

Figure 2 is a side elevation of the same;

Figure 3 is a vertical section through the same;

Figure 4 is a horizontal section through the air inlet of the carburetor;

Figure 5 represents detached detail views of the air valve;

Figure 6 is a plan view showing detached views of the operating arm attached thereto;

In the drawings I have shown a carburetor comprising a main casting, 1, which has a fuel inlet valve, 2, provided with a forwardly-directed pin, 3, which fits loosely in a fuel inlet opening, 4, in a screw-threaded plug, 5, carried by a diaphragm housing, 5a. A lock nut, 6, retains the plug, 5, in its desired position, and screwed in the end of the plug, 5, there is a retainer-screw, 7, which holds in position a spiral spring, 8, fitting against the rear end of the valve, 2. Screwed upon the outside of the plug, 5, there is a sleeve, 9, having peripheral apertures, 10, therein, and carrying outside of said apertures a cylindrical screen or strainer, 11, to prevent the entry of solid materials into the carburetor with the liquid fuel, which may be gasoline or naptha. Said sleeve, 9, furthermore, preferably has a shoulder, 12, to retain in place a coupling, 13, which is connected to a fuel supply pipe, 15. The liquid fuel may be supplied to the pipe, 14, from a fuel supply tank of any desired character and located at any desired point. The flow of the liquid fuel from the aperture, 4, is controlled by the position of the valve, 2, and the position of said valve is determined by the position at any given moment of the rear diaphragm, 16, of a bellows or sylphon device comprising also the diaphragm, 17, hereinafter mentioned. Said diaphragm, 16, is made of thin flexible material, as, for example, copper, and has secured in the center of the same a metallic button, 16a, adapted to contact with the forward-directed pin, 3. At its periphery the diaphragm, 16, is secured to a middle diaphragm, 17, of similar character, which is connected at its center to a metal ring, 18, that is also connected to the center of an inner diaphragm, 19, constructed in a similar manner to the diaphragms, 16 and 17, but of stiffer material. This diaphragm, 19, is held upon the main casting, 1, by means of the diaphragm housing, 5a, recessed to form a chamber, 23a, and which is shown as secured to the main casting, 1, by screws, 20.

The metal ring, 18, has on its rear face a

recess, 21, to receive the button, 16ª, as well as peripheral milled passageways, 22, to provide communication between a chamber, 22ª, in advance of the diaphragm, 19, and the diaphragm chamber, 23, located between the diaphragms, 16 and 17. In this form the diaphragm, 19, serves as an adjustable support for the bellows formed by the diaphragms, 16 and 17, the adjustment of which support is accomplished by the movement of the screw, 24, carried by the main casting, 1, said screw having an operating handle, 25, and a nut, 26, located on the opposite side of the carburetor. The rearward end of said screw, 24, normally supports the forward end of the plug, 18, access to the aperture, 20ª, not being interfered with because of the presence of a channel, 27, milled in the end of the screw, 24. Fuel from the chamber, 23ª, thus formed at the rear of the diaphragm, 19, is fed through a passageway 28, located in the diaphragm housing, 5ª, and the main casting, 1, to a chamber, 29, from which it passes through a nozzle, 30, screwed in said chamber, 29, and is discharged therefrom through a nozzle opening, 31, into a mixing chamber, 32, of the carburetor.

The lower part of the chamber, 29, is closed by means of a screw plug, 33. Communication between the chamber, 32, and the forward side of the diaphragm, 19, is secured by the presence of a tube, 34, having a downwardly directed inlet opening, 35, which tube is screwed in the main casting 1.

In the form shown, said tube, 34, also serves to hold in place a choke tube, 36, carried in the chamber, 32, through which choke tube, 36, tube, 34, passes transversely. Said chamber, 32, has a right-angled extension, 37, thereon for the inlet of air which is controlled by means such as a valve, 38, carried by a shaft, 39. The shaft, 39, is provided with an operating lever, 40, upon its outer end. Furthermore, said shaft, 39, is so arranged as either to permit a regulated amount of outside air to enter the chamber, 22ª, or to entirely prevent the air from entering the same. This is accomplished by providing upon the inner end of the shaft 39, an inclined face, 41, to permit regulated communication from the chamber, 22ª, to the outer air by a vent, 42, in the main casting, 1, the bore in the casting, 1, which forms the journal bearing for the shaft, 39, being extended for opening into the chamber, 22ª. In order to hold the shaft, 39, in a given position to which it may be adjusted longitudinally within the casting, 1, said shaft has thereon a spring, 39ª, fitted against a threaded sleeve, 43, screwed in the casting, 1, and provided with a milled flange, 44, to permit ready manipulation by rotation.

The rotation of the flange, 44, serves to adjust the relative position between the vent, 42, and the inclined face, 41, thus changing both the time when, at a given rotation of the shaft, 39, by the lever, 40, said vent, 42, will be opened and closed, and also the degree to which the passage is opened. The adjusted position of the sleeve, 43, is preferably maintained by the presence of means such as a spring-pressed plunger, 45, the head of which co-operates with a series of recesses, 47, on the face of the flange, 44.

The operation of the above described structure is as follows: Fuel being supplied from a suitable source in any desired manner through the pipe, 14, and the engine running with the throttle valve, 38, open, there will be a difference of pressure between the inside and the outside of the bellows formed by the diaphragms, 16 and 17. The pressure outside the bellows operating to collapse the bellows, will be sub-atmospheric to a degree determined by the velocity of the air flow through the choke tube or venturi, 36, past the nozzle discharge, 31, and the opposed pressure within the bellows will be also sub-atmospheric, but will be greater than the outside pressure in the chamber, 23ª, to the extent of the pressure due to air impact at the intake, 35 of the Pitot tube, 34,—said intake facing the air intake of the carburetor,—and the atmospheric pressure for which access is afforded through the port, 42.

The expansion of the bellows due to the excess of interior over exterior pressure, causing the button, 16ª, to encounter the valve pin, 3, will determine the degree of opening of the valve, 2; and since the excess pressure for such expansion of the bellows will be greater or less as the air velocity through the air intake passage,—and particularly through the choke tube or venturi, 36,—is greater or less, the quantity of fuel drawn in past the valve, 2, and discharged from the nozzle will increase and diminish with the increase and reduction of the air velocity.

Also it will be understood that any variations of pressure, due to variations in the head of the liquid fuel supply, causing any increase in pressure tending to collapse the bellows also tends to cause the withdrawal of the button, 16ª, from the valve pin, 3, and permit the valve, 2, to approach its seat and restrict the fuel delivery, thereby automatically compensating increase of pressure and tending to render the quantity of fuel delivered unaffected by variations in the head or pressure afforded in any manner upon the fuel supply through the conduit, 14.

It will be understood further, that the degree of opening of the atmosphere port, 42, at any given longitudinal adjustment of the throttle valve pivot member, 39, varies with the adjustment of the throttle from open to closed position, said pivot being turned in adjusting the throttle, and the port, 42, being open to the maximum determined by the

longitudinal adjustment of the pivot when the throttle is closed, and being closed by opening the throttle to an extent varying from one half its area to total closure, according to the longitudinal adjustment of the beveled end of said pivot bolt, 39. This feature, therefore, constitutes a means for varying at will, and according to running conditions, at the judgment of the operator, the pressure in the chamber, 22^a, and inside the bellows.

I claim:—

1. A carburetor, comprising an air conduit adapted to discharge into the engine intake passage a fuel delivery nozzle terminating for discharge of fuel in the air conduit, and means exposed to and adapted to be operated by the resultant of two pressures derived from two different sources for affecting the fuel admission to the nozzle, said means comprising an expansible and reducible member, the source of one of said pressures being a duct which opens in the air conduit toward the air inflow therethrough, the other of said pressures being uniform, whereby the movement causing pressure operating on said expansible and reducible member for expanding it increases with the increase of velocity in the air inflow through the air conduit.

2. In the construction defined in claim 1, foregoing, the source of the uniform pressure mentioned being the atmosphere.

3. A carburetor comprising an air conduit, adapted to discharge into the engine intake passage a fuel delivery nozzle terminating for discharge of fuel in the air conduit, and means exposed to and adapted to be operated by two opposed pressures, one derived from a point in the air intake passage and the other from the atmosphere at another point, for controlling by the difference of said opposed pressures the fuel admission to the nozzle, said means comprising an expansible and reducible element for increasing the fuel admission by the expansion of said element controlling means for opening the same by the expansion of said element, a duct for communicating pressure to the interior of said element which is open in the air conduit toward the air inflow therethrough, and a second duct leading to the nozzle and communicating pressure to the exterior of said collapsible element; whereby the interior pressure tending to expand said expansible element increases relatively to the exterior pressure with the increase of velocity in the air flow through the air intake passage.

4. A carburetor comprising an air conduit adapted to discharge into the engine intake passage provided with an air conduit in combination with a fuel delivery nozzle terminating for discharge of fuel in the air conduit, means exposed to and adapted to be operated by the resultant of two pressures derived from two different sources for affecting the fuel delivery to the nozzle, said means comprising an expansible and reducible member, the source of one of said pressures being a duct which opens in the air conduit in the direction of the air inflow therethrough, the other of said pressures being derived from the atmosphere a chamber in which the last mentioned pressure operates and means adjustable at will for affording and controlling atmospheric entrance to said chamber.

5. In a carburetor having a main air inlet passage and a fuel inlet passage; throttle valve means controlling said main air passage; a chamber to which atmospheric pressure is admitted for affecting the rate of fuel admission to the fuel inlet, a duct admitting air to said chamber and valve means controlling air admission to said duct, said last mentioned valve means consisting of a slide member which constitutes the pivot for said throttle valve means and extends therethrough, the atmospheric inlet being formed in the slide bearing of said sliding pivot member, the latter being formed to operate as a valve at said inlet, adapted for opening and closing the same both by sliding and rotating and being connected with the throttle valve for rotation therewith and means for sliding said pivot through the throttle valve without rotation of the latter, said means being operable at will.

6. In a carburetor in combination with a fuel mixture conduit comprising a mixing chamber, a fuel discharge passage and a fuel conduit from a fuel source; a chamber into which said fuel conduit leads and out of which said discharge passage leads, comprising a part which is movable for reducing and expanding said chamber; means for modifying the movement of said movable part consisting of a passage for admitting atmospheric pressure thereto, and means for controlling said passage in accordance with the admission of air to the engine through the fuel mixture conduit.

7. In a carburetor in combination with a fuel mixture conduit comprising a mixing chamber, a fuel discharge passage, and a conduit from a source of liquid fuel, a chamber having a moving wall for rendering it expansible and reducible in capacity, said chamber forming a part of the fuel passage by being in separate communication with said liquid fuel conduit, and with the fuel discharge passage, a throttle valve controlling flow through the fuel mixture conduit and means for modifying the movement of the movable wall of the chamber for changing its capacity, consisting in a communication for applying pressure to said wall in accordance with the opening of the throttle.

8. In a carburetor in combination with a fuel mixture conduit comprising a mixing chamber, a venturi for accelerating the flow through the mixing chamber, a fuel dis-

charge passage delivering into the venturi, and a conduit from a source of liquid fuel; a chamber into which the liquid fuel conduit leads and out of which the fuel discharge passage leads, said chamber having a movable wall for rendering it expansible and reducible in capacity, and means for modifying the movement of the movable wall for changing the capacity of the chamber consisting in a means for applying to said wall yielding pressure derived from the air flow of the engine in accordance with the velocity of that flow.

9. In combination, a carburetor including an air conduit, a fuel conduit, and means for supplying fuel thereto, comprising a normally shut fuel inlet valve in the fuel conduit, said fuel conduit including a wall portion movable in response to pressure differences on opposite sides thereof to open said valve and connections between the air conduit and opposite sides of the movable wall arranged to subject said wall to differential pressures caused by the speed of the air through the air conduit.

10. A carburetor adapted to be mounted in communication with an internal combustion engine for delivery of fuel mixture to the engine, and having an air supply conduit; means controlling the supply of fuel to said conduit comprising a valve in the fuel course leading to the conduit, a chamber having a movable wall member partitioning the chamber and operatively associated with said valve for controlling the same, passages communicating with the air conduit and the partitioned chamber on opposite sides of the movable partitioning member, the connections of said passages with the conduit being arranged to cause differential reduction of pressure on opposite sides of said partitioning member due to the velocity of the air stream through said conduit and a throttle valve controlling air flow through said conduit positioned therein anterior to the communication of said passages.

11. A carburetor having a manually operable throttle and an engine intake passage comprising an air conduit in combination with a fuel delivery nozzle terminating for discharge of the fuel in the air conduit, means exposed to and adapted to be operated by the resultant of two pressures for affecting the fuel admission to the nozzle, said means comprising a pressure responsive device exposed at one side to the variable pressure of the fuel being fed and on the other side to pressure derived from the engine intake passage beyond the throttle.

12. A carburetor adapted to be mounted in communication with an internal combustion engine for delivery of fuel mixture to the engine having an air supply conduit, means for conducting and controlling the supply of fuel mixture thereto including a chamber communicating with the fuel course having a movable wall member, connections from the air supply conduit of the carburetor leading to opposite sides of said movable wall and transmitting differential pressures thereto due to the velocity of the air flow through said conduit.

13. A carburetor adapted to be mounted in communication with an internal combustion engine for delivery of fuel mixture to the engine having an air supply conduit; means for conducting and controlling the supply of fuel mixture thereto comprising a chamber having a movable wall member, a valve arranged to be operated by said movable wall to variably control the flow of fuel to said chamber and maintain a substantially uniform pressure in said chamber throughout wide variations in head of the fuel supply and automatic means controlling said movable wall for adjusting said uniform pressure in accordance with the requirements of the engine demand.

14. A carburetor adapted to be mounted in communication with an internal combustion engine and having an air supply conduit for delivery of fuel mixture to the engine; means for controlling the supply of fuel to said conduit, comprising a valve in the fuel course leading to the conduit, a movable member associated with said valve for controlling the same, passages for communication of fluid pressure in different degrees to the opposite sides of said movable member for moving it to control said valve, a throttle valve, and means by which the throttle valve in its opening and closing movements variably admits fluid pressure to one side of the movable member for causing its valve controlling movement coincidentally with the opening and closing of the throttle valve.

15. A carburetor adapted to be mounted in communication with an internal combustion engine and having an air supply conduit for delivery of fuel mixture to the engine; means for controlling a supply of fuel to said conduit comprising a valve in the fuel course leading to said conduit, a movable member associated with said valve for controlling the same, said movable member constituting a partition between two chambers at opposite sides, the chamber at one side being in communication with the fuel course leading for discharge of fuel in the air conduit, a manually operable throttle valve and a passage leading from a source of fluid pressure to the chamber at the other side of said movable partition member and means by which the throttle valve controls access of said fluid pressure to said second chamber coincidentally with the opening of said throttle valve.

16. A carburetor adapted to be mounted in communication with an internal combustion engine for discharge of fuel mixture to the engine; means for controlling the supply of

fuel mixture comprising a mechanically operated valve, means for closing said valve and maintaining said valve in closed position when the carburetor is empty of fuel, the valve operating means comprising a diaphragm constituting a movable wall of a variable capacity chamber having fluid pressure connections for expanding and reducing the chamber upon variation in engine suction and air flow to the engine, the diaphragm being normally spaced from the valve at the closed position of the latter and arranged to be moved into engagement with the valve for opening it upon a change in the capacity of the chamber, and means to relatively adjust the diaphragm with respect to the valve to position the part of the diaphragm which engages the valve predeterminedly spaced from the valve at the position of normal capacity of the chamber.

17. A carburetor adapted to be mounted in communication with an internal combustion engine for discharge of fuel mixture to the engine; means for controlling the supply of fuel mixture comprising a mechanically operated valve, means for closing said valve and maintaining said valve in closed position when the carburetor is empty of fuel, the valve operating means comprising a diaphragm constituting a movable wall of a variable capacity chamber having fluid pressure connections for expanding and reducing the chamber upon variation in engine suction and air flow to the engine, the diaphragm being arranged to be moved into engagement with the valve for opening it upon predetermined change in the capacity of the chamber, said diaphragm and valve being constructed for assembly with a predetermined spacing between their engaging parts at normal position of the diaphragm when the carburetor is inactive.

18. A carburetor comprising a fuel supply conduit, an air supply conduit, a Venturi throat into which the air and fuel supply conduits extend, a normally closed valve controlling the flow of fuel from the fuel conduit into the Venturi throat and means for automatically controlling the valve in response to pressure conditions within the Venturi throat including a movable wall defining a chamber through which the fuel flows, said wall being subject on one side to atmospheric pressure and on the other side to pressure in the Venturi throat, and means to modify the pressure on opposite sides of the movable wall in response to variations in velocity pressure within the Venturi throat.

19. In a carburetor in combination with a fuel mixture conduit comprising a mixing chamber, a fuel discharge passage, and a conduit from a source of liquid fuel, a chamber in communication at one end with the liquid fuel conduit and the fuel discharge passage; a movable wall operating by displacement in said chamber, whereby the movement of said wall in one direction causes the fuel to be delivered through the fuel discharge passage while the fuel which flows past said movable wall to the other end of said chamber is not lost from the carburetor, a manually operated throttle valve controlling flow through the fuel mixture conduit and means for actuating said wall controlled by the opening and closing movement of the throttle.

In testimony that I claim the foregoing, I have hereunto set my hand this 11th day of March, 1919.

EDWARD A. ROCKWELL.