April 1, 1930. C. S. BRAGG ET AL 1,753,165

APPARATUS FOR OPERATING SUCTION ACTUATED DEVICES IN CONNECTION WITH THE SUCTION PASSAGES OF INTERNAL COMBUSTION ENGINES

Original Filed March 16, 1925 2 Sheets-Sheet 1

Fig. 1.

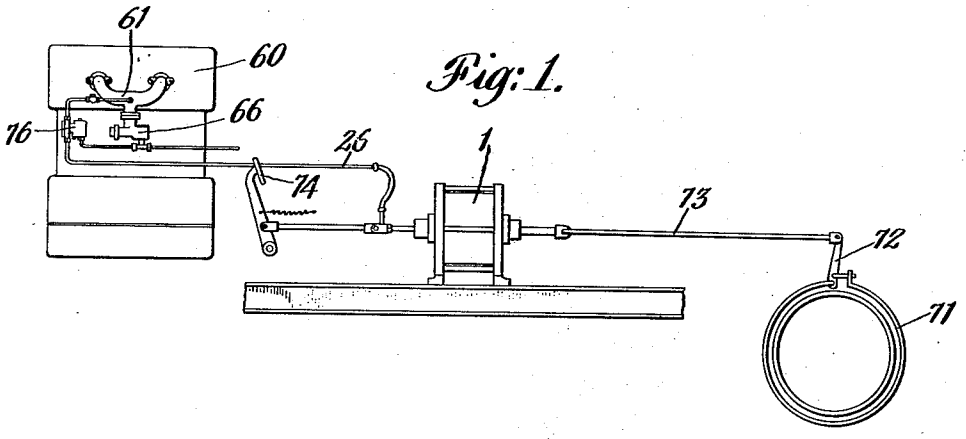
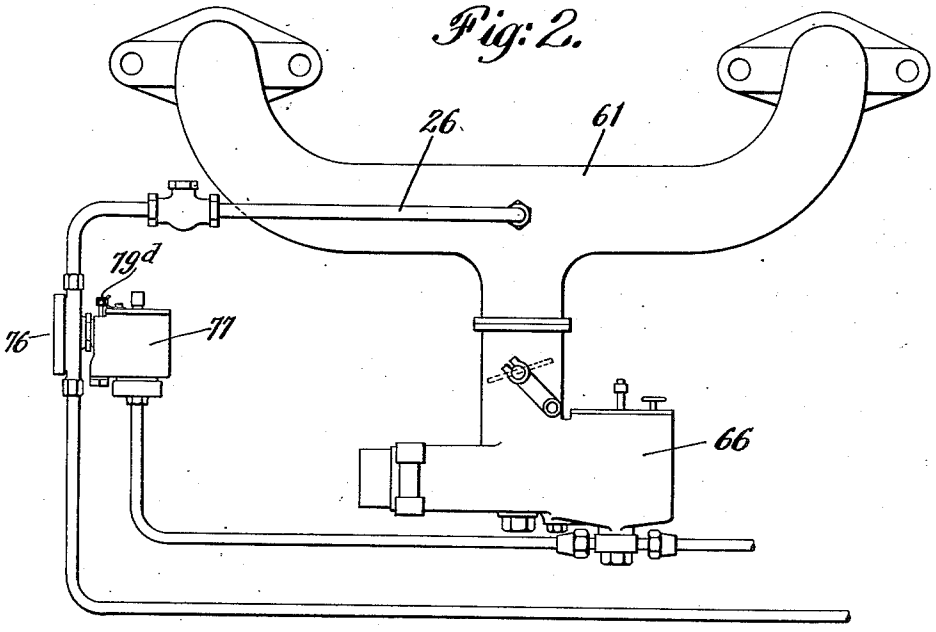


Fig. 2.



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Fig: 4.

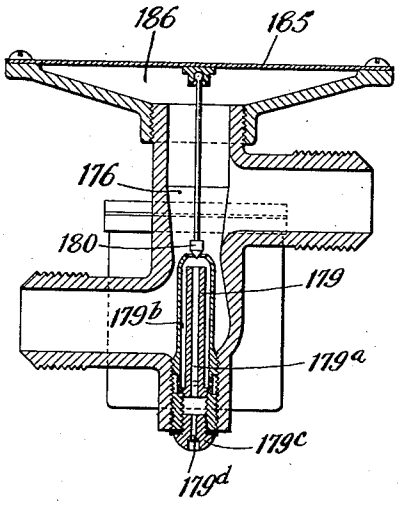
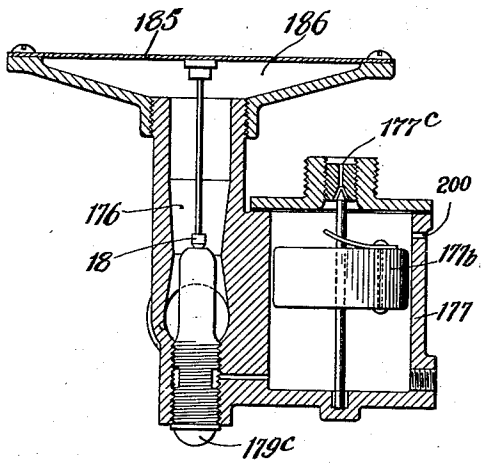


Fig: 5.



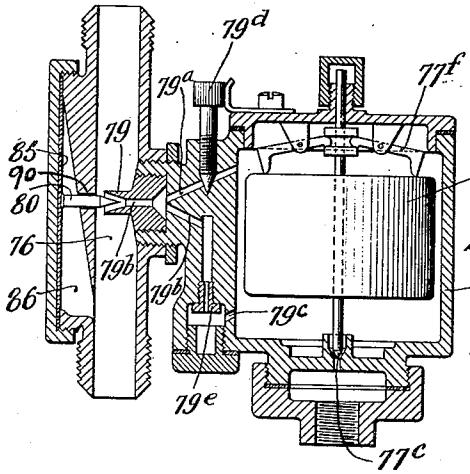


Fig: 3.

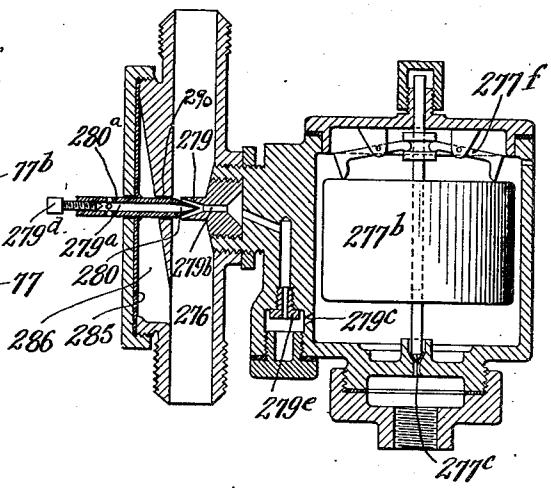


Fig: 6.

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UNITED STATES PATENT OFFICE

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APPARATUS FOR OPERATING SUCTION-ACTUATED DEVICES IN CONNECTION WITH THE SUCTION PASSAGES OF INTERNAL-COMBUSTION ENGINES

Application filed March 16, 1925, Serial No. 15,732. Renewed January 5, 1929.

Our invention consists in the novel features hereinafter described, reference being had to the accompanying drawings which show several embodiments of the same, selected by us for the purpose of illustration, and the said invention is fully disclosed in the following description and claims.

In the operation of vacuum brakes for automotive vehicles, it is extremely convenient to obtain the necessary suction or partial vacuum from a suction passage of the internal combustion engine, ordinarily employed for the propulsion of the vehicle, said suction passage being located between the throttle valve for controlling the supply of explosive mixture and the cylinder, and it is particularly convenient and desirable to connect the vacuum brake mechanism with the intake manifold of the engine. It will be understood further that the air exhausted from the brake actuating mechanism and delivered into the intake manifold of the engine necessarily has a tendency to either prevent the drawing in of the proper quantity of liquid fuel from the atomizer of the carburetor by reducing the partial vacuum in the suction passage, or to dilute the explosive mixture passing thru the suction passage from the carburetor, and such dilution may in some instances bring about a mixture which will not readily ignite in the engine. In either case, the engine, if turning over idly, would be likely to stall and the admission of air into the manifold in this manner may also materially delay the starting of the engine. For the proper operation of the brake mechanism, it is desirable that the air exhausted into the manifold shall be withdrawn from the brake actuating mechanism as rapidly as possible to secure quick action of the brake, and any restriction in the connection between the brake mechanism and the intake manifold for the purpose of avoiding the stalling of the engine, will necessarily somewhat retard the operation of the brake mechanism.

In our former application for Letters Patent of the U. S., filed February 26, 1925, and given Serial Number 11,683, we have set forth an arrangement by which the connection between the vacuum brake actuating mechanism and the intake manifold is provided with means entirely separate from and independent of the carburetor for the engine for carbureting the air withdrawn from the actuating mechanism before it reaches the manifold, so that it arrives at the manifold in a condition of explosive mixture which readily mixes with the explosive mixture furnished by the main carburetor. This is preferably accomplished by providing a separate or an auxiliary carburetor for the air connection from the vacuum actuator to the intake manifold. In the operation of apparatus of this kind it has been found that it is necessary to equalize the pressure on the surface of the liquid in the float chamber of the auxiliary carburetor and in the nozzle, as the latter is subjected to varying degrees of rarification during the operation of the vehicle and without some provision of this kind the liquid fuel would at times be withdrawn from the nozzle when no air was passing through the separate carburetor, which would result in the accumulation of liquid fuel in the air connection, which would be objectionable and which might drain back into the actuator and injuriously affect it.

Our present invention consists in providing improved means for preventing this undesired leakage of motor liquid from the nozzle of the separate carburetor for the air connection by providing a communication from the atmosphere to the nozzle above the normal liquid level therein, thereby equalizing the pressure on the liquid in the nozzle, as the liquid in the float chamber is also open to the atmosphere.

In this construction it is necessary to employ a needle valve to control the discharge opening of the jet, as otherwise air and liquid fuel would be continually drawn from the jet when any considerable degree of rarification exists in the air connection from the suction operated device to the manifold. We prefer, therefore, to employ a needle valve in the separate carburetor for the air connection operatively connected with a part operated upon by the rarification in said air connection, so as to hold the needle valve closed, as

for example a diaphragm forming a wall of a chamber communicating with the said air connection or other suitable device similarly actuated, as shown in our former application above referred to. The separate carburetor is, therefore, responsive to the conditions existing in the air connection from the suction actuated device to the suction passage of the engine, and is entirely independent of the main or engine carburetor, and is no part of the normal charge forming mechanism of the engine. The separate carburetor is only brought into operation when the suction actuated device is operated, and then acts to prevent the operation of the suction actuated device from interfering with the normal operation of the engine by charges supplied from the main or engine carburetor under the control of the throttle valve, and to prevent stalling the engine if idling.

As a result of providing for admitting atmospheric pressure to the surface of the liquid in the nozzle of the separate carburetor, slight vibrations of the disc or diaphragm controlling the needle valve which may be due to pulsations in the intake manifold, do not cause material amounts of fuel to be forced out of the jet when no air is passing through the said separate carburetor from the actuator; slight opening and closing of the needle valve caused by such vibrations of the diaphragm would merely admit small amounts of atmospheric air. When, however, air is passing through the suction pipe and the needle valve of the said separate carburetor is raised from the nozzle, air will be admitted by the air inlet to the nozzle under the control of an adjustable restricting device so that it may not admit sufficient air to materially affect the suction in the Venturi passage or reduce the suction through the air inlet to the nozzle much below the degree of suction in the Venturi passage. Therefore, when the needle valve is open, liquid fuel will be sucked from the jet by reason of a certain amount of rarification above the liquid level in the nozzle, as well as by the action of the air rushing by the jet. The amount of air can be regulated by the adjustable restricting device for the air passage to the nozzle.

Another advantage of our invention is that when the motor is stopped, atmospheric air will gradually leak into the actuator cylinder and connecting pipes, so that the vacuum operated needle valve of the separate carburetor will gradually open the needle valve of the jet while there is still a considerable degree of vacuum or rarification present in the separate carburetor. Under these conditions, only air will be admitted from the discharge orifice of the jet and no liquid fuel will enter to flood the carburetor and pipes connected therewith. The needle valve will of course open very slightly while the state of rarification is comparatively high and as the state of rarification becomes less and the needle valve is correspondingly opened to a greater extent, there is correspondingly less suction so that the air vent passage to the nozzle will have sufficient capacity to prevent any fuel being sucked through the jet nozzle under such conditions.

Referring to the accompanying drawings,

Fig. 1 is a diagrammatic view showing an installation in an automotive vehicle comprising an internal combustion engine, brake mechanism for the vehicle and a vacuum operated power actuator for the brake mechanism, and having our present invention embodied therein.

Fig. 2 is an enlarged view of certain of the parts illustrated in Fig. 1, showing the intake manifold, the main carburetor and the auxiliary carburetor in the suction line from the power actuator.

Fig. 3 is an enlarged sectional view of one form of auxiliary carburetor embodying our present invention.

Fig. 4 is a sectional view of an auxiliary carburetor, illustrating a further modification of our invention.

Fig. 5 is a sectional view of the same, taken at right angles to the plane on which Fig. 3 is taken.

Fig. 6 is a sectional view of an auxiliary carburetor, illustrating a further modification of our invention.

In Fig. 1 we have shown diagrammatically an installation in an automotive vehicle of a power actuator for the brake mechanism of the vehicle, in which our invention is embodied. In this figure, 1 represents the power actuator operated by suction, and connected with the intake manifold, 61, of the internal combustion engine, 60, which is provided with the main or engine carburetor, 66, and with the separate and independent carburetor, 76, located in the suction line, 26, leading from the actuator to the intake manifold for operating the actuator. The actuator is connected by link 73 with brake mechanism diagrammatically illustrated at 77, 71 and 72, and is controlled by valve mechanism connected with the usual pedal lever, 74. The particular construction and operation of the actuator and brake mechanism have no bearing on our present invention and need not be more particularly described.

Referring to Fig. 3 which shows in detail the preferred form of the separate and independent carburetor for the suction pipe from the suction actuated device, 77 represents the float chamber of the auxiliary carburetor, provided with the float, 77^b, operatively connected with the usual fluid inlet valve, 77^c, in this instance by the usual lever, 77^f, for controlling the supply of gasoline or other motor liquid to the float chamber and maintaining a predetermined liquid level therein.

76 represents the Venturi tube in which is located the jet or nozzle indicated at 79. In this instance, the nozzle, 79, is provided with a liquid passage, 79b, communicating with the float chamber below the liquid level therein by passage 79c, provided with means for regulating the flow of gasoline, in this instance a detachable screw, 79e, having an aperture therein, which screw can be removed and substituted by another with a different size aperture for varying the liquid feed to the nozzle. The nozzle is also provided with an air passage indicated at 79a, connecting it with the float chamber above the liquid level. The float chamber, it will be understood, is open to the atmosphere above the liquid level, as is customary in carburetor construction and as indicated in the drawing, at 100, and the passage, 79a, therefore equalizes the pressure on the liquid at the nozzle with the pressure on the liquid in the float chamber. The nozzle is provided with a needle valve indicated at 80, operatively connected with a diaphragm, 85, forming one wall of a chamber, 86, in communication with the interior of the Venturi passage and engaging a guiding recess, 90, in the other wall. The diaphragm is therefore subjected to pressure on the exterior, which will force the needle valve into closed position when rarification exists in the Venturi tube and the passages or pipes connected therewith. It will be seen that the air passage, 79a, to the nozzle will admit atmospheric air above the liquid level in the nozzle and this passage is preferably provided with suitable means for adjusting it, for example a screw threaded valve, as shown in Fig. 3, at 79d. It will be understood that when the actuator is not in operation, and the engine is in operation, the highest degree of rarification exists in the air connection from the manifold, but no air is actually passing through the air connection, and in such case, the diaphragm, 85, will hold the needle valve closed and prevent any liquid fuel from being drawn into the carburetor to flood the same and the portions of the air connection, connected therewith by reason of the high degree of rarification in the Venturi tube. Even if the needle valve for the nozzle is slightly open, as by vibrations of the diaphragm caused by pulsations in the intake manifold or otherwise, no appreciable amount of liquid will be admitted but such opening of the needle valve would merely allow air to issue from the nozzle, from the air passage, 79a. When air is being withdrawn from the actuator and conducted to the intake manifold, the actual degree of rarification will be less and the needle valve will therefore be opened by the diaphragm and the air in passing the nozzle will withdraw both liquid fuel and air from the nozzle and form an explosive mixture which is delivered to the manifold. The air inlet, 79a, is so adjusted as to admit as much air as possible without too greatly diluting the explosive mixture, as the admission of air with the fluid assists the formation of the explosive mixture. The air passage, 79a, however, would not admit sufficient air to reduce the degree of rarification at the discharge aperture of the nozzle materially below the degree of rarification within the Venturi passage, and therefore, as before stated, the fuel will be withdrawn from the jet by a degree of rarification above the surface of the liquid, when the needle valve is open, as well as by the air rushing past the nozzle. In other words, when the needle valve is open and air is being withdrawn from the actuator, there would be a slight partial vacuum on the surface of the liquid in spite of the air passage 79a, so that the pressure on the surface of the liquid in the float chamber will under these conditions assist the delivery of the liquid into the current of air passing through the Venturi tube.

When the engine is stopped, a condition of rarification would necessarily exist in the air connection, 26, which would gradually decrease as air leaks into the actuator and its connections, so that a time would arrive when the needle valve, 80, would begin to open slightly, while there was still a considerable degree of rarification within the air connection, 26, and the Venturi passage, 79a. At such time, atmospheric air only will enter the Venturi tube from the discharge aperture of the nozzle from the equalizing air passage, 79a, which will be of sufficient capacity to supply the air admitted by the slight opening of the needle valve and thus prevent the formation of a partial vacuum above the surface of the liquid in the nozzle. By the time the degree of rarification in the Venturi tube and connected passages has fallen so as to effect the greater opening of the needle valve, 80, the suction being correspondingly less, the equalizing air passage, 79a, will still be able to furnish sufficient air to prevent the formation of a partial vacuum above the surface of the liquid in the nozzle, and therefore the flooding of the separate carburetor and air connection under these conditions will be entirely prevented.

Figures 4 and 5 illustrate a slight modification of our invention in which the corresponding parts are indicated by the same numerals, with the addition of 100.

In this instance, the nozzle, 179, is provided with an equalizing air passage indicated at 179a, extending directly to the atmosphere instead of to the float chamber. In these figures the nozzle is shown provided with two co-axial passages, the central passage, 179a, being the air passage and a surrounding annular passage, 179b, being provided for the liquid. The central air passage communicates at the bottom of the nozzle directly with the atmosphere, but a restrict-

ing device is provided in this instance, a removable screw, 179c, provided with a hole, 179d, therethrough, it being understood that this screw can be removed and replaced with another having a different size aperture for the purpose of adjusting the air inlet to the nozzle. 180 represents the needle valve controlled by the diaphragm, 185, and the operation of this form of our invention is exactly the same as that which has been heretofore described. In this figure the float chamber above the liquid level is in communication with the atmosphere through an aperture indicated at 200.

In Fig. 6 we have shown another modification of our invention, a portion of the separate carburetor being illustrated and similar parts being given the same numerals, with the addition of 200. Thus in this figure, 276 represents the Venturi passage and 279 the nozzle, supplied with liquid fuel by the passage, 279b, in the same manner as indicated in Fig. 3, from the float chamber. In this instance the nozzle is provided with a needle valve, 280, secured to the diaphragm, 285, and operating in the same manner as hereinbefore described, and the equalizing air passage for the nozzle is in this instance formed in the needle valve, 280, and its stem, 280a, said valve and stem being hollow, as indicated, to form the air inlet passage, 279a, for admitting atmospheric air to the nozzle above the liquid level therein, through the lateral passages in the portion of the valve stem exterior to the diaphragm, and an adjusting screw indicated at 279d, is provided in the valve stem for regulating the said apertures. The operation of this form of separate carburetor for the air connection will be the same as that previously described and it will be seen that the equalizing passage, 279a, will admit air to the nozzle above the liquid level and thus equalize the pressure on the liquid in the nozzle and in the float chamber to prevent flooding at any time when the valve is open and no air is passing through.

In Fig. 6, the float valve is shown in communication with the atmosphere above the liquid level by an aperture, 300.

What we claim and desire to secure by Letters Patent is:

1. The combination with an internal combustion engine, provided with a suction passage, a main carburetor for the engine communicating therewith and a throttling valve for said passage, of a suction actuated device comprising an actuator cylinder, a piston therein and controlling valve mechanism, an air connection extending from the actuator cylinder to said suction passage, means for preventing interference with the operation of the engine, or stalling it if idling, by the operation of the suction actuated device, comprising a separate and independent carburetor for the air withdrawn from the suction actuated device located in said air connection and provided with a float chamber, a float and liquid fuel control valve connected therewith, the space above the liquid in the float chamber being in communication with the atmosphere, a jet nozzle connected with said float chamber for supplying fuel to the air passing through said air connection and means for equalizing the pressure on the discharge orifice of the jet nozzle and in said float chamber to prevent flooding the separate carburetor and the air connection, when the suction actuated device is not in operation.

2. The combination with an internal combustion engine, provided with a suction passage, a main carburetor for the engine communicating therewith and a throttling valve for said passage, of a suction actuated device comprising an actuator cylinder, a piston therein and controlling valve mechanism, an air connection extending from the actuator cylinder to said suction passage, means for preventing interference with the operation of the engine, or stalling it if idling, by the operation of the suction actuated device, comprising a separate and independent carburetor for the air withdrawn from the suction actuated device located in said air connection and provided with a float chamber, a float and liquid fuel control valve connected therewith, the space above the liquid in the float chamber being in communication with the atmosphere, a jet nozzle discharging into said air connection and means for admitting atmospheric air at all times to the surface of the liquid in the jet nozzle adjacent to the discharge orifice thereof to equalize the pressure thereon with the pressure on the liquid in the float chamber to prevent the suction of the engine from causing leakage of liquid fuel from said jet when air is not being withdrawn from the suction actuated device.

3. The combination with an internal combustion engine, provided with a suction passage, a main carburetor for the engine communicating therewith and a throttling valve for said passage, of a suction actuated device comprising an actuator cylinder, a piston therein and controlling valve mechanism, an air connection extending from the actuator cylinder to said suction passage, means for preventing the interference with the operation of the engine, or stalling it if idling, by the operation of the suction actuated device, comprising a separate and independent carburetor located in said air connection and provided with a float chamber, a float and liquid fuel control valve connected therewith, the space above the liquid in the float chamber being in communication with the atmosphere, a jet nozzle discharging into said air connection and means for admitting atmospheric air at all times to the surface of the liquid in the jet nozzle adjacent to the discharge orifice thereof to equalize the pressure

thereon with the pressure on the liquid in the float chamber and prevent the suction of the engine from causing leakage of liquid fuel from said jet when air is not being withdrawn from the suction actuated device, and means for regulating the admission of air to said nozzle to prevent the leakage of too large quantities of air into said air connection.

4. The combination with an internal combustion engine, provided with a suction passage, a main carburetor for the engine communicating therewith and a throttling valve for said passage, of a suction actuated device comprising an actuator cylinder, a piston therein and controlling valve mechanism, an air connection extending from the actuator cylinder to said suction passage, means for preventing interference with the operation of the engine, or stalling it if idling, by the operation of the suction actuated device, comprising a separate and independent carburetor located in said air connection and provided with a float chamber, a float and liquid fuel control valve connected therewith, the space above the liquid in the float chamber being in communication with the atmosphere, a jet nozzle discharging into said air connection and means for admitting atmospheric air at all times to the surface of the liquid in the jet nozzle adjacent to the discharge orifice thereof to equalize the pressure thereon with the pressure on the liquid in the float chamber, a valve for preventing the discharge of liquid from said nozzle when in closed position, and means controlled by the suction within said air connection for automatically controlling said valve.

5. The combination with an internal combustion engine, provided with a suction passage, a main carburetor for the engine communicating therewith and a throttling valve for said passage, of a suction actuated device comprising an actuator cylinder, a piston therein and controlling valve mechanism, an air connection extending from the actuator cylinder to said suction passage, a separate and independent carburetor located in said air connection and provided with a float chamber, a float and liquid fuel control valve connected therewith, the space above the liquid in the float chamber being in communication with the atmosphere, a jet nozzle connected with said float chamber for supplying fuel to the air passing through said air connection means for equalizing the pressure on the discharge orifice of the jet nozzle and in said float chamber, a valve for preventing the discharge of liquid from said nozzle, and a yielding diaphragm for controlling said valve adapted to hold the valve in open position and to be deflected in a direction to close the valve by the presence of a pre-determined degree of rarification in said air connection whereby a slight opening of said valve will permit small quantities of air to enter the air connection without admitting appreciable quantities of fuel, but the greater opening of said valve effected by larger quantities of air passing through said air connection from the suction actuated device will effect the discharge of fuel from said nozzle to fuelize said air.

6. The combination with an internal combustion engine, provided with a suction passage, a main carburetor for the engine communicating therewith and a throttling valve for said passage, of a suction actuated device comprising an actuator cylinder, a piston therein and controlling valve mechanism, an air connection extending from the actuator cylinder to said suction passage, means for preventing interference with the operation of the engine, or stalling it if idling, by the operation of the suction actuated device, comprising a separate and independent carburetor located in said air connection and provided with a float chamber, a float and liquid fuel control valve connected therewith, the space above the liquid in the float chamber being in communication with the atmosphere, a jet nozzle discharging into said air connection, and provided with a liquid supply passage connected with the float chamber, and an air supply passage communicating with the atmosphere to prevent the suction of the engine from causing leakage of liquid fuel from said jet when air is not being withdrawn from the suction actuated device.

7. The combination with an internal combustion engine, provided with a suction passage, a main carburetor for the engine communicating therewith and a throttling valve for said passage, of a suction actuated device comprising an actuator cylinder, a piston therein and controlling valve mechanism, an air connection extending from the actuator cylinder to said suction passage, means for preventing interference with the operation of the engine, or stalling it if idling, by the operation of the suction actuated device, comprising a separate and independent carburetor located in said air connection and provided with a float chamber, a float and liquid fuel control valve connected therewith, the space above the liquid in the float chamber being in communication with the atmosphere, a jet nozzle discharging into said air connection and provided with co-axial passages, one of which communicates with the float chamber for supplying liquid therefrom to the nozzle and the other of which communicates with the atmosphere whereby the suction of the engine is prevented from causing leakage of liquid fuel from said jet when air is not being withdrawn from the suction actuated device.

8. The combination with an internal combustion engine, provided with a suction passage, a main carburetor for the engine communicating therewith and a throttling valve

for said passage, of a suction actuated device comprising an actuator cylinder, a piston therein and controlling valve mechanism, an air connection extending from the actuator cylinder to said suction passage, means for preventing interference with the operation of the engine, or stalling it if idling, by the operation of the suction actuated device, comprising a separate and independent carburetor located in said air connection and provided with a float chamber, a float and liquid fuel control valve connected therewith, the space above the liquid in the float chamber being in communication with the atmosphere, a jet nozzle discharging into said air connection, and provided with a liquid supply passage connected with the float chamber, a valve for closing the discharge orifice of the nozzle, a diaphragm connected with said valve and constructed to be actuated in a direction to close said valve by the presence of a pre-determined degree of rarification in said air connection, said valve being provided with an air inlet passage extending to the outer side of said diaphragm whereby the suction of the engine is prevented from causing leakage of liquid fuel from said jet when air is not being withdrawn from the suction actuated device.

9. The combination with an internal combustion engine, provided with a suction passage, a main carburetor for the engine communicating therewith and a throttling valve for said passage, of a suction actuated device comprising an actuator cylinder, a piston therein and controlling valve mechanism, an air connection extending from the actuator cylinder to said suction passage, means for preventing interference with the operation of the engine, or stalling it if idling, by the operation of the suction actuated device, comprising a separate and independent carburetor located in said air connection and provided with a float chamber, a float and liquid fuel control valve connected therewith, the space above the liquid in the float chamber being in communication with the atmosphere, a jet nozzle discharging into said air connection, and provided with co-axial passages, one connected with the float chamber below the liquid level therein and the other with the atmosphere, a valve for preventing the discharge of liquid from said nozzle and a flexible diaphragm connected with said valve and constructed to be moved to close said valve by the presence of a pre-determined degree of rarification in the said air connection without closing the coaxial passage connected with the atmosphere, whereby flooding of the separate carburetor and said air connection is prevented.

10. The combination with an internal combustion engine provided with a suction passage and a main carburetor for the engine, of a suction actuated device, an air connection from the suction actuated device to the suction passage, a separate and independent carburetor located in said air connection, including a jet nozzle, and means for equalizing the pressure on the discharge orifice of the jet nozzle and in the float chamber of said separate carburetor when the suction actuated device is inoperative.

11. The combination with an internal combustion engine provided with a suction passage and a main carburetor for the engine, of a suction actuated device, an air connection from said suction actuated device to said suction passage, a separate and independent carburetor having a jet nozzle located in said connection, valve mechanism for said actuated device, an operator operated part for said valve mechanism, said separate carburetor arranged to fuelize the air passing from said actuated device to the suction passage when the valve mechanism is operated by the operator operated part, and means for equalizing the pressure on the jet nozzle and in the float chamber of said separate carburetor to prevent flooding of the separate carburetor and the air connection when the suction actuated device is not in operation.

12. In brake mechanism for automotive vehicles, the combination with an internal combustion engine provided with a suction passage and a main carburetor for the engine communicating therewith, of a suction actuated device comprising an actuator cylinder, a piston therein connected to the brake mechanism and controlling valve mechanism, an air connection extending from the actuator cylinder to said suction passage, a separate and independent carburetor located in said air connection, and including a jet nozzle, said separate carburetor arranged to fuelize the air passing from the suction actuated device to the suction passage when said valve mechanism is operated to produce a power stroke of the piston, and means for equalizing the pressure on the discharge orifice of the jet nozzle and in the float chamber of said separate carburetor to prevent flooding the separate carburetor and the air connection when no air is being withdrawn from the suction actuated device.

In testimony whereof we affix our signatures.

CALEB S. BRAGG.
VICTOR W. KLIESRATH.