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GAS CARBURETING APPARATUS

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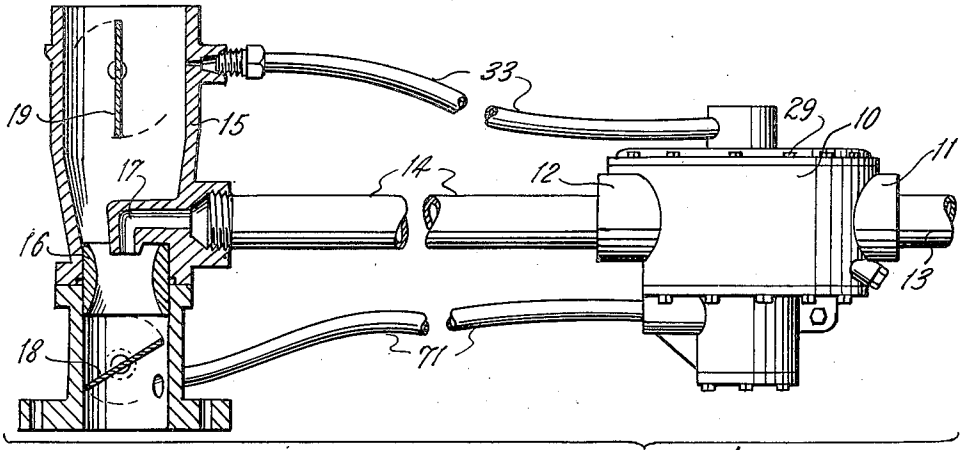


Fig. 1

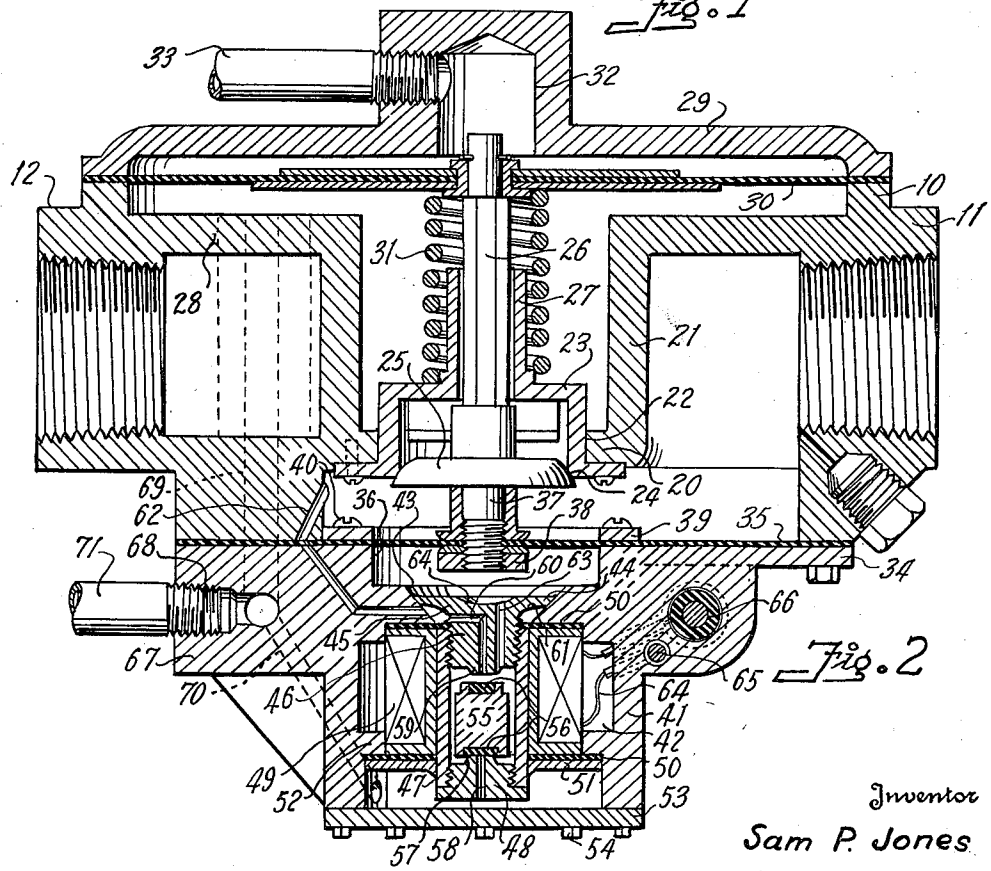


Fig. 2

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GAS CARBURETING APPARATUS

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10 Claims. (Cl. 48—180)

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This invention relates to new and useful improvements in gas carbureting apparatus.

One object of the invention is to provide an improved carburetor particularly adapted for the handling of gaseous fuels such as propane-butane, wherein an improved provision is made for positively shutting off the gas control valve when the engine to which the carburetor is connected, is not functioning.

A particular object of the invention is to provide an improved carburetor particularly adaptable for use with gaseous fuels, in which the fuel control valve is balanced when the carburetor is operating, but is unbalanced toward a closed position when the carburetor is not in operation.

An important object of the invention is to provide an improved carburetor of the character described having a balanced fuel control valve which permits the utilization of an extremely light valve spring, with its consequent sensitivity, and therefore allows the incorporation of a relatively large venturi in the intake stack of the engine with which the carburetor is employed.

A still further object of the invention is to provide an improved carburetor of the character described in which increase of the pressure of the gas supply will not force the fuel control valve open; and wherein rupture or damage to the control diaphragm or diaphragms will not result in a leakage of fuel gas.

A further and particular object of the invention is to provide an improved carburetor of the character described in which balancing and unbalancing of the fuel control valve is occasioned electrically by the turning on and off of the ignition switch of the engine with which the carburetor is employed.

A construction designed to carry out the invention will be hereinafter described together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, wherein examples of the invention are shown, and wherein:

Fig. 1 is a side elevation of a carburetor constructed in accordance with this invention, and includes a sectional view of the intake stack of an engine with which the carburetor is associated, and

Fig. 2 is an enlarged, vertical, sectional view of the carburetor body.

It has long been a problem in internal combustion engines to obtain or design a carburetor, either for use with gaseous fuels such as butane,

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or liquid fuels such as gasoline, which will give the full available power or efficiency at various engine speed and throttle settings. One principal problem which heretofore has not been successfully solved is the restrictive effect of the venturi in intake stacks or passages of such engines. The use of the venturi is almost universal, and provides the necessary fluctuation in pressure in accordance with the air flow to the engine. This fluctuating pressure is employed to meter the fuel being used and to regulate the flow of fuel in accordance with the engine demand. The prior devices in this particular art operate very well over intermediate speed and power ranges. However, it has been found that when an engine is operating under a heavy load or at relatively high speed, the restrictive effect of the venturi becomes of consequence and prevents full and complete flow of air through the intake stack. Thus, with a full throttle setting, the manifold pressure of an internal combustion engine will drop exponentially as the speed or revolutions per minute of the engine increases. In some instances, this drop in manifold pressure due to the restrictive action of the venturi in obstructing flow of air into the engine will amount to 4½ inches of mercury, as illustrated in Fig. 10—10 of the publication Internal Combustion Engines by J. A. Polson, published by John Wiley & Sons, Inc. in 1931. Thus curve represents mean effective pressure in inches of mercury plotted against speed in miles per hour for a typical automobile engine, and shows a manifold pressure drop of approximately 4½ inches of mercury at a speed of 90 miles per hour.

One obvious solution of this problem is to enlarge the size of the venturi so as to present a larger cross-sectional area for the flow of air into the engine. However, as the venturi is enlarged in diameter, the action in creating a pressure drop proportional to the air flow threrethrough begins to decrease. Thus, a smaller pressure differential is made available for metering purposes, and the problem of such metering increases in difficulties. Where spring controlled elements are arranged to respond to this pressure differential, the spring value or strength must be decreased to maintain sensitivity, especially over the intermediate and lower speed ranges.

The use of large area venturis and light weight regulator springs has been attempted in the gaseous fuel art of carburetion. However, a serious problem has been the leakage of the fuel gas past the metering valve when the latter is in a supposedly closed position. This problem arises be-

cause of the light weight spring employed and the inability of such a spring to hold the metering valve in a tight seating position unless the metering valve is absolutely balanced.

It will be seen from the foregoing that the adequate closing of a metering valve depends in part upon the valve being of a balanced nature. It is also extremely desirable that the valve should be of the pressure-closing type, that is, a valve which is urged toward a closed position by the pressure of the gaseous fuel supply. However, a second problem, common to carburetors, arises in connection with the balancing of the valve, and this is the supplying of adequate fuel under idling or low speed or load conditions of the engine. When an internal combustion engine is idling or operating at low power loads, the air flow through the intake stack may be quite small and inadequate to create a pressure drop in the venturi section sufficient to actuate the metering structure of the carburetor. It is customary, therefore, to make special provision for idling of such an engine by establishing communication with the intake stack below the throttle valve where the manifold suction is relatively high, and to communicate this high suction, or low pressure, to a diaphragm or some other suitable element operatively connected to the metering valve. This structure, however, results in unbalancing of the valve element and thus works in opposition to the solution of the high power loading problem. The present invention solves both problems by the incorporation of an additional structure into the carburetor which makes available means for selectively controlling the various pressures and fluid flows encountered in devices of this type to achieve a balanced valve when such is desired and an unbalanced valve when the latter condition becomes of benefit.

Proceeding now with a description of one embodiment of the invention, the numeral **10** designates in the drawings, a relatively flat, cylindrical body or fuel metering valve casing which is hollow and provided with a screw-threaded inlet boss **11** and a screw-threaded outlet boss **12** diametrically opposed to the boss **11**. An inlet pipe **13** is connected into the boss **11** for supplying fuel gas, such as butane, propane, natural gas and the like, to the carburetor, while an outlet pipe **14** is connected into the boss **12** for conducting metered fuel gas from said carburetor body. The carburetor is used in conjunction with the air intake stack **15** of an internal combustion engine (not shown), said stack including a venturi section **16**, the pipe **14** connecting into a nozzle or fuel inlet **17** associated with the venturi section. The usual throttle valve **18** is provided in the stack **15** below or downstream of the venturi section **16**, while a choke valve **19** is positioned in the stack above or upstream from said venturi.

An integral transverse plate **20** extends across the lower portion of the carburetor body **10** and forms a fuel chamber thereabove and a fuel supply chamber therebelow. An integral inlet box **21** encloses the inner end of the inlet boss **11**, the lower end of the inlet box **21** opening through the plate or wall **20** so that incoming fuel gas may flow through said inlet box and into the fuel supply chamber beneath the plate **20**. A central opening **22** is provided in the plate **20** and receives a valve spider **23** having a valve seat **24** at its lower extremity. A fuel inlet valve **25**, formed of synthetic rubber or some other suitable material, is adapted to engage the seat **24** upon upward movement, the upstanding shank **26** of said valve passing through a valve stem guide **27** which projects upwardly from the spider **23**.

The outlet boss **12** is provided with an outlet box **28** formed integrally with the carburetor body **10** and the plate **20**, and disposed within the fuel chamber so as to encompass the outlet to the pipe **14**. An adjustable metering or regulating valve (not shown) is provided in one side wall of the box **28** for regulating communication between said box, and therefore the pipe **14**, and the interior of the valve body **10** above the plate **20** designated as the fuel chamber. This valve functions in the usual manner to control the richness of the fuel mixture. A suitable cap **29** is provided for the valve body, and a flexible control diaphragm **30** is clamped between said cap and the upper end of the valve body. The stem **26** of the valve **25** is secured to the central portion of the diaphragm **30** in the usual manner A coiled spring **31** is confined between the underside of the diaphragm **30** and the upper end of the spider **23**, the spring thus constantly urging said diaphragm upwardly to draw the stem **26** and the valve **25** upwardly and close the latter. An inverted well or recess **32** is formed in the cap **29** and is open to the upper side of the diaphragm **30**, while a suitable small pipe or conductor **33** extends between said recess and the interior of the intake stack **15**, the connection of the pipe **33** into said stack being at a point upstream at all times of the choke valve **19**.

The structure illustrated and described up to this point amounts to the usual type of fuel gas pressure regulating instrumentality and serves to maintain a metered supply of fuel gas to the pipe **14**. Fuel gas flows from the inlet boss **11**, and is metered by the valve **25** in accordance with the relative pressures above and below the diaphragm **30**.

The lower end of the body **10** is closed by a base plate **34** spaced below the plate **20** there being a suitable biasing diaphragm **35** clamped between the lower edge of the housing **10** and the upper side of said plate. A relatively shallow and wide sump or chamber **36** is formed in the central portion of the base plate **34**, and receives the lower end of a depending stem **37** carried by the valve **25**. The diaphragm **35** overlies the open upper end of the well **36**, and the depending stem **37** extends through the central portion of said diaphragm and is clamped thereto by a nut **38**. The stem **37**, the central portion of the diaphragm **35**, and the valve **25** thus move vertically within the carburetor as an integral unit. For the purpose of confining the flexing of the diaphragm **35** to the portion overlying the well **36**, an annular clamping ring **39** rests upon the upper surface of said diaphragm and is held upon the plate **34** by engagement beneath shoulders **40** (one shown) cut into the underside of the housing **10**. The inside diameter of the ring **39** is substantially equal to the inside diameter of the well **36**, and the diaphragm is thus clamped to the plate **34** around the margin of said well **36**.

The additional diaphragm **35** provides a means for selectively controlling the movement of the valve **25**, since differential pressures applied across the diaphragm will serve to urge said valve either toward an open or closed position. The plate **34** is provided with a circular depending skirt or wall **41** which defines a substantially cylindrical chamber **42** beneath the well **36**. A bevelled, upwardly divergent opening **43** is cut in

the bottom of the well 36 and extends into the chamber 42 thereby providing communication between the well and the chamber. The bevelled opening 43 receives the bevelled head 44 of a screw-threaded plug 45, the screw-threaded pin 46 of said plug projecting downwardly into the chamber 42. A guide sleeve 47 has its upper end internally screw-threaded and receiving the screw-threaded pin 46 so as to support said sleeve 47 from the plug 45. A screw-threaded plug 48 screws into the lower end of the sleeve to close the same. The sleeve 47 is surrounded by the windings of a solenoid coil or electromagnetic coil 49, insulating washers 50 being disposed between the upper end of said coil and the upper end of the chamber 42, and beneath the lower end of said coil. The sleeve 47 carries a relatively wide, outwardly extending flange 51 which engages beneath the lowermost insulating washer 50 and presses its outer marginal edge upwardly against an internal, annular flange 52 formed upon the interior of the chamber 42 and projecting radially inwardly from the wall 41. The open lower end of the chamber 42 is closed by a transverse plate 53 secured thereto by bolts 54.

A cylindrical valve plug or solenoid armature 55 is received within the sleeve 47 and confined between the plugs 45 and 48. Suitable disk-like valve elements 56 are recessed in the upper and lower ends of the plug 55, said disks being formed of fiber or any other suitable semi-resilient material. The lower plug 48 is provided with an upstanding teat or valve seat 57 and an axial passage or inlet 58 communicating between the lower end of said plug and the upper end of the teat 57. The lowermost valve disk 56 is adapted to seat upon the upper end of the teat 57 and shut off the passage 58.

The upper plug 46 carries a similar teat or valve seat 59 which depends from its lower end and is adapted to be engaged by the uppermost valve disk 56. A passage or inlet 60 extends upwardly from the lower end of the teat 59 into the body of the plug 46 and then laterally into communication with an annular groove 61 encompassing the bevelled head 44. Communication is thus established between the interior of the sleeve 47 and the groove 61. For communicating gas pressure to and from the groove 61, a restricted passage 62 is formed in the body 10 and the plate 34, and extends from a point within the body 10 below the wall 20, through said body, through the diaphragm 35, and through the plate 34, into the wall of the bevelled opening 43 in horizontal alinement with the annular groove 61. Fuel gas may thus pass from the upstream side of the valve 25 through the passage 62, the groove 61 and the passage 60, and into the interior of the sleeve 47.

The plug 46 also carries a longitudinally extending passage or outlet 63 which communicates with the lower end of the plug exteriorly or outwardly of the teat 59 and extends into a shallow sump 64 cut in the upper surface of the head 44. Since the lower end of the passage 63 is positioned outwardly of the depending teat 59, the engagement of said teat by the upper valve disk 56, will not shut off communication through the passage 63. Thus, the valve plug and the teats 57 and 59 form a three-way valve or selective control valve for alternately placing the well 36 in communication with the passages 58 and 60.

The valve plug or cylinder 55 is formed of a suitable magnetic material, such as soft iron, so as to be responsive to changing magnetic fields and to respond to energization of the magnetic coil 49, the relative length of the interior of the sleeve 47 and of the plug 55 being such as to permit said plug to undergo a limited longitudinal movement within said sleeve when an electric current is passed through coil 49. For supplying such electric current to the coil 49, a pair of electrical leads 64 are connected thereto, one of said leads being secured to a ground connection 65, while the other extends to an electrical terminal 66. Suitable connection (not shown) is made between the terminal 66 and the ignition switch (not shown) of the engine upon which this carburetor is to be used.

The plate 34 is provided with a depending boss 67 at one side, said boss having a screw-threaded opening 68 extending horizontally thereinto from its outer side. A passage 69 has its lower end communicating with the opening 68 and extends upwardly through the material of the boss 67, the carburetor body 10 and the wall of the box 28, to a point within the upper portion of the carburetor body immediately below the diaphragm 30. A second passage 70 communicates between the opening 68 and that portion of the chamber 42 below the flange 51 and above the bottom plate 53. The opening 68 is connected with the air intake stack 15 by a suitable pipe or idling conductor 71, said pipe connecting into the intake stack below the throttle valve 18. Thus, the manifold pressure existent within the engine and below the throttle valve 18, is communicated at all times to the passages 69 and 70.

In the operation of this carburetor, the coil 49 is energized automatically when the ignition switch of the engine is turned to "on" position. The energization of the coil 49 results in the creation of a magnetic flux within the sleeve 47, thereby causing the valve plug 55 to move upwardly within the sleeve and press the upper valve disk 56 into engagement with the lower end of the depending teat 59. Communication through the passage 60 is thus cut off, and the manifold pressure of the engine is communicated through the pipe 71, the passage 70, the passages 58 and 63, to the underside of the diaphragm 35. As soon as cranking of the engine is commenced, the manifold pressure drops which results in downward flexing of the diaphragm 35 and opening of the valve 25 to permit fuel gas to flow to the nozzle 17 and result in starting of the engine. While the engine is idling, the air flow through the venturi section 16 is insufficient to create an adequate pressure drop within the pipe 14 for actuation of the diaphragm 30 and proper opening of the valve 25. However, the low manifold pressure characteristic of an idling condition is communicated to the passages 69 and 70. As previously recited, the reduced pressure within the passage 70 permits the diaphragm 35 to flex downwardly under the pressure of the gas supply above said diaphragm to compress the spring 31 and to open the valve 25 for the supplying of sufficient fuel for idling purposes. This fuel may flow to the intake stack through either or both of the pipes 14 and 71, and is admixed with the incoming air stream within said intake stack. As the throttle valve 18 is opened and the speed or power output of the engine is increased, the air flow through the venturi section 16 becomes adequate to cause the necessary pressure drop within said section, and therefore within the pipe 14, to cause the diaphragm 30 to function and take over almost the entire control of the metering action provided by the valve 25.

The idling action described is of considerable importance when it is kept in mind that the venturi section 16 is somewhat larger than the

normal element of this type, and that the lack of pressure drop under idling conditions in this enlarged venturi section is much more nearly complete than is the case with smaller venturi sections.

Having placed the engine in operation and properly provided for its fuel supply from the time of starting up to the intermediate load, the enlarged venturi section now becomes of value in accommodating the large volumes of air required for heavy power load operation of the engine. As the speed and/or power load upon the engine reaches relatively high values, the enlarged venturi section permits the entry of sufficient volumes of air to provide for such loads, but, due to its large cross-sectional area, it does not impress a permanent pressure gradient upon this incoming air sufficient to hamper the full power operation of the engine. With this structure, the maximum power output of the engine is limited by its displacement and other factors rather than by the quantity of air which may be forced through the venturi section under atmospheric pressure. Thus, the drop in manifold pressure at high loads is relatively small, and the full power capacity of the engine is realized.

Now, when it is desired to shut off the engine, the ignition switch is moved to its "off" position thereby de-energizing the solenoid coil **49**. When this occurs, the valve plug **55** drops onto the upper end of the teat **57** and closes off the passage **58**. The manifold pressure is thereby no longer exerted within the well **36**, but rather the pressure of the gaseous fuel supply exerted through the pipe **13**, is also exerted through the passage **62** and the passages **60** and **63** to the underside of the diaphragm **35** within said well **36**. Obviously, this same pressure is being exerted upon the upper side of said diaphragm and the latter is completely balanced. Of course, when the engine stops, atmospheric pressure is exerted through the pipes **14** and **33** to both sides of the diaphragm **30**, and this diaphragm is also completely balanced. Under these conditions, the relatively light-weight spring **31** is capable of closing the valve **25** in a secure condition, and to this closing force exerted by the spring is added pressure directed upon the under side of the valve **25** by the supplied fuel gas. A pressure differential exists across the valve tending to urge it toward a closed position, and the possibility of leakage is thereby minimized.

Should the diaphragm **35** become ruptured or torn for any reason, no harm can result since all avenues of escape for the fuel gas have been cut off. The pressure of this gas within the sleeve **47** only serves to urge the lower valve disk **56** into tighter engagement with the upper end of the teat **57** and more securely close off the passage **58**.

It is obvious that this invention solves a problem of long standing, and does so in a completely satisfactory and desirable fashion. It permits the utilization of a large diameter venturi section within the air intake stack of an engine with the resultant minimizing, if not elimination, of the undesrable pressure drop through said venturi section when the engine is operating under heavy loads. The invention permits this use by providing for the light-weight regulating spring which must necessarily be employed in conjunction with such a venturi, and eliminates the undesirable results following the utilization of a "soft" spring and the hazards characteristic thereof. The device automatically unbalances one valve regulating diaphragm when the engine is in operation so as to provide for an adequate fuel supply under idling and low load conditions. The light-weight spring takes care of the metering function during intermediate and heavy loads, the small force it exerts causing it to be adequately responsive to the relatively small variations of pressure inherently existent in a venturi section of large diameter. However, when the engine is stopped, and it is necessary to shut-off all possible leakage of the fuel gas, the valve regulating diaphragm is again balanced thus permitting the light-weight spring to close said valve and seat the same sufficiently to preclude such leakage. In addition, the pressure-closing structure of the valve takes advantage of the force exerted by the gaseous fuel supply to bias the valve toward a closed position. However, it is to be noted that this use of the fuel supply pressure is adequately compensated for during operation of the engine by the differential loading of the diaphragms **30** and **35**.

The foregoing description of the invention is explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

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

1. A gas carbureting apparatus for internal combustion engines having an engine intake stack with an air inlet and a fuel inlet and a throttle valve in the stack down stream of the fuel inlet, including, a fuel metering valve casing having a fuel chamber, a conductor connecting the fuel chamber with the stack inlet, a fuel inlet valve in the casing controlling the supply of fuel to the fuel chamber, a fuel supply conductor leading to the fuel inlet valve, a diaphragm in the casing connected to the inlet valve having one side exposed to the fuel gas pressure upstream of the inlet valve, the casing having a chamber exposed to the opposite side of the diaphragm, an idling conductor leading from the intake stack downstream of the throttle valve to the fuel chamber, a second valve in the casing, a bypass conductor leading from the idling conductor to the second valve, a bypass passage leading from the fuel supply conductor upstream of the fuel inlet valve to the second valve, the second valve having a flow passage communicating with the last named chamber and flow passages communicating with the bypass conductor and bypass passage, and means for actuating said valve to place the bypass conductor and the bypass passage selectively in communication with the chamber enclosing the opposite side of the diaphragm.

2. A gas carbureting apparatus for internal combustion engines having an engine intake stack with an air inlet and a fuel inlet and a throttle valve in the stack downstream of the fuel inlet, including, a fuel metering valve casing having a fuel chamber, a conductor connecting the fuel chamber with the stack inlet, a fuel inlet valve in the casing controlling the supply of fuel to the fuel chamber, a diaphragm in the casing connected to the inlet valve having one side exposed to the fuel gas pressure upstream of the inlet valve, a three-way valve having one passage communicating with the opposite side of the diaphragm, one passage communicating with the intake stack downstream of the throttle valve, and one passage communicating with the first-named side of the diaphragm, and means for actuating

the three-way valve to selectively place the second and third-named passages in communication with the opposite side of the diaphragm through the first-named passage.

3. A gas carbureting apparatus for internal combustion engines having an air intake stack with an air inlet and a fuel inlet and a throttle valve in the stack downstream of the fuel inlet, including, a fuel metering valve casing having a fuel chamber and a fuel supply chamber, a conductor connecting the fuel chamber with the stack inlet, a fuel inlet valve between the fuel chamber and the fuel supply chamber, a diaphragm in the casing connected to the inlet valve having one side exposed to the fuel supply chamber, the casing having a chamber exposed to the opposite side of the diaphragm, a second valve in the casing, an idling conductor leading from the intake stack downstream of the throttle valve to the fuel chamber, a bypass conductor leading from the idling conductor to the second valve, a bypass passage leading from the fuel supply chamber to said second valve, the second valve having a flow passage communicating with the last-named chamber and flow passages communicating with the bypass conductor and bypass passage, and means for actuating said valve to selectively place the bypass conductor in the bypass passage in communication with the last-named chamber enclosing the opposite side of the diaphragm.

4. A gas carbureting apparatus as set forth in claim 3, and a magnetic coil for operating the control valve.

5. A gas carbureting apparatus for internal combustion engines having an engine intake stack with an air inlet and a fuel inlet and a throttle valve in the stack downstream of the fuel inlet, including, a fuel metering valve casing having a fuel chamber and a fuel supply chamber, a conductor connecting the fuel chamber with the stack inlet, a fuel inlet valve between the fuel chamber and the fuel supply chamber, a diaphragm in the casing connected to the inlet valve having one side exposed to the fuel supply chamber, a three-way valve having one passage communicating with the opposite side of the diaphragm, one passage communicating with the intake stack downstream of the throttle valve, and one passage communicating with the first-named side of the diaphragm, and means for actuating the three-way valve to selectively place the second and third-named passages into communication with the opposite side of the diaphragm through the first-named passage.

6. In a gas carbureting apparatus for internal combustion engines having an engine intake stack with an air inlet and a fuel inlet and a throttle valve in the stack downstream of the fuel inlet, including, a fuel metering valve casing having a fuel chamber and a fuel supply chamber, a conductor connecting the fuel chamber with the stack inlet, a fuel inlet valve between the fuel chamber and the fuel supply chamber, a diaphragm in the casing connected to the inlet valve having one side exposed to the fuel supply chamber, the casing having a valve chamber communicating with the opposite side of the diaphragm, a solenoid coil surrounding the chamber, a solenoid armature in the chamber, a valve member on each end of the armature, a pair of valve seats in the valve chamber adapted to be engaged by said valve members, one seat communicating with the fuel supply chamber, and

the other seat communicating with the intake stack downstream of the throttle valve.

7. A gas carbureting apparatus for internal combustion engines having an engine intake stack with an air inlet and a fuel inlet and a throttle valve in the stack downstream of the fuel inlet, including, a metering valve casing fuel having a fuel chamber and a fuel supply chamber, a conductor connecting the fuel chamber with the stack inlet, a fuel inlet valve between the fuel chamber and the fuel supply chamber, a control diaphragm in the casing connected to the inlet valve, one side of the diaphragm being in communication with the fuel chamber, a biasing diaphragm in the casing connected to the inlet valve having one side exposed to the fuel supply chamber, and a control valve selectively placing the opposite side of the biasing diaphragm in communication with the fuel supply chamber when in one position and in communication with the intake stack downstream of the throttle valve when in another position.

8. A gas carbureting apparatus for internal combustion engines having an engine intake stack with an air inlet and a fuel inlet and a throttle valve in the stack downstream of the fuel inlet, including, a fuel metering valve casing having a fuel chamber and a fuel supply chamber, a conductor connecting the fuel chamber with the stack inlet, a fuel inlet valve between the fuel chamber and the fuel supply chamber, a control diaphragm in the casing connected to the inlet valve, one side of the diaphragm being in communication with the fuel chamber, a biasing diaphragm in the casing connected to the inlet valve having one side exposed to the fuel supply chamber, the casing having a valve chamber communicating with the opposite side of the biasing diaphragm, a solenoid coil surrounding the chamber, a solenoid armature in the chamber, a valve member on each end of the armature, and a pair of valve seats in the valve chamber adapted to be engaged by said valve members, one seat communicating with the fuel supply chamber, the other seat communicating with the engine intake stack downstream of the throttle valve.

9. A gas carbureting apparatus for internal combustion engines having an engine intake stack with an air inlet and a fuel inlet and a throttle valve in the stack downstream of the fuel inlet, including, a fuel metering valve casing having a fuel chamber and a fuel supply chamber, a conductor connecting the fuel chamber with the stack inlet, a fuel inlet valve between the fuel chamber and the fuel supply chamber, a control diaphragm in the casing connected to the inlet valve, one side of the diaphragm being in communication with the fuel chamber, a biasing diaphragm in the casing connected to the inlet valve having one side exposed to the fuel supply chamber, said casing having a chamber exposed to the opposite side of the diaphragm and a bevelled opening in the bottom of the chamber, a tapered plug extending downwardly through the bevelled opening, a sleeve secured to the depending end of the plug, a valve seat on the lower end of the plug, the plug having a longitudinal passage and having a passage between its valve seat and its side wall, the casing having a passage between the side wall of the plug and the fuel supply chamber, a second plug in the lower end of the sleeve having a valve seat on its upper end and a passage extending between the seat and its

lower end, an idling conductor communicating between the intake stack downstream of the throttle valve and the lower end of the second plug, a solenoid coil surrounding the sleeve, means for electrically energizing said coil, an armature in the sleeve, and valve elements on both ends of the armature adapted to engage the valve seats on the two plugs.

10. A gas carbureting apparatus for internal combustion engines having an engine intake stack with an air inlet and a fuel inlet and a throttle valve in the stack downstream of the fuel inlet, including a fuel metering valve casing with a fuel chamber and a fuel supply chamber therein and a fuel inlet valve between the chambers, a biasing diaphragm connected to the inlet valve, one side of the diaphragm being in pressural communication with the fuel supply chamber, and a three-way valve having one passage communicating with the opposite side of the diaphragm, one passage adapted to be placed

in pressural communication with the intake manifold of the engine, and one passage in pressural communication with the fuel supply chamber, and means for actuating the three-way valve to selectively place the second and third-named passages in communication with the opposite side of the diaphragm through the first-named passage.

SAM P. JONES.

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