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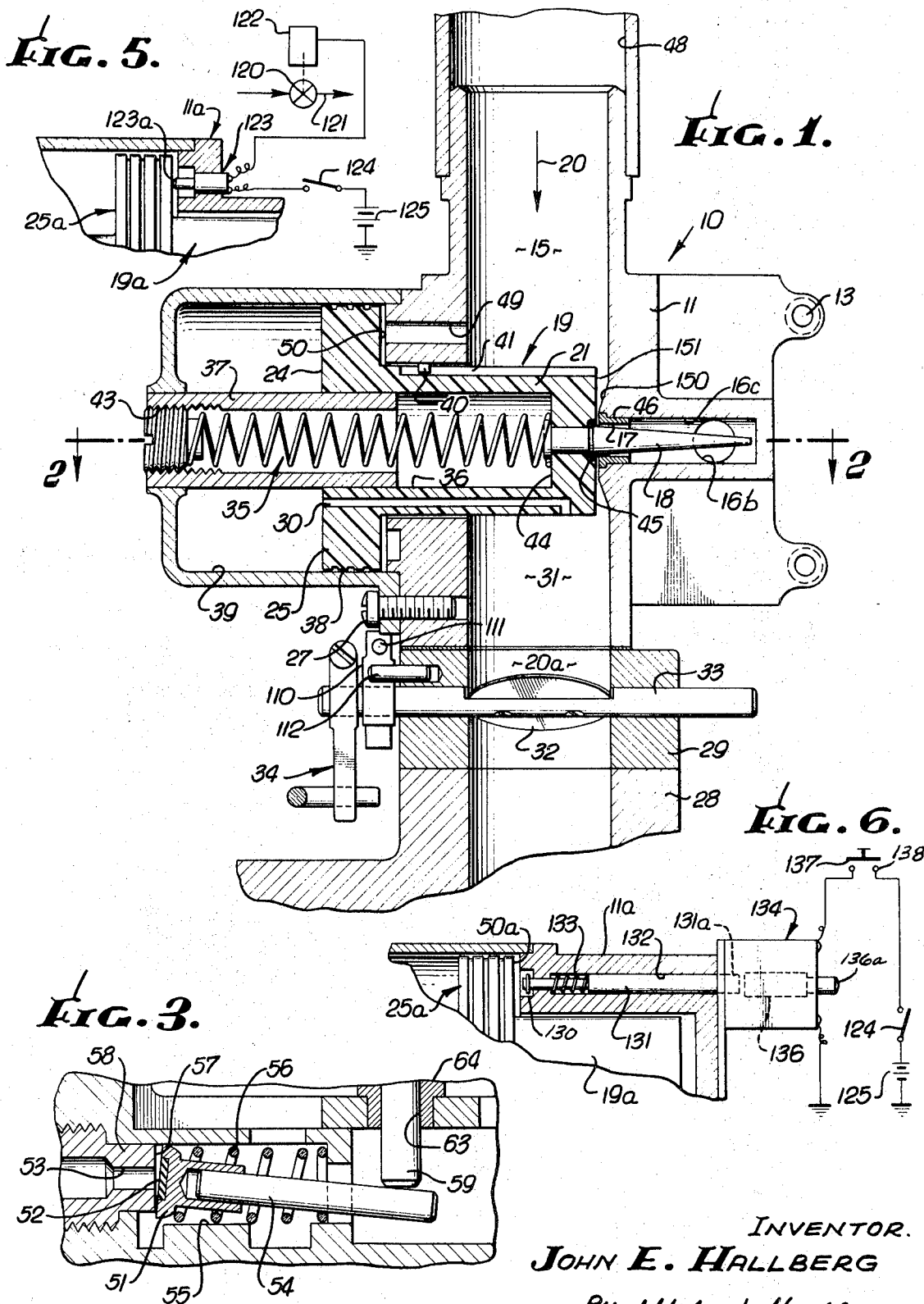
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FUEL CARBURETION APPARATUS

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FUEL CARBURETION APPARATUS

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18 Claims

ABSTRACT OF THE DISCLOSURE

LPG carburetion apparatus provides for safe relief of pressure build-up, eliminates auxiliary air bleeds, and does not turn the air flow direction through the carburetor. A plunger movably transversely in the air intake passage controls air flow in that passage as well as the clearance between a needle valve and an orifice which passes gaseous LPG to that passage; as gaseous fuel pressure drops in a regulated pressure passage upstream of the orifice, a regulator valve admits more fuel to that passage, the regulator valve being heated by heat transfer from circulating liquid, inadvertent freezing of which cannot crack the body structure. Provision is made for fuel shut off in response to plunger closure, and for mechanically induced displacement of the plunger, if needed on start-up. The device also eliminates diesel engine smoking.

BACKGROUND OF THE INVENTION

This invention relates generally to carburetion, and more specifically concerns improvements in carburetion of pressurized gaseous fuel, such as liquefied petroleum gas or LPG, or pressurized natural gas.

Carburetors for LPG have in the past suffered from certain disadvantages. Among these are lack of sufficient simplicity of construction and capability for disassembly while installed on an engine; lack of provision for safe relief of LPG pressure build-up; absence of sufficiently accurate LPG metering; the need for auxiliary air bleeds, which have the unwanted effect of decreasing vacuum on cranking; prior need for complex linkages to control air and gas flow, and which function inaccurately under idling conditions; and undesirable turning of air flow direction through the carburetor. Another problem, which can be overcome by means of an application of the present invention, is the tendency of diesel engines to operate at full power under too rich conditions, producing undesirable smoking and raw fuel emission.

SUMMARY OF THE INVENTION

It is a major object of the present invention to overcome these as well as other problems associated with pressurized gaseous fuel carburetion and engine operation. Basically, the invention is embodied in fuel conversion and carburetion apparatus, comprising body structure forming an intake air passage and a pressurized gaseous fuel passage having side communication with the air passage; means to deliver fuel in pressurized gaseous state to the gaseous fuel passage; plunger structure projecting within the air passage for movement therein to variably restrict air flow through the passage; the plunger being urged in one direction of movement by yieldable means and also having a surface communicating with the air passage at the downstream side of the plunger to receive application of vacuum tending to move the plunger in the opposite direction against resistance imposed by the yieldable means; and an orifice through which pressurized gaseous fuel is flowable to mix with air in the air passage and a needle valve controlling the orifice, one of the orifice and needle valve elements being movable relative

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to the other by the plunger structure to control the flow of gaseous fuel through the orifice.

Typically, the plunger is movable transversely of the air passage toward and away from the orifice whereby gaseous flow of LPG into the air passage is controlled in combustible mixture producing relation to air flow in the passage, all without change of direction of air flow; also, the needle valve is typically carried by the plunger to project through the orifice and it tapers in a transverse direction endwise of the plunger, with the result that very accurate fuel flow metering into the air passage is obtainable in relation to stroking of the plunger transversely of the major extent of the air passage. Further, the device is self cleaning by virtue of air flow over the plunger and across the orifice. Also, in the event of excessive gas pressure buildup, the needle valve and plunger will deflect to allow the gas to pass through the orifice into the air passage and to the engine, for safety. In this regard, the plunger typically includes a piston defining the vacuum receiving surface, the piston being contained by a body chamber at one side of the air passage, and a spring extends transversely within the chamber to urge the piston in a direction to reduce air flow and fuel metering. That chamber can be disassembled to permit removal repair of the piston, spring and chamber, all without removing the carburetor body from installation on an engine.

Further important aspects of the invention include provision for interconnected body members defining the gaseous fuel passage, one member carrying the orifice and the other member carrying the means to deliver fuel to that passage, whereby a simple, one-piece carburetor and converter may be realized; the provision of a pivotable gas fuel pressure regulating inlet valve yieldably biased toward fully closed position and an actuator including a diaphragm and spring responsive to pressure drop in the gas passage to pivot the inlet valve for increasing fuel flow to the gaseous fuel passage; provision for adjustment of both the actuator spring tension and the plunger spring tension to control both regulated pressure of fuel in the gas fuel passage and the idling position of the plunger structure; provision for circulating hot liquid in heat transfer relation with the body member proximate the inlet valve; provision of a yieldable wall at one side of a passage in which the hot liquid circulates for deflecting in the event of liquid freezing; provision for fuel shut-off in response to plunger movement to closed position; provision for mechanically induced displacement of the plunger if needed upon engine start-up in cold weather; and incorporation of the invention as a diesel engine smoke control, wherein during increased fuel injection to the diesel engine, gaseous LPG and air are transmitted to the diesel cylinders to burn the excess injected fuel.

These and other objects and advantages of the invention, as well as the details of an illustrative embodiment, will be more fully understood from the following detailed description of the drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical section taken through carburetion apparatus incorporating the invention;

FIG. 2 is a section taken on line 2—2 of FIG. 1;

FIG. 3 is an enlarged fragmentary section showing operation of the liquid LPG inlet valve;

FIG. 4 is a diagrammatic view showing application of the invention as a diesel engine smoke control.

FIG. 5 is a fragmentary section showing fuel flow control in response to plunger movement; and

FIG. 6 is a fragmentary section showing mechanically induced plunger initial displacement.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIGS. 1 and 2, body structure is indicated generally at 10 as including first and second body members 11 and 12 interconnected as by fasteners 13, a gasket 14 sealing off between the members. The first member 11 forms a vertical air passage 15 and a pressurized gaseous fuel passage having sections 16a, 16b and 16c is formed by both body members to have side communication with the air passage. Typically, an orifice 17 is provided for flowing gaseous fuel from the gas passage 16 to mix with air in the air passage, such flow being controlled by a needle valve 18 projecting transversely of the air passage and through the orifice. Associated with the second body member 12 is what may be generally referred to as means to deliver fuel to the gaseous fuel passage accompanied by fuel pressure drop and fuel conversion from liquid to gaseous state, as will be described.

Associated with the first body member 11 is plunger structure generally indicated at 19 as projecting within the air passage 15 for lateral movement therein to variably restrict air flow downwardly through that passage, i.e. in the direction of arrow 20. Flow of gaseous fuel through the orifice 17 is controlled by such lateral movement of the plunger, and as an example of this the needle valve 18 may typically be carried by the plunger stem 21 at 22 with the plunger being movable between needle valve closed position as approximately seen in FIG. 1, and needle valve fully open position as indicated by the broken line 23 in FIG. 2 defining the leftwardmost travel position of the plunger surface 24. That surface is typically defined by a plunger structure piston 25 received within a body chamber 26 having removable attachment at 27 to the first body member 11, whereby removal of the chamber allows access to the plunger structure for cleaning and servicing purposes without removal of the remainder of the apparatus from mounted relation to an engine. Typical engine structure is indicated at 28 and 29 in FIG. 1.

Surface 24 has communication via a duct 30 in the plunger piston and stem with the air passage 15 at the downstream side 31 of the plunger structure, for receiving application of engine produced vacuum tending to move the plunger structure in a leftward direction, as seen in FIG. 1, increasing air flow downwardly through passage 20 and gaseous fuel inlet to such air flow, to reduce the vacuum. Such vacuum is typically communicated to the downstream side 31 of the plunger structure upon increased opening of a butterfly valve 32 within the downstream section 20a of the air passage, the butterfly valve being mounted on a pivot pin 33 rotatable by the accelerator linkage 34 controllable by the operator. In this regard, the engine structure 28 typically comprises the engine intake manifold for passing the fuel air mixture to the engine cylinders.

Leftward movement of the plunger structure 19 as described is opposed or resisted by yieldable means urging the plunger structure rightwardly in FIG. 1. Such yieldable means typically comprises a coil spring 35 extending transversely within the plunger bore 36 and within a tubular part 37 acting as a guide for the plunger by virtue of close reception within the plunger bore. The plunger transverse movement is further characterized by close reception of the piston air seal labyrinth periphery 38 within the chamber bore 39, and rotation of the plunger is prevented by reception of a guide lug 40 on the body member 11 in a transverse groove 41 extending at the upper periphery of the piston stem 21. Tension in the spring 35 is controllable by adjustable means such as the plug 42 having threaded reception at 43 within the tubular part 37, the spring extending between the plug 42 and the inner bore shoulder 44 of the plunger stem. Such adjustment of the spring tension controls the idling position of the plunger structure indicated in FIG. 1, wherein the O-ring seal 45 carried by the plunger is slightly spaced from

the orifice member 46 defining the orifice 17, and the rightwardly tapering needle valve 18 defines with the orifice 17 a slight clearance for exit of gaseous fuel from the passage 16c into the air passage 15. The fuel air mixture under such conditions is sufficient for engine idling.

It should be noted that in the event of undesirable increase of gaseous fuel pressure within the pressurized gaseous fuel passage 16, such increased pressure will displace the plunger structure leftwardly to allow escape of the excess pressure into the air passage for upward venting through the air inlet system as indicated at 48, thereby providing for increased safety in LPG carburetion systems. It should also be noted that a passage 49 is provided at the upstream side of the plunger structure to communicate upstream air pressure to the rightward face 50 of the piston 25. Also, the wall of the body 11 is tapered at 150 to allow air pressure application against the end 151 of the plunger. Accordingly, vacuum applied to the leftward face 24 of the piston will produce a differential pressure across the piston for moving it leftwardly. As the piston moves leftwardly, that differential pressure is reduced inasmuch as the pressure at the downstream side 31 of the plunger structure increases toward the pressure at the upstream side of the plunger structure. Body 11 is transversely bored at 153 to receive the plunger 19, bore 153 being slightly larger than bore of passage 15.

Turning now to FIGS. 2 and 3, the aforementioned means to deliver fuel to the gaseous fuel passage includes a pivotable pressure regulating inlet valve yieldably biased toward fully closed position, and an actuator responsive to a pressure drop in the gaseous fuel passage to pivot the inlet valve for increasing fuel flow to the gaseous fuel passage 16. As an example of this, the inlet valve may include a plug 51 having a seal 52 facing the fuel inlet port 53, as better seen in FIG. 3. The inlet valve also includes a stem 54 carried by the plug for pivoting the latter to variably control the flow of fuel from the port 53 into the labyrinth passage 55 provided in the body member 12. Such pivoting is resisted by a coil spring 56 engaging the plug to urge it toward engagement with the face 57 of the tubular insert 58 defining the port 53 thereby to close the port.

The actuator includes a stem 59 engaging the valve stem 54 to variably pivot the inlet valve relative to the port 53 as described, the actuator stem 59 being carried by an actuator diaphragm 60 seen in FIG. 2, stem 59 being guided in a bore 63 of an insert 64 carried by the body member 12. The diaphragm is peripherally clamped between the body member 12 and a cap 65 in such manner that the diaphragm has one side exposed to gaseous pressure within the passage 55 communicating with the gas passage 16, whereas the opposite side of the diaphragm communicates with the external atmosphere via bleed 160. A diaphragm spring 66 at said opposite side of the diaphragm resists diaphragm deflection induced by increased pressure in the passage 55 accompanied by pivoting of the inlet valve plug 51 in a direction to reduce the fuel flow to the fuel passage 16. In other words, when less fuel is demanded by the engine, the pressure in the gas passages 55 and 16 increases, resulting in diaphragm deflection in FIG. 2 toward the spring 66 and reduced fuel inlet to the passage 55. Conversely, as the engine demands more fuel, i.e. as the butterfly valve 32 is increasingly opened, the plunger structure 19 in FIG. 1 moves leftwardly, admitting more air and fuel to the engine and reducing the pressure of the fuel in the passages 55 and 16. Under such conditions, the diaphragm 60 deflects away from the spring 66 thereby to increasingly pivot the inlet valve plug 51 for admitting more fuel. The tension in spring 66 is adjustable to facilitate adjustment of the regulated pressure of fuel in the gaseous passages 55 and 16. Such adjustment may typically be provided by a plug 68 having threaded reception at 69 in the threaded bore 70 of the cap 65, the spring 66 bearing against the plug as well as against the diaphragm plate 71.

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Referring now to FIG. 2, fuel supplied by the fitting 72 thread connected at 73 to the body member 12 may typically consist of LPG, such as liquefied propane, which is to be evaporated at the inlet valve to gaseous state within the passage 55. On the other hand, it is also contemplated that the fuel so supplied may already have been evaporated to gaseous state, but at a considerably higher pressure than the pressure in the passage 55. In either event, the pressure reducing action at the inlet valve is accompanied by a temperature decrease at the inlet valve, and it is another purpose of the invention to provide against freezing of that valve under all normal operating conditions. In this regard, the body structure forms another passage for circulating hot liquid in heat transfer relation with the body member 12 proximate the inlet valve, together with a yieldable wall at one side of that additional passage. The latter may take the form of the passage 80, seen in FIG. 2, through which hot liquid is circulated as via ducting indicated at 81, there being a partition 82 separating the warm liquid passage 80 from the cool gas passage 55. Also, the partition has heat conducting connection with the fitting 72 proximate the inlet valve, i.e. in the area 83, whereby heat may readily be transferred to that area and to the inlet valve for preventing freezing thereof.

The yieldable wall may typically be provided, at least in part, by the gasket portion 84 at the side of the passage 80 opposite the partition 82, whereby the wall extends between the body members 11 and 12 for simplicity of construction and assembly. The wall may also typically include a yieldable cellular mass such as a sponge 85 carried in a recess 86 provided in the body member 11. The yieldable wall structure is so located as to receive force exerted thereon by the liquid contents of the passage 80, whereby in the event of freezing of those contents under extremely adverse conditions, the yieldable wall will yield upon expansion of such contents thereby preventing fracture of the body members. In this regard, a duct 86 communicates between the passage 15 and the mass 85 to exhaust air from the cellular mass during yielding of the yieldable wall.

It will also be observed that the body construction is such as to readily accommodate supply of pressurized natural gas directly to the gas passage 16b in body member 11. For example, the body member 12 may be detached from member 11, and a pressurized natural gas line may be connected to member 11 at the threaded entrance 116b to passage 16b, thereby extending the utility of the device in terms of operating not only with LPG but also with natural gas.

Turning now to FIG. 4, a diesel engine air intake manifold is shown at 90 as connected to receive air and gaseous LPG from the structure 91, as described in FIGS. 1 and 2, for delivery to an engine cylinder or cylinders. A suitable air cleaner is indicated at 92 as connected at the top of the structure 91, and a suitable source of LPG is indicated at 93 as connected via duct 94 with the fuel supply to the apparatus 91. Engine fuel injection means is provided to increase and decrease the quantity of fuel injected for combustion in the engine cylinders. Typically, such injection means may include the injectors 95 having rotary parts 96 serving to increase the quantity of fuel injected as such parts rotate counterclockwise in response to rightward movement of the rack 97. The latter has toothed engagement at 98 with the injector rotary parts 96. Conversely, as the rack moves leftwardly, the parts rotate clockwise to decrease the quantity of fuel injected for combustion by the cylinders.

Control means is also provided in FIG. 4 to increase the flow of air and gaseous LPG from the air passage in structure 91 to the manifold 90 during increased fuel injection as described. Such control means typically includes a butterfly or damper valve 99 corresponding to butterfly valve 32 in FIG. 1; also, the control means includes an electrical connection operable in response to

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increased fuel injection, and a solenoid connection to operate the damper valve to increase the flow of air and gaseous LPG to the manifold in response to operation of the electrical connection. Such a solenoid is indicated at 100 as having a coil connected in series with the switch 101 and the battery 102, the solenoid also having a plunger 103 operating the butterfly valve 99 via a suitable connection 104. In operation, when the rack 97 is moved rightwardly to increase fuel injection to the diesel cylinders, a point is reached where under full power conditions the injected fuel will not completely burn but will form a smokey exhaust from the engine. At that point or near to it the switch 101 is actuated by a suitable element 105 on the rack to operate the solenoid 100 and thereby open the butterfly valve 99 for admitting air and LPG to the air stream 106 flowing to the engine cylinders. The adjustment is such that the additional air and LPG when combusted in the engine cylinders will reduce or eliminate the smokey condition of the diesel exhaust. As an alternative, a mechanical link may be provided between element 105 and the damper valve 99.

Referring back to FIG. 1, a lever 110 on pivot pin 33 is spring urged at 111 in a direction to rotate the engine throttle butterfly 32 toward closed position in passage 20a. A stop pin 112 engages the lever 110 when the butterfly approaches closed position, and the linkage 34 is actuable to rotate the butterfly toward open position, and against resistance imposed by the spring 111.

An additional aspect of the invention concerns the provision of control means to alter fuel delivery to the gaseous fuel passage in response to a change in the position of the plunger structure, the control characterized in that fuel delivery is inhibited when the plunger structure has advanced position in the air passage for blocking air flow through that passage, and fuel delivery is increased when the plunger structure is retracted from such advanced position. In the illustrative embodiment of FIG. 5, the plunger 19a is shown in advanced (i.e. rightwardmost) position relative to the body structure 11a, and corresponding to completely closed condition of the orifice 17 as well as closing of the air passage 15. The control means includes a control valve 120 for controlling fuel delivery at 121 to the gaseous fuel passage, an electrically energizable operator such as solenoid 122 for the valve, and an electrical switch 123 operable in response to plunger advancement to advanced position to control the operator for closing the control valve.

The switch is connected in series with the ignition switch 124, the solenoid 122 and the current source 125. In the position shown, the switch plunger 123a is urged to the right by the piston 25a to turn the switch 123 "off," the solenoid 122 is deenergized to close valve 120, and fuel delivery is inhibited. When the engine cranks, the piston 25a is urged to the left by vacuum as explained above, the switches 123 and 124 are closed or "on," and the solenoid is energized to open valve 120 allowing fuel to flow. Should the ignition switch 124 be inadvertently left "on," the switch 123 will be "off" when the engine is not running, and no fuel will flow, obviating a fire hazard. Also, should the engine die for some reason, the fuel flow will be interrupted.

A further aspect of the invention concerns the provision of an unusually effective primer useful for example in extremely cold climates where the engine may turn at a very slow, cranking speed upon start-up. Basically, the primer comprises a pusher carried by the carburetor body structure, and an operator for the pusher that functions to displace the pusher to mechanically urge the plunger structure in a direction such that the fuel gas orifice is initially opened. For example, as seen in FIG. 6, a pusher is seen at 130 on an operator stem 131 in a bore 132 in the body structure 11a, extending generally parallel to the axes of plunger 19a. The stem is spring urged at 133 out of engagement with the face 50a of plunger piston 25a.

The operator for the pusher may also include a solenoid 134 carried by the body 11a to displace the stem 131 toward and into engagement with the piston face 50a in response to electrical energization of the solenoid. For example, the solenoid core structure 136 is movable to engage and displace the terminal 131a of the stem 131 to so displace the stem. To this end, a push button 137 is operable to close switch 138 to connect the solenoid with battery 125 when ignition switch 124 is closed. Alternatively, the exposed terminal 136a of the core is manually operable to so displace the stem; also, if the solenoid is removed, the terminal 131a of the stem is exposed for manual operation.

Once the plunger structure 19a is so displaced by the pusher, the safety switch 123 in FIG. 5 is operated to effect fuel flow to the gas fuel passage, as described. Stem 131 may be made of non-magnetic material such as aluminum, so as not to be attracted by the solenoid produced magnetic flux.

I claim:

1. Fuel carburetion apparatus for an engine, comprising

body structure forming an air passage and a pressurized gaseous fuel passage having side communication with said air passage,

plunger structure projecting within said air passage for movement therein to variably restrict air flow through the passage,

yieldable means urging the plunger structure in one direction of movement, the plunger structure having a surface communicating with the air passage at the downstream side of the plunger structure to receive application of vacuum tending to move the plunger structure in the opposite direction against resistance imposed by said yieldable means,

and an orifice through which pressurized gaseous fuel is flowable to mix with air in said air passage and a needle valve controlling said orifice, one of said orifice and needle valve being movable relative to the other by the plunger structure to control said flow of gaseous fuel through said orifice,

said body structure including interconnected body members defining said gaseous fuel passage, one member carrying said orifice, and means on the other member to deliver fuel to said gaseous fuel passage, the gaseous fuel passage having intercommunicating sections in said body members, one gaseous fuel passage section in said one member terminating at a face of said one member toward which the other member is connectible and said means on the other member to deliver fuel including a connection for duct means to supply fuel directly to said other gaseous fuel passage section.

2. Apparatus as defined in claim 1 wherein said plunger structure is movable transversely of said air passage toward and away from said orifice, the needle valve being carried by the plunger to project through the orifice, and the needle valve tapering in a transverse direction endwise of the plunger.

3. Apparatus as defined in claim 1 including control means to alter said fuel delivery in response to a change in the position of the plunger structure characterized in that fuel delivery is inhibited when the plunger structure has advanced position in the air passage for blocking air flow through said passage and said fuel delivery is increased when the plunger structure is retracted from said advanced position.

4. Apparatus as defined in claim 1 in which the plunger structure includes a piston defining said surface, the piston having an oppositely facing surface communicating with the air passage at the upstream side of the plunger structure, said body structure including a removable chamber receiving said piston, said yieldable means comprising a spring urging said plunger structure toward said orifice.

5. Apparatus as defined in claim 4 wherein the plunger structure has an engine idling position, and including adjustable means to adjust the spring tension thereby to control said idling position of the plunger structure.

6. Apparatus as defined in claim 1 wherein said means to deliver fuel to said gaseous fuel passage includes a pivotable pressure regulating inlet valve yieldably biased toward fully closed position, and an actuator responsive to a pressure drop in said gaseous fuel passage to pivot the inlet valve for increasing fuel flow to said gaseous fuel passage.

7. Apparatus as defined in claim 6 in which said actuator includes a diaphragm having one side exposed to pressure in said gaseous fuel passage, and a diaphragm spring resisting such directional deflection of the diaphragm induced by increased pressure in the gaseous fuel passage as tends to pivot the inlet valve for reducing fuel flow to said gaseous fuel passage.

8. Apparatus as defined in claim 7 including adjustable means to adjust the diaphragm spring tension thereby to adjust the regulated pressure of fuel in said gaseous fuel passage.

9. Apparatus as defined in claim 1 in which said means to deliver fuel to said gaseous fuel passage includes a pressure regulating inlet valve and an actuator responsive to a pressure drop in said gaseous fuel passage to actuate the inlet valve for increasing fuel flow to said gaseous fuel passage, said body structure forming another passage for circulating hot liquid in heat transfer relation with said other body member proximate said inlet valve, and a yieldable wall at one side of said other passage.

10. Apparatus as defined in claim 9 in which said yieldable wall is received between said body members, and including a yieldable cellular mass carried by said one body member to receive force transmitted via said wall and exerted thereon by the contents of said other passage.

11. Apparatus as defined in claim 10 in which said mass comprises a sponge.

12. Apparatus as defined in claim 10 including a duct communicating between said mass and said air passage to pass air therebetween in response to compression and expansion of the mass.

13. Fuel carburetion apparatus for an engine, comprising

body structure forming an air passage and a pressurized gaseous fuel passage having side communication with said air passage,

plunger structure projecting within said air passage for movement therein to variably restrict air flow through the passage,

yieldable means urging the plunger structure in one direction of movement, the plunger structure having a surface communicating with the air passage at the downstream side of the plunger structure to receive application of vacuum tending to move the plunger structure in the opposite direction against resistance imposed by said yieldable means,

an orifice through which pressurized gaseous fuel is flowable to mix with air in said air passage and a needle valve controlling said orifice, one of said orifice and needle valve being movable relative to the other by the plunger structure to control said flow of gaseous fuel through said orifice.

means to deliver fuel to said gaseous fuel passage, and control means to alter said fuel delivery in response to a change in the position of the plunger structure characterized in that fuel delivery is inhibited when the plunger structure has advanced position in the air passage for blocking air flow through said passage and said fuel delivery is increased when the plunger structure is retracted from said advanced position, said control means including a fuel delivery control valve, an electrically energizable operator for said valve, and an electrical switch operable in response to plunger advancement to said advanced position to

control the operator for closing said control valve.

14. Fuel carburetion apparatus for an engine, comprising

body structure forming an air passage and a pressurized gaseous fuel passage having side communication with said air passage,

plunger structure projecting within said air passage for movement therein to variably restrict air flow through the passage,

yieldable means urging the plunger structure in one direction of movement, the plunger structure having a surface communicating with the air passage at the downstream side of the plunger structure to receive application of vacuum tending to move the plunger structure in the opposite direction against resistance imposed by said yieldable means,

an orifice through which pressurized gaseous fuel is flowable to mix with air in said air passage and a needle valve controlling said orifice, one of said orifice and needle valve being movable relative to the other by the plunger structure to control said flow of gaseous fuel through said orifice, and

a pusher carried by the body structure and an operator therefor operable to mechanically urge the plunger structure in said opposite direction to initially open said orifice.

15. Apparatus as defined in claim 14 in which said operator includes a stem operatively connected with the pusher and a solenoid carried by the body structure to displace the stem in response to electrical energization of the solenoid.

16. Apparatus as defined in claim 14 including a fuel delivery control valve for controlling flow of fuel to said gaseous fuel passage, an electrically energizable operator for said valve, and circuitry to effect approximately simultaneous electrical energization of said pusher operator and said valve operator allowing flow of fuel to the gaseous fuel passage when the plunger structure is mechanically urged in said opposite direction.

17. In combination with engine carburetor body structure forming air and fuel passages and plunger structure movable to control air flow in the air passage and fuel flow to the air passage, the plunger structure having an advanced position in which air and fuel flow are substantially blocked, the improvement comprising a pusher

carried by the body structure and an operator therefor operable to mechanically urge the plunger structure out of said advanced position, said operator including a stem operatively connected with the pusher and a solenoid carried by the body structure to displace the stem in response to electrical energization of the solenoid, the solenoid being removable from the body structure, following which the stem is exposed for manual displacement operating the pusher to urge the plunger out of advanced position.

18. In combination with engine carburetor body structure forming air and fuel passages and plunger structure movable to control air flow in the air passage and fuel flow to the air passage, the plunger structure having an advanced position in which air and fuel flow are substantially blocked, the improvement comprising a pusher carried by the body structure and an operator therefor operable to mechanically urge the plunger structure out of said advanced position, said operator including a stem operatively connected with the pusher and a solenoid carried by the body structure to displace the stem in response to electrical energization of the solenoid,

the solenoid having core structure exposed for manual displacement operating the stem and pusher to urge the plunger out of said advanced position.

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