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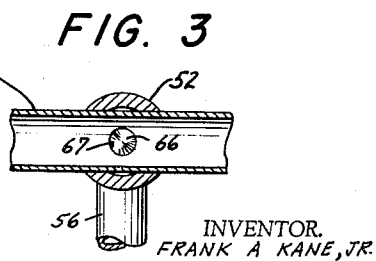
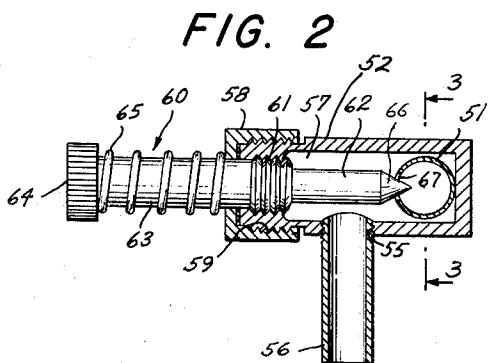
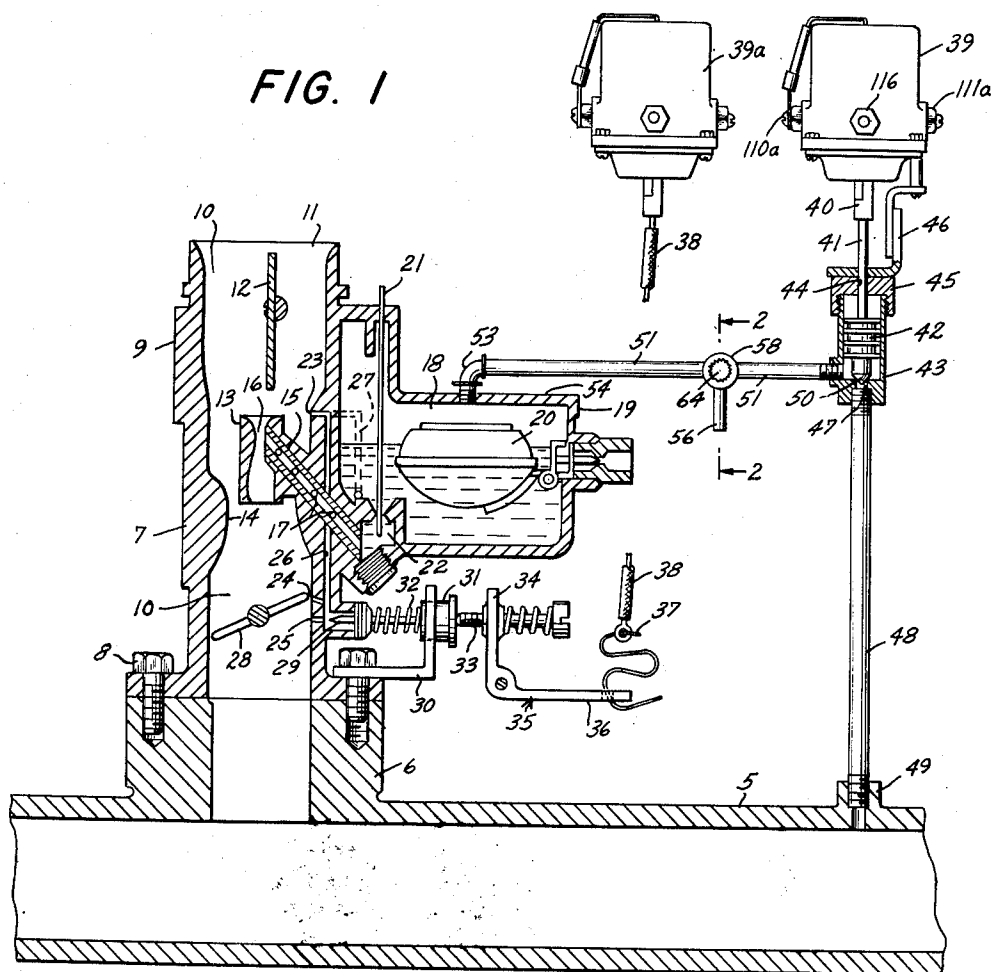
F. A. KANE, JR

3,080,858

061 F. A. KANE, JR
DEVICE FOR CONTROLLING THE ADMISSION OF FUEL
INTO AN INTERNAL COMBUSTION ENGINE

Filed July 5, 1961

2 Sheets-Sheet 1



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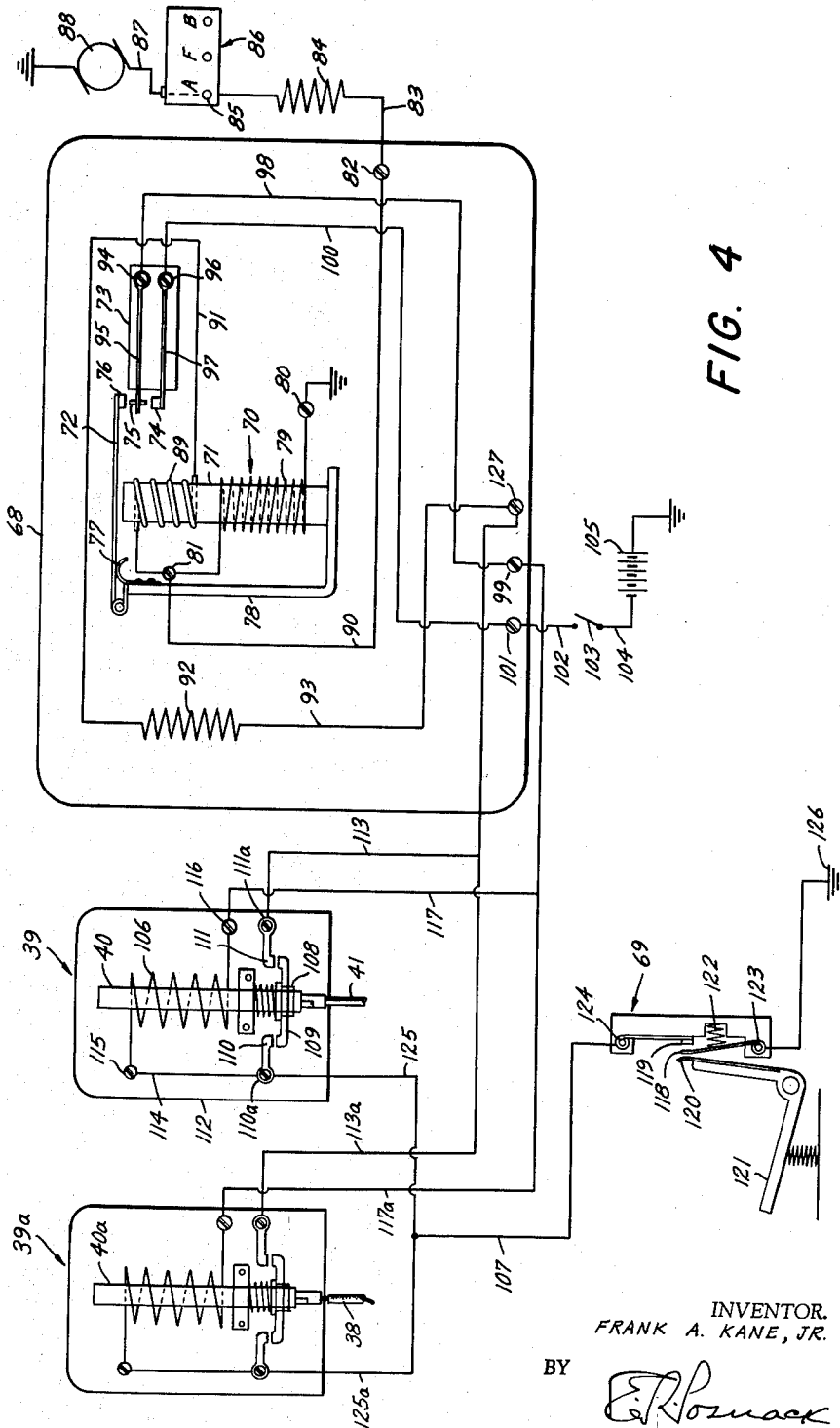


FIG. 4

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DEVICE FOR CONTROLLING THE ADMISSION OF FUEL INTO AN INTERNAL COMBUSTION ENGINE

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6 Claims. (Cl. 123-102)

This invention relates to the control of fuel admission into internal combustion engines, particularly in motor vehicles, this application being a continuation-in-part of the application filed February 18, 1959, Serial No. 794,006 and having matured into Patent No. 3,003,487, dated October 10, 1961.

The said prior application relates to a fuel shut-off valve operatively connected, through a novel electro-mechanical system, to the generator and accelerator pedal of an automotive vehicle whereby, upon a releasing action of the pedal during deceleration, the said valve is operatively closed—to be opened again upon the pick-up of speed. The present invention, in a preferred embodiment thereof, employs the said or similar electro-mechanical system, to produce an increased negative pressure in the float bowl upon deceleration, thereby to obviate the excessive gasoline flow through the carburetor's main jet that occurs during the deceleration cycle.

Such excessive flow, it has been found, results from two conditions prevailing during deceleration. Firstly, upon a change from a higher to a lower vehicle speed, there is an inertial flow-over of the liquid fuel from the float bowl through the main jet into the mixing chamber and main passageway of the carburetor, causing what is sometimes referred to as carburetor "drool." Secondly, there is an increased suction in the intake manifold and said main passageway during deceleration, thereby pulling in excessive fuel from the float bowl. Both actions result in an unduly rich air and gas mixture, with consequent wastage of fuel, unburnt gases emitted from the exhaust and smog-creating conditions.

It is an object of this invention to prevent such undesirable conditions by utilizing, during deceleration, the increased negative pressure within the intake manifold to create a partial vacuum in the float bowl, thereby to prevent the aforesaid condition of carburetor drool, as well as to counterbalance the aforesaid increased pull of fuel from the float bowl.

And it is a further objective of my invention to control the said reduction of float bowl pressure during deceleration by means of the aforesaid electro-mechanical system described in said parent application for controlling the idler shut-off valve, whereby both of said controls may be simultaneously effectuated.

Other objects, features and advantages will appear from the drawings and the description hereinafter given.

Referring to the drawings,

FIG. 1 is a fragmentary sectional elevation of an intake manifold and carburetor assembly, showing in elevation and partly in section the float bowl vacuum control device of my invention, and also showing in fragmentary elevation an idler fuel shut-off device adapted for conjoint use with the present invention, both devices being shown in inoperative positions.

FIG. 2 is an enlarged section of FIG. 1 taken along line 2-2, showing the air-bleed control valve in partly open position.

FIG. 3 is a fragmentary section of FIG. 2 taken along line 3-3.

FIG. 4 is a schematic diagram showing the float bowl vacuum control device and the shut-off device of FIG. 1

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operatively connected to an electro-mechanical arrangement of a relay control device, the generator and the accelerator pedal of an automobile engine, the coactive contacts of the electrical system of said relay device being shown separated.

In the form of my invention illustrated, the intake manifold 5 contains the boss 6 to which the carburetor generally designated 7 is secured by the studs 8. Said carburetor which, for the purpose of this specification, is semi-schematically illustrated, comprises the casing 9 through which extends the fuel mixture passageway 10 the upper portion 11 of which constitutes the air entrance and contains the conventional choke valve 12. Below said valve 12 is the venturi nozzle 13 communicating with the restricted throat 14 of said passageway 10. Extending into said venturi 13 is the perforated tube 15 the discharge terminal of which is disposed substantially in throat 16 of said venturi, the perforations 17 of said tube 15 communicating with the air chamber 18 of the float bowl 19 in a manner not illustrated but well known to those skilled in the art. Said float bowl contains therein the float 20, valve member 21, fuel compartment 22 and other conventional components that are not herein described and only schematically represented since a detailed description thereof is not necessary for the purpose of this specification. Communicating with passageway 10 are the low speed orifices 23, 24 and 25, the latter being the idler orifice, these orifices communicating with each other through channel 26 and communicating through channel 27 with said float bowl 19 in well-known manner. Positioned at the lower portion of passageway 10 is the throttle valve 28, said idler orifice 25 being adjacent thereto on the intake manifold side of said throttle valve.

An idler needle valve 29 is operatively adjacent the idler orifice 25, said needle valve being operatively movable between the normal open or inoperative position illustrated in FIG. 1 and an operative position in closing relation to said orifice 25 whereby no fuel can flow from passageway 26 through said idler orifice into the passageway 10 and intake manifold 5. The needle valve 29 is of the type referred to in said application Serial No. 794,006 as well as in U.S. Patent No. 2,877,997, it being operated by an electrical system to be hereinbelow described, said system being like that described in the said application. In the embodiment illustrated, the bracket 30 slidably supports the head 31 of said needle valve 29, the spring 32 urging the valve outwardly into its open position. In abutting engagement with said head 31 of valve 29 is the spring-loaded adjusting screw 33, the shank of said screw being in threaded engagement with the arm 34 of the lever 35, the arm 36 of said lever being connected to the spring member 37 attached to the Bowden wire 38, the latter being operatively connected to the solenoid 39a. The arrangement is such that upon an operative actuation of said solenoid, said Bowden wire is pulled upwardly to produce a counter-clockwise rotation of lever 35, whereupon said screw 33 forces the needle valve 29 into closing engagement with said idler orifice 25. When the solenoid 39a is de-energized, said needle valve is operatively returned by spring 32 to its normal open position, in the manner described in said application Serial No. 794,006.

In the float bowl vacuum control aspect of my invention illustrated, a solenoid 39 is employed, this being similar in construction to that of said solenoid 39a, the basic details of such construction being set forth below. The solenoid plunger 40 is connected to the valve stem 41 upon which is mounted the valve member 42 slidably movable within the casing 43, said stem extending through the aperture 44 of the casing's cap 45, the latter being fixedly secured by bracket 46 to said solenoid 39. The said casing 43 contains a port 47 communicating

with the pipe 48, the latter being affixed to the boss 49 of the intake manifold 5 and being in communication with the interior thereof. In the normal inoperative position of solenoid 39, the terminal portion 50 of the valve 42 is in closing relation to said port 47, said valve being raised to an open position when the plunger 40 is raised upon an energization of solenoid 39.

Connected to and in communication with said casing 43 is another pipe 51, said pipe extending through the air-bleed casing 52 (see FIGS. 2 and 3) and continuing to the said float bowl 19, the terminal portion 53 of pipe 51, in the particular embodiment illustrated, being connected to the top wall 54 of the float bowl and in communication with the air chamber 18 thereof. Said casing 52 is completely enclosed, except for opening 55 in the lateral wall of the casing, the short vent pipe 56 being attached to said latter wall and being in communication through said opening with the interior 57 of the casing. Extending through the cap 58 mounted over the threaded end portion 59 of said casing is the valve member 60, the particular embodiment illustrated comprising a threaded portion 61 in engagement with the internally threaded end portion 59, an inner valve stem 62, an outer shank 63 and knob 64, the spring 65 around shank 63 being in abutting engagement with said knob 64 and said cap 58. The inner terminal portion 66 of said valve stem is positioned in operative relation to the orifice 67 in the portion of pipe 51 that is disposed within the interior of the casing 52, said orifice 67 being in communication with the vent pipe 56 when the valve member 60 is in an operatively open position. Since said terminal portion 66 is, in the structure illustrated, of conical configuration, the size of the effective opening at orifice 67 can be readily varied by an adjusting manipulation of knob 64.

The arrangement is hence such that when the solenoid 39 is energized and the valve 42 actuated into an open position, there will be communication between the interior of the intake manifold 5 and the interior 18 of the float bowl 19 through pipes 48 and 51, so that air will be drawn from the float bowl due to the negative pressure prevailing within the said intake manifold. In other words, when there is an increase in manifold vacuum, such as occurs during deceleration, a partial vacuum will be created within the float bowl 19, provided the valve 42 is in its open position. By the electro-mechanical means shown in FIG. 4, the solenoid 39 is operatively energized during the deceleration cycle simultaneously with the energization of said shut-off control solenoid 39a in the manner set forth in said application Serial No. 794,006, as will more clearly hereinafter appear—whereby the valve 42 is operatively opened at a predetermined point in said cycle.

The creation of a partial vacuum in the air chamber 18 of float bowl 19 during deceleration has been found to be effective as a check against the inertial spilling over into the carburetor's passageway 10 of gasoline occurring during a sudden slowing down of the vehicle. Moreover, the creation of such a condition of partial vacuum in the float bowl has been found also to offset the excessive drawing in of the fuel through the main jet comprising the tube 15 and venturi 13 that normally occurs during deceleration. In other words, the increase in the degree of vacuum within the intake manifold 5 during the deceleration cycle—which causes an increase in the suction in carburetor passageway 10—also increases the suction in chamber 18 of the float bowl, thereby eliminating the increased pressure differential between said passageway 10 and the float bowl that takes place during deceleration in conventional internal combustion engines. The optimum dynamic balance between the float bowl and main mixing passageway can readily be obtained by manually manipulating the knob 64 to adjust the position of air bleed valve 60, since the degree

of partial vacuum within the float bowl will depend upon the effective opening of orifice 67.

It has been found that the combined action of the float bowl vacuum control effected by the energization of the solenoid 39 and of the idler shut-off device effected by the energization of said solenoid 39a results in a marked reduction in unburnt exhaust gases such as are caused, in conventional engines, by the unduly rich gas mixture sucked into the intake manifold during deceleration. The simultaneous use of both of said controls in internal combustion engines is accordingly adapted to effect a reduction in smog conditions that result from inefficient action of conventional carburetors during deceleration cycles.

The electro-mechanical apparatus for operating solenoids 39 and 39a is illustrated in FIG. 4. The novel relay control means of this invention are contained within a casing generally designated 68, such means being operatively connected in parallel to both of said solenoids and the pedal switch 69 adapted to be actuated by the accelerator pedal when the latter is in a predetermined position, all in a manner to be hereinafter described.

Casing 68 contains the relay device 70 comprising the core 71, the spring-loaded switch-actuating armature arm 72 and the relay switch 73, the latter having the two normally separated contacts 74 and 75—contact 75 being positioned in coactive relation with the terminal 76 of said arm 72, so that when the arm 72 is operatively drawn down upon the magnetization of core 71, terminal 76 will engage contact 75 and cause it in turn to engage contact 74. In the form of my invention illustrated in FIG. 4, said arm 72 is engaged by spring element 77 mounted on the bracket 78, the arm 72 being normally urged away from contact 75, so that contacts 75 and 76 are normally separated.

Surrounding core 71 is the fine wire coil 79 one end of which is connected to terminal 81 on said bracket 78 and electrically connected by conductor 90 to terminal 82 which in turn is electrically connected by conductor 83 to the resistance 84, the latter being connected to the armature terminal 85 of the conventional voltage regulator 86, said terminal 85 being electrically connected through conductor 87 to the armature of the generator 88. The opposite end of coil 79 is connected to the grounded terminal 80 on the casing 68.

Disposed over core 71 is another coil of relatively heavy wire 89 and of fewer turns than coil 79, the differential electrical characteristics of said coils being predetermined for purposes to be hereinafter set forth. One end of coil 89 is connected to said terminal 81 and then by said conductor 90 to said terminal 82 in series with the generator 88, the other end of coil 89 being connected by conductor 91 to the fixed resistance 92 mounted within casing 68, said resistance being electrically connected by conductor 93 to the terminal 127. It is important to note that in the particular embodiment illustrated coils 79 and 89 are wound about core 71 in opposite directions.

The said relay switch 73 has thereon two terminals, one being terminal 94 electrically connected by conductor 95 to said contact 75, and the other being terminal 96 electrically connected by conductor 97 to said contact 74 of the switch. Connected to the terminal 94 is the conductor 98 which leads to the battery circuit terminal 99 on casing 68; and connected to said terminal 96 is the conductor 100 which leads to terminal 101 on the casing 68 connected to which is the conductor 102 leading to the ignition switch 103 which is connected by conductor 104 to the battery 105 one terminal of which is grounded.

The solenoid device 39 contains the solenoid coil 106 within which is operatively disposed the spring-loaded plunger 40 the lower terminal of which is connected to the said valve stem 41. Fixedly mounted upon the plunger 40 and separated therefrom by the insulator 108

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is the conductor disk 109 proportioned and positioned for operative engagement, when the plunger 40 is in its upper operatively retracted position, with the contacts 110 and 111 of the respective terminals 110a and 111a on the solenoid casing 46 of insulating material. Said terminal 111a is connected through said conductor 113 to terminal 127 of relay device 70; and said terminal 110a is connected through conductor 114 to terminal 115 to which one end of the solenoid coil 106 is connected, the other end of the said coil being connected to terminal 116 on the casing 112. Electrically connecting said terminal 116 and terminal 99 of the relay device 70 is the conductor 117.

The said accelerator pedal switch 69 contains the two contacts 118 and 119 normally held closed by the arm 120 of the accelerator pedal 121, the spring 122 normally keeping said contacts separated—contact 118 being operatively engageable by said arm. The arrangement is such that when the accelerator pedal is in its normal undepressed or low-speed position, the contacts 118 and 119 are in engagement; but when the pedal is depressed away from said low-speed position, the contacts 118 and 119 are separated. Contact 118 is connected to grounded terminal 123 of the casing switch 69; and terminal 119 is electrically connected to terminal 124 of said switch casing, said terminal 124 being connected, through conductors 107 and 125, to said terminal 110a of solenoid casing 112. Said terminal 123 of the pedal switch is grounded at 126.

Upon depressing the accelerator pedal, the resultant increase in generator speed will cause an engagement of the relay contacts 74 and 75, but the solenoid will not be energized until said contacts 118 and 119 are brought into contact; and this will only occur when the pedal is released to a predetermined low-speed position, preferably in the region of the idling position. Upon the operative energization of the solenoid through the said release of the pedal, the valve 42 is operatively elevated to its open position, in the manner aforesaid, and will remain open until the diminishing motor speed is reduced to a predetermined critical speed—preferably just above idling speed—at which point the valve 42 will quickly be closed.

The electro-mechanical operation for accomplishing this result will appear from the following: Coil 106 of the solenoid 39 is in the battery circuit, and in series with the contacts 74 and 75 of the relay switch 73 and the contacts 118 and 119 of the accelerator pedal switch 69. It is only when this battery circuit is closed—that is, when the respective contacts 118, 119 and 74, 75 are in engagement—that the solenoid 39 will be actuated to open valve 42. This condition can occur only when two other conditions are satisfied, (1) when the accelerator pedal is in a predetermined released position with the contact arm 120 holding contacts 118 and 119 together, and (2) when the relay arm 72 is being held in its operative position by the adequately magnetized core 71, the terminal 76 of said arm 72 holding said contacts 74 and 75 together. The float bowl control valve 42 will continue to be held open, as long as the current in coil 79 is of such magnitude as to maintain the core 71 sufficiently magnetized so that it could continue to hold down arm 72. It is only when the magnetization of the core 71 is reduced to a point where its holding power can no longer attract arm 72 that the contacts 74 and 75 will be separated to effect a release of solenoid plunger 40 and a consequent closing of the valve 42 to disconnect the float bowl from the intake manifold.

It is of importance to note that it is the combined action of the magnetizing coil 79 and demagnetizing coil 89, in cooperation with their respective electrical circuits which effects the required opening and closing of contacts 74 and 75 and the consequent actuation of the solenoid 39 for opening and closing the valve member 42. When the pedal contacts 118 and 119 are closed and the solenoid 39 actuated to close contacts at 110 and 111,

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the second coil 89 (the demagnetizing-coil) will be cut in—since the circuit containing said coil 89 also contains the generator 88 and the switch at contacts 110 and 111. (It should be noted that contacts 74 and 75 have already been closed due to the previous high energization of the first coil 79). At the instant of energizing the second coil 89, the core 71 is still attracting the arm 72, inasmuch as the generator voltage has not as yet been lowered to the predetermined critical magnitude at which the core will release the arm. In other words, during the deceleration cycle the predetermined critical voltage is reached after the demagnetizing coil is cut in. When the energization of coil 79 is further reduced, due to the inertial slowdown of the engine and generator, the magnetizing force of the core will be reduced to a condition of such weakness (at the critical voltage) that it will quickly release the arm 72, and thereby effect a quick and positive closing of valve 42. The above-described lag between the time of cut-in of coil 89 and the release of the arm eliminates the danger of over-sensitive make and break that would produce valve flutter.

The new cycle starts with depressing the pedal to accelerate, whereby the pedal switch contacts 118 and 119 are separated, the speed of the motor and generator increasing until it exceeds said critical point. It now creates enough current in coil 79 to cause its core to attract arm 72 and close the relay contacts 74 and 75. However, the closing of the latter contacts will have no effect on the solenoid coil 106 in series with the separated pedal switch contacts 118 and 119, so that the solenoid 39 remains inoperative and the valve 42 remains in closed position, until operatively opened in the manner above explained.

Although the drawings show the apparatus of my invention as including both solenoids 39 and 39a, either of said solenoids and their operatively associated parts may be used alone, to control either the float bowl vacuum or the said idler shut-off valve. For most effective operation, however, both can be simultaneously employed by being electrically connected to the relay device 68, the accelerator pedal 121 and the generator 88, in the manner illustrated.

The shut-off control solenoid 39a is, in the particular embodiment shown in the drawings, similar to solenoid 39, the core 40a being operatively connected to the Bowden wire 38. Both solenoids are connected in parallel to the relay mechanism and accelerator pedal, conductors 113a and 117a electrically connecting solenoid 39a to the respective terminals 127 and 99, and conductor 125a electrically connecting said solenoid 39a through conductor 107 with terminal 124, in the manner of the electrical connections of the correspondingly numbered parts.

The arrangement is hence such that both solenoids—and the float bowl and idler shut-off devices operatively connected thereto—will be operated by a single electro-mechanical system connected to the vehicle's generator and accelerator pedal. Upon the operative energization of said solenoids, the idler needle valve 29 will be closed and the float bowl vacuum control valve 42 will be opened, and upon a de-energization of said solenoids, said valve 29 will be opened and valve 42 closed, in the manner above described—both of said valves thereby cooperating, during deceleration, effectively and efficiently to control the admission of fuel into the engine.

In the above description, the invention has been disclosed merely by way of example and in a preferred manner; but obviously many variations and modifications may be made therein. It is to be understood, therefore, that the invention is not limited to any specific form or manner of practicing same, except insofar as such limitations are specified in the appended claims.

I claim:

1. In a fuel control device for an internal combustion engine having an intake manifold and a fuel mixture

passageway operatively communicating therewith and with a carburetor having a float bowl with an air chamber therein, the combination of conduit means communicating between said intake manifold and said float bowl air chamber, a valve member in said conduit means movable between open and closing positions relative thereto, air vent means in said conduit means positioned between said valve member and said air chamber and in constant communication with said air chamber, an electrical generator connected to said engine, whereby the speed of the engine will control the operative speed of the generator, electro-mechanical means comprising a core and two opposing conducting coils operatively disposed thereabout, the first being a magnetizing coil and the second a demagnetizing coil, an armature arm in operative relation to said core and movable between two respective limiting positions when said core is operatively magnetized and operatively demagnetized, an electrical circuit connecting said generator to said first coil, another electrical circuit connecting said generator to said second coil, switch means in said latter circuit, actuating means for said switch means, valve-actuating means operatively connected to said valve member and operatively responsive to said armature arm in one of its said positions, whereby said valve-actuating means will actuate said valve member when said arm is operatively actuated by said electro-mechanical means, the electrical characteristics of said respective coils and their said respective circuits being such that in response to generator voltage above a predetermined critical magnitude said core will be magnetized to a degree sufficient for magnetically holding said arm, and in response to generator voltage below said critical magnitude said core will be operatively demagnetized, said electrical characteristics being also such that at the time of the operative closing of said switch means the consequent energization of said second coil will occur when the generator voltage is at a higher magnitude than said critical magnitude, said generator being operable at a range of speeds for producing voltage of magnitudes ranging from below to above said critical magnitude.

2. In a fuel control device for an internal combustion engine having an intake manifold, a fuel mixture passageway operatively communicating therewith and with a carburetor having a float bowl with an air chamber therein, a low-speed fuel inlet communicating with said passageway, and a needle valve operatively associated with said fuel inlet and movable between a normally open position and an operative closed position relative to said inlet, the combination of conduit means communicating between said intake manifold and said float bowl air chamber, a valve member in said conduit means movable between a normally closed position and an operative open position relative thereto, electro-mechanical means operatively connected to said needle valve and valve member to move them from their said respective normal positions to their said respective operative positions, whereby upon the energization of said electro-mechanical means said

needle valve will be closed and said valve member opened, and means to energize said electro-mechanical means.

3. In a fuel control device for an internal combustion engine having an intake manifold and a fuel mixture passageway operatively communicating therewith and with a carburetor having a float bowl with an air chamber therein, the combination according to claim 2, said electro-mechanical means comprising two solenoids with plungers operatively connected to said needle valve and valve member, respectively, two electrical circuits in parallel operatively connected to said respective solenoids, and a source of electrical energy connected to said two circuits.

4. In a fuel control device for an internal combustion engine having an intake manifold, a fuel mixture passageway communicating therewith and with a carburetor having a float bowl with an air chamber therein, and a throttle valve in said passageway disposed between said manifold and the air intake of said passageway, the combination of conduit means communicating between said intake manifold and said float bowl air chamber, a valve member in said conduit means movable between a position in closing relation to said conduit means and another position in open relation thereto, electro-mechanical actuating means operatively connected to said valve member for moving it from one to the other of its said two positions, and pre-adjusted fixed air vent means in said conduit means positioned between said valve member and said air chamber and in constant communication with said air chamber.

5. In a fuel device, the combination according to claim 4, said air vent means comprising an apertured portion in said conduit means communicating with the atmosphere, a vent-control valve adjustably positioned in relation to said apertured portion, and adjusting means for said valve.

6. In a fuel device, the combination according to claim 4, said air vent means comprising an apertured portion in said conduit means communicating with the atmosphere, a vent-control valve adjustably positioned in relation to said apertured portion, adjusting means for said valve, an air bleed casing through which said conduit means extends, said apertured portion communicating with the interior of said casing, said casing having an opening communicating with the atmosphere, said vent-control valve adjustably extending through said casing and having a manually manipulable outer portion and an inner operative portion in adjustable operative relation to said apertured portion.

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