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E. O. WIRTH ET AL
FUEL SYSTEM FOR STARTING

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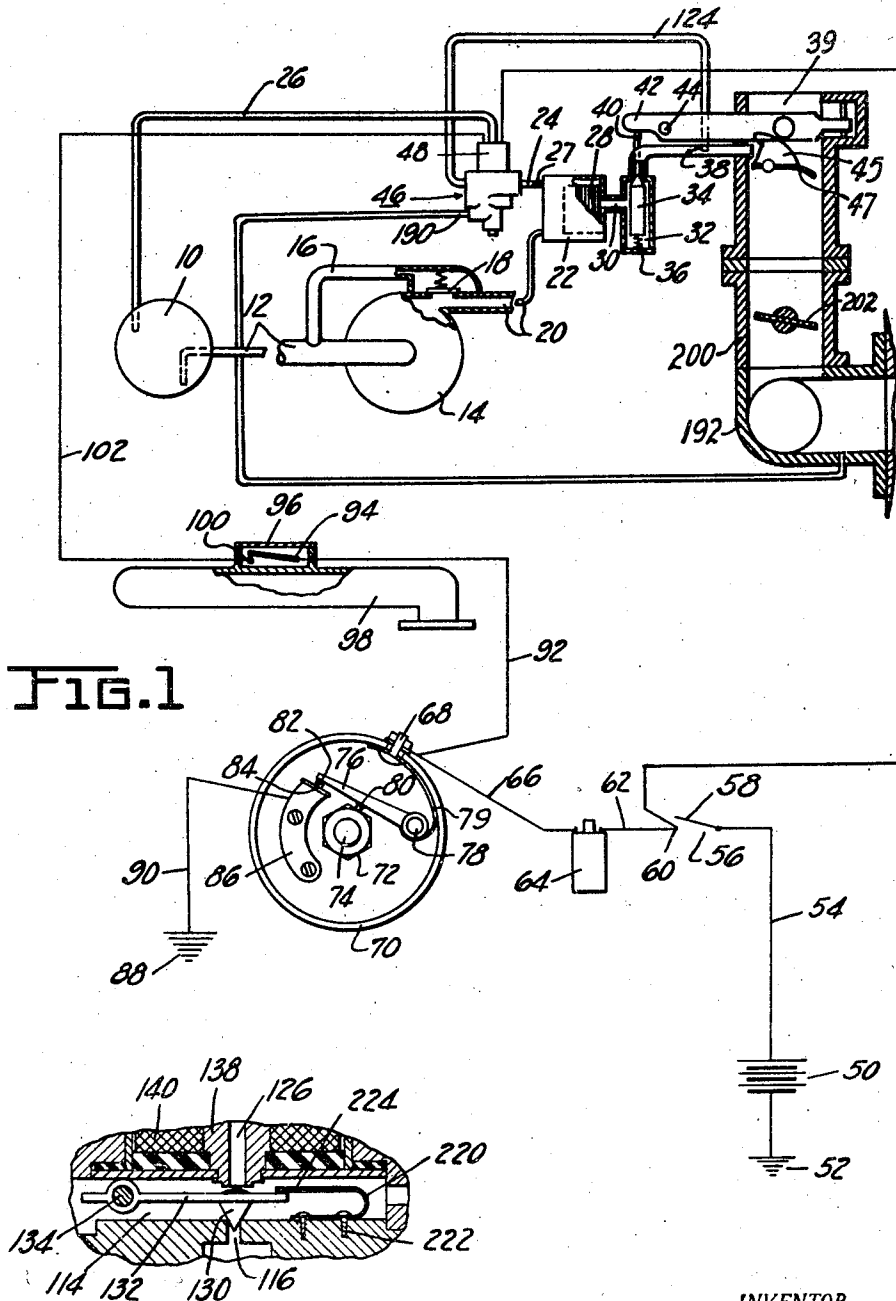


FIG. 1

FIG. 3

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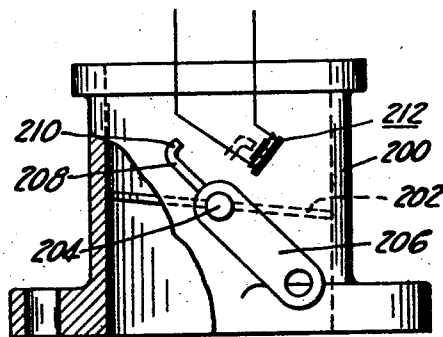
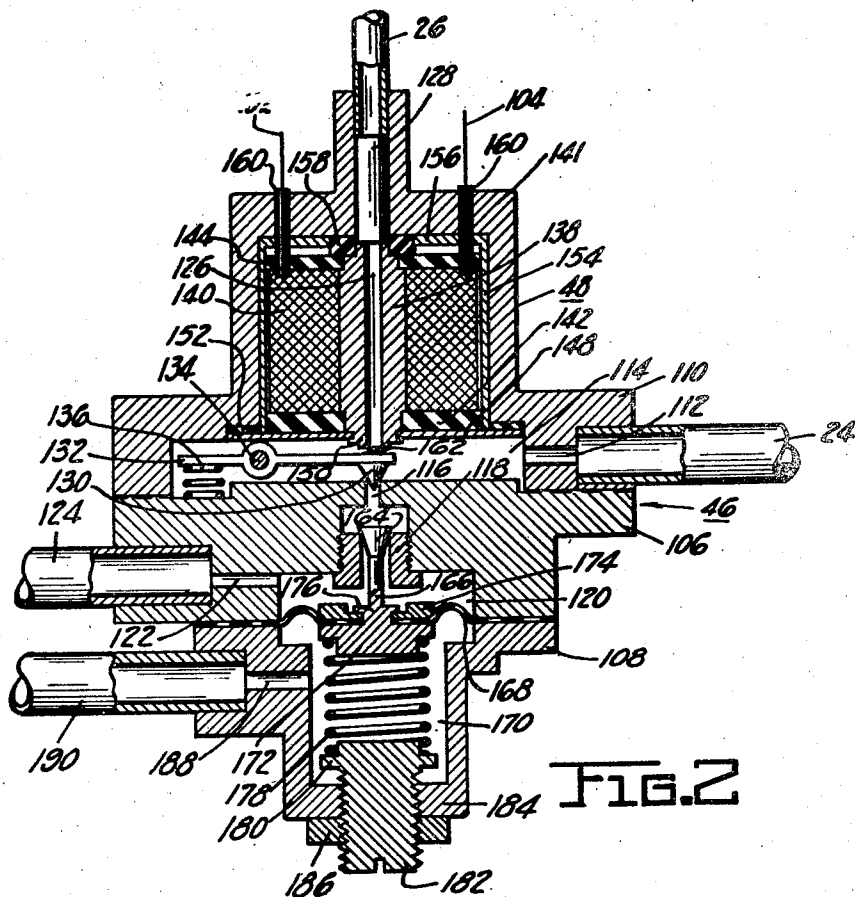


FIG. 4

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FUEL SYSTEM FOR STARTING

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29 Claims. (Cl. 123—180)

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This invention relates generally to fuel systems for internal combustion engines, and more particularly to means for supplying an auxiliary or supplemental quantity of fuel to meet the engine requirement under certain abnormal conditions of operation.

The present invention is shown as being used in connection with the fuel system disclosed in the application of Leibing and Fageol, Serial No. 533,848, filed May 3, 1944. While very valuable when applied to this type of fuel system, which will be hereinafter more particularly described, it is not limited to such use but is obviously available, with or without modification, in a great variety of cases where a supplemental quantity of fuel is desired.

As is well known, an internal combustion engine requires a richer fuel mixture for starting when the engine is cold than for operation at normal temperatures. In present day carburetors, enrichment for starting is generally effected by cutting down the quantity of air for the fuel mixture as by closing the choke valve of the carburetor. This method of securing mixture enrichment for starting a cold engine impairs the volumetric efficiency and makes cold starting more difficult. A more satisfactory method of securing such enrichment is accomplished by providing an additional or auxiliary quantity of fuel whereby a substantially unrestricted supply of enriched mixture may be secured. It is therefore, an object of the present invention to effect enrichment for such cold starting by the latter method.

Another object of the invention is to provide means to facilitate starting of the engine which will be automatic in its operation.

Another object of the invention is to provide a generally new and improved fuel system for automatically controlling the fuel to air ratio under cold starting and warming up conditions of the engine.

Further objects and advantages of the invention will be apparent to those skilled in the art, from the following description, taken in connection with the accompanying drawings, and skilled persons will understand that many variations may be made without departing from the principles disclosed, and we contemplate the improvement of any structures, arrangement, or modes of operation that are properly within the scope of the appended claims.

In the drawings:

Figure 1 is a diagrammatic view of a fuel system embodying the present invention;

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Figure 2 is an enlarged diagrammatic sectional view of the priming device;

Figure 3 is a sectional view of a temperature responsive fuel control which is adapted to vary the quantity of auxiliary fuel delivered to the carburetor; and

Figure 4 is a diagrammatic view of a deflooding arrangement which may be used in the present system.

The fuel system generally

The fuel system illustrated in the drawings comprises the usual fuel tank 10, connected by a conduit 12 to a fuel pump 14, of standard or known construction. The pump may be of the diaphragm type commonly used on present day automobiles, but for simplicity is shown as a centrifugal pump having a by-pass 16 leading from its outlet side back to the conduit 12 and controlled by a pressure responsive valve 18. Whatever the type of pump, it should supply fuel to the carburetor at a fairly constant pressure, and should preferably prevent flow through the line when the engine is not operating. Fuel pumps commonly used on automobiles and which supply fuel at a pressure of about five pounds per square inch, with variations of about 10 per cent plus or minus with varying engine speeds, are satisfactory for the purposes of this invention.

An outlet line 20 leads from the pump to a separating chamber 22, from the upper portion of which a return line, comprising conduits 24 and 26, conveys excess fuel, together with any vapor which may be present in the line, back to the tank 10. The conduit 24 may be provided, at its point of connection with the chamber 22, with a restriction 27 of such size as to permit pressure to be built up in the chamber. At the outlet of chamber 22 is a filter, preferably of the known type formed of a cylindrical pile of disks 28 wherein the fuel flows radially inwardly through apertures at the edge of the disks to an axial outlet passage and thence, in the illustrated embodiment, to passage 30. From the passage 30 the fuel passes into a chamber 32 in which a valve 34 is disposed and urged in the closing direction by a spring 36. The valve controls the flow of fuel to a fuel discharge nozzle 38 which discharges into the induction passage of a carburetor. In the present arrangement, the valve 34 is provided with a stem 40 which is adapted to be engaged by one end of a lever 42 pivoted at 44 and actuated by a cam 46 and a vane 47 disposed in the carburetor induction passage 39 and adapted to be actuated by air flow through said passage. Vane 47 which is pivoted on an off-

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center shaft anterior to the throttle valve is rotated in a clockwise direction by air flow in the induction passage, and, as a result, cam 45 which is carried by said vane and the lever 42 are moved in the direction to open fuel valve 34 to discharge fuel through nozzle 38 into the induction passage.

A primer, more fully described hereinafter but indicated generally at 46, is interposed in the return line between the conduits 24 and 26, the fuel entering said primer by way of the conduit 24 and normally leaving same by way of conduit 26.

Electrical control for the primer

The primer is provided with a solenoid, indicated generally at 48 in Figure 2, and more particularly described hereinafter, which is connected with the primary circuit of the engine ignition system. Generally such ignition systems include a storage battery 50 grounded at 52 and having a wire 54 leading to the ignition switch, generally indicated at 56, and having a movable switch member 58 adapted to engage a fixed switch contact 60. From the contact 60 a wire 62 leads to a spark coil 64 which is connected by a wire 66 with a terminal 68 secured in casing 70 of the distributor. Within the distributor is an interrupter cam 72 secured to a drive shaft 74. The cam may have any number of high spots or projections, depending on the number of cylinders of the engine, but in the present instance six are shown, the device being used in connection with a six-cylinder engine. The cam is adapted to contact a movable arm or lever 76 which is pivoted at 78 and is provided with a cam contact point 80 of fiber or other insulating material. The free end of the lever 76 carries a contact point 82 which is adapted to contact a fixed contact point 84 secured to an adjustable plate 86 which is connected with the ground 88 by a wire 90. The lever 76 is connected by a spring 79 with the terminal 68, said spring urging the lever counterclockwise or toward cam 72. A wire 92 is connected to the terminal 68 of the primary circuit and leads to a bi-metallic thermostatic element 94 which may be housed in a hot spot 96 of the engine exhaust manifold 98. Although the thermostat is shown as being housed in the exhaust manifold hot spot it may be located in any other suitable place which is subjected to the temperature of the engine. The bi-metallic element 94 is so arranged as to function as a switch and the free end of said element is adapted to engage a contact 100 when cold and to move away from said contact upon a rise in temperature beyond a predetermined value which is approximately normal engine operating temperature. The contact point 100 is connected to the solenoid 48 by a wire 102 and said solenoid is also connected with the contact point 60 of the ignition switch by a wire 104.

Primer

The primer 46 comprises a main body section 106, a lower section 108, and an upper section 110. Fuel from the conduit 24 enters the passage 112 in the upper section 110 and thence flows into a chamber 114 formed in the lower portion, as shown in the drawing, of the upper section. Priming fuel from the chamber 114 is adapted to flow through a passage 116 and a jet 118 secured in an enlarged portion of said passage 116. The fuel then is adapted to enter a chamber 120 in the lower portion of the main section 106 and thence flow through a passage 122 and enter a conduit 124 which is connected with the fuel

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nozzle 38. However, an independent auxiliary fuel discharge nozzle may be used if desired. When the primer is inoperative the fuel in chamber 114 is adapted to flow through passages 126 and 128 and thence into the conduit 26 which carries said fuel back to the tank 10.

Passage 116 is controlled by a valve 130 secured to the one free end of a lever 132, which lever is pivoted at 134 intermediate the lever's ends, and a spring 136, of proper calibration, is adapted to urge the opposite end of lever 132 in a clockwise direction for urging the valve 130 closed. The lever 132 and valve 130 are of suitable magnetic material such as iron and the pivot pin 134 is preferably of brass or other suitable non-magnetic material. The spring 136 should also be of non-magnetic material or, if it is of a magnetic material, it should be insulated either from the lever 132 by a washer or the like, or insulated from the main body section 106 against which it is adapted to react.

The valve 130 is adapted to be actuated by the solenoid 48 which has an iron core 138 through which the passage 126 extends. The solenoid coil 140 is wound about the iron core 138, said coil being disposed in the housing 141 formed by a portion of the upper section 110. At the ends of the coil 140 are fiber washers 142 and 144 respectively, the latter being at the upper end of said coil. These washers are press fitted onto the core 138. Adjacent the lower end of the coil is a brass plate 146 which is also press fitted onto the core 138 and secured thereon by overturning an end portion 150 of said core. The plate 146 is also press fitted into a recess of the section 110 adjacent the chamber 114 and a neoprene gasket 152 is interposed between said plate 146 and the bottom of the recess. The coil is encased in an iron housing 154 closed at its upper end 156 and open at its lower end. The lower end of the housing 154 sealably receives the fiber washer 142 and a fiber washer 158 is sealably received in an opening provided therefor at the end 156 of the iron housing and is also in sealable engagement with a shoulder and reduced end portion of the core 138, there being a central opening in said washer 158 which is in register with the passage 126. The wires 102 and 104 extend through the housing 141 in insulating conduits 160 which are snugly fitted into openings provided therefor in the housing 141, the housing 154 and washer 144. The purpose of the foregoing construction, relative to the solenoid is to adequately seal the coil against the entrance of fuel and also to provide for relatively powerful magnetic impulses for actuation of the valve 130. It is to be noted that the valve 130 is tapered downwardly and cooperates with the entrance of the passage 116 for controlling said passage. The upper end of valve 130 is somewhat convex at 162 and this portion 162 is adapted to cooperate with the adjacent end of the passage 126 which is in substantial alignment with the passage 116.

The jet 118 is controlled by a valve 164 having a stem 166 which is connected with a diaphragm 168 which forms one wall of the chamber 120. The diaphragm is marginally clamped between the main section 106 and the lower section 108 which contains a chamber 170 therein opposite the chamber 120. The stem 166 is shown as being formed integrally with a spring retainer 172 on the side of the diaphragm opposite the valve although it may be a separate piece secured to said retainer. On the valve side of the diaphragm 168

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a washer 174 is provided in clamping association with the diaphragm and is held in position by an overturned portion 176 of the retainer 172. A spring 178 is disposed in the chamber 170 and reacts between the spring retainer 172 and a spring retainer 180 of an adjustment screw 182 which is threadably received in an opening in the lower wall 184 of the lower section 108. A lock nut 186 is received on the screw 182 for securing same in adjusted position. The chamber 170 has a passage 188 which is connected with a conduit 190 leading to the engine intake manifold 192 thus the chamber and consequently the diaphragm 168 are subjected to manifold vacuum (posterior to the throttle valve) or engine charging pressure. It is to be noted that the valve 164 is of the reverse type and that the spring 178 urges said valve in the opening direction while the manifold vacuum urges the valve in the closing direction.

Operation

Assuming the engine is to be cranked when cold, the free end of thermostat 94 will be in contact with the point 100 to provide an electrical connection between the wire 92 and the wire 102. The valve 164 will be urged to relatively wide open position by spring 178 and the valve 130 will be urged to the closed position by the spring 136.

To start the engine the ignition switch 56 is closed as well as the starter switch not shown. The starter motor will begin to crank the engine and as the pistons start to reciprocate they will pump the normal fuel mixture into the cylinders and effect such movement of the vane 47 in the induction passage which actuates lever 42 as to effect opening of the fuel valve 34. Simultaneously the pump 14 will supply fuel through conduit 20, chamber 22, filter 28, conduit 30, chamber 32 and fuel nozzle 38. With the valve 130, Figure 2, in the position shown excess fuel would be carried by the return line 24, through conduit 112, chamber 114, passage 138 and conduits 128 and 26 and delivered to the fuel tank 10. However, as the engine is cranked, the distributor interrupter cam 72 will be rotated, by shaft 74, and effect a making and breaking of the contact points 82 and 84. Each time there is a making of said contact points there will be an electrical impulse to the solenoid which will become energized and effect a counterclockwise movement of the lever 132, thus opening the valve 130 and closing the adjacent end of the conduit 126. Excess fuel is then diverted from the return conduit 26 into the passage 116, orifice 118, chamber 120, passage 122 and thence into the conduit 124 which carries said fuel to the fuel nozzle 38, posterior to valve 34, from which it is discharged into the induction passage. Thus an auxiliary or supplemental supply of fuel is delivered to the induction passage to enrich the fuel mixture delivered to the engine. The quantity of the supplemental fuel delivered to the engine is varied in accordance with manifold vacuum or engine charging pressure to which the diaphragm 168 is subjected, said vacuum being adapted to draw said diaphragm downwardly, as shown, and effect restricting movement of the valve 164.

As the cam 72 rotates directly in accordance with engine speed it will be obvious that as the speed of the engine increases, as when the engine begins to fire or is accelerated the more frequently will be the electrical impulses to the solenoid and consequently the valve 130 will be

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opened with greater frequency, corresponding to the increased speed of the engine. The auxiliary fuel will continue to be supplied to the engine as long as the temperature of the engine is below a predetermined value but when said temperature exceeds said value the free end of the bi-metallic thermostat 94 will move in a direction to break the connection between wires 92 and 102, whereupon the valve 130 will be closed by spring 136 and retained in said position and the passage 126 will be opened and will remain open. Overflow of fuel will then be carried back to the fuel supply tank 10 by conduit 26 as long as the engine is operating at normal temperatures.

During the warming up period of the engine, when the thermostat switch 94 is closed, the valve 164 will control the metering orifice of the jet 118 in accordance with manifold vacuum. When the manifold vacuum is high the valve will be more nearly closed than when the vacuum is low. Thus should the throttle valve be opened, as for acceleration of the engine, a greater supply of auxiliary fuel will be provided than when the engine is idling. This is a desirable feature in securing proper acceleration of the cold engine.

It is to be noted that the possibility of flooding the engine cylinders with excessive quantities of fuel, such as would prevent the engine from starting, is minimized by arranging the solenoid circuit in such a way that when the ignition switch is open the solenoid circuit is also open and no auxiliary fuel will be supplied to the engine. Consequently only the normal quantity of fuel will be supplied and in most cases flooding will not occur.

It is also desirable to control the quantity of auxiliary fuel delivered to the engine in accordance with engine temperature conditions. For example, when the engine is started cold a greater ratio of fuel for the fuel mixture is generally required than when the engine is warmed up and it is desired to supply the auxiliary fuel in such a manner as to progressively decrease the quantity thereof as the engine warms up.

In the present invention such control of the auxiliary fuel is provided by a thermostatic device which, as shown, comprises a bi-metallic thermostat element 220, Figure 3, having a substantially U-shaped form located in the chamber. The thermostat is positioned horizontally, as shown in the drawing, and the lower arm is attached to the upper face of the main section 106 by screws 222. The other arm, 224, extends over the adjacent free end of lever 132. When the thermostat is cold the arms thereof separate and as it warms up the free end of the upper arm 224 moves downwardly. When the engine is cold the upper arm of a thermostat is adapted to move to a position whereat movement of the lever 132 is unrestricted by the thermostat so that the maximum quantity of auxiliary fuel is supplied to the engine when the primer is operating. As the thermostat warms up the upper arm 224 moves downwardly and limits opening movement of the valve 130 in accordance with the temperature of the fuel which reflects engine temperature. When the engine has fully warmed up the fuel in chamber 114 reaches a temperature of such value as to cause the thermostat 220 to retain the valve securely in a fully closed position. At this time, of course, the thermostatic switch 94 opens so that a solenoid is rendered inoperative.

However, if desired, as an additional precaution, means for effecting deflooding of the engine may be provided, such an arrangement being

shown in Figure 4. In this figure there is shown a throttle body 200 having a throttle 202 located therein and mounted on a throttle shaft 204 to which is attached the usual throttle lever 206 which is adapted to be connected by suitable linkage with the accelerator pedal, not shown. In Figure 1 throttle body 200 is shown mounted on intake manifold 192. The throttle lever 206 is provided with an extension 208 having a laterally turned portion 210 which is adapted to be moved to a position to engage and open a normally closed switch, indicated generally at 212, which is interposed in the solenoid circuit. The switch is so located that it will be opened upon movement of the throttle in the opening direction beyond a predetermined position. When the engine is cold, the primer would ordinarily supply auxiliary fuel, when the switch is closed, in the manner above described but when said switch is open the primer will be rendered inoperative and no supplemental fuel will be supplied. Thus, with the switch open, the engine may be cranked to effect deflooding, large quantities of air being drawn into the cylinders due to the relatively wide opening of the throttle.

While the foregoing arrangement has been shown and described in connection with a particular type of fuel system it is to be understood that said invention may also be used in connection with many other types of pressure fuel systems for supplying an auxiliary or supplemental fuel to the engine for starting and warming up of same. For example, in a fuel system having a float type of carburetor the auxiliary fuel is supplied by the pump and delivered to the induction passage under the control of the primer. In using the primer arrangement of the present invention it is unnecessary for the carburetor to have a choke valve with its controls which are manual or automatic in operation.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinabove described being merely a preferred embodiment.

We claim:

1. In an auxiliary fuel system for an internal combustion engine having an ignition system: a source of fuel under pressure; a conduit connecting said source with the engine; a valve for controlling said conduit; electrical means for controlling said valve; and a circuit connecting the electrical means with a circuit of the ignition system whereby the operation of said valve is controlled in accordance with the speed of the engine.

2. The invention defined by claim 1 wherein the first mentioned circuit is connected with a primary circuit of the ignition system.

3. The invention defined by claim 1 wherein the ignition system includes a switch and the first mentioned circuit is controlled by the ignition switch.

4. The invention defined by claim 1 wherein the ignition system includes a distributor having a cam; a breaker arm operated by the cam for making and breaking the primary circuit; and the first mentioned circuit is connected to the ignition circuit in such a way that every time the primary circuit is made an electrical impulse is supplied to the electrical means.

5. The invention defined by claim 1 wherein the ignition system includes a distributor having a cam; a breaker arm operated by the cam for making and breaking the primary circuit; the first mentioned circuit being connected to the ignition circuit in such a way that every time the breaker arm moves to a position to complete the ignition circuit an electrical impulse is supplied to the electrical means; and a thermostat located in a position whereat it is responsive to engine heat for controlling said first mentioned circuit.

6. The invention defined by claim 1 wherein there is an induction passage controlled by a throttle; and a switch for the first mentioned circuit controlled in accordance with throttle position, said switch being opened upon opening of the valve beyond a predetermined position.

7. The invention defined by claim 1 wherein there is a temperature responsive device variably limiting movement of the valve.

8. The invention defined by claim 1 wherein there is a second valve for regulating the flow of auxiliary fuel; and means for controlling said second valve in accordance with manifold vacuum.

9. In a fuel system for an internal combustion engine having an ignition system: means for supplying fuel to the engine under superatmospheric pressure; an auxiliary fuel supply conduit receiving fuel from said means and adapted to deliver auxiliary fuel to the engine; means including a valve, for controlling the supply of auxiliary fuel; an electric coil for operating said valve; and an electric circuit so connecting the coil with the ignition system that the coil will be energized with a frequency depending upon engine speed.

10. The invention defined by claim 9 wherein the ignition system includes a primary circuit to which the coil is connected.

11. The invention defined by claim 9 wherein the ignition system includes a distributor having a circuit; a contact lever for making and breaking the distributor circuit and a cam for operating said lever; and the connection for the coil is with the distributor circuit whereby an electrical impulse is transmitted to the coil upon each making of the distributor circuit.

12. The invention defined by claim 9 wherein there is a temperature responsive switch controlling the coil.

13. The invention defined by claim 9 wherein the degree of movement of the valve is controlled by a temperature responsive device.

14. The invention defined by claim 9 wherein the supply of auxiliary fuel is also regulated by a second valve; and there is means responsive to engine charging pressure for controlling said second valve.

15. The invention defined by claim 9 wherein there is a temperature responsive device for controlling the valve; and there is vacuum operated means for regulating the quantity of auxiliary fuel supplied to the engine.

16. In an internal combustion engine: means for supplying fuel for the fuel mixture at a substantially constant superatmospheric pressure; a return conduit for conveying a limited quantity of fuel to said means; an ignition system; a conduit for conveying the return fuel to the engine as an auxiliary fuel supply for the engine fuel mixture; means for controlling the auxiliary supply; electrical means for controlling the last mentioned means; and means for connecting the electrical means with the ignition system.

17. In an internal combustion engine having an ignition system including a distributor in the primary circuit, said distributor including a contact lever controlled by a cam whereby the primary circuit is made and broken: a main fuel supply system; an auxiliary fuel supply system; a primer controlling the auxiliary system; a valve for said primer; a solenoid for actuating said valve; and an electric circuit connecting the solenoid with said distributor for intermittently energizing said solenoid while said primer is in operation.

18. The invention defined by claim 17 wherein there is temperature responsive means for controlling the solenoid circuit.

19. The invention defined by claim 17 wherein the engine includes a throttle for controlling the fuel mixture supplied thereto and there is a switch in the solenoid circuit adapted to be controlled in accordance with throttle position.

20. The invention defined by claim 17 wherein there is a thermostat controlling the primer valve.

21. The invention defined by claim 17 wherein the supply of auxiliary fuel is also regulated by engine charging pressure.

22. In a fuel system for an internal combustion engine having an ignition system including a primary circuit and a distributor therefor having a circuit breaking device controlled by a cam: a source of fuel; a pump for supplying fuel to the engine at a substantially constant predetermined superatmospheric pressure; a return line connected with said pump for returning at least a limited quantity of fuel back to the source; a primer, including a conduit, interposed in the return line and adapted to divert fuel flowing therethrough to a point for enriching the engine fuel mixture, said primer having a valve which alternately closes the return line and opens the conduit; and a solenoid connected with the primary circuit of the ignition system and adapted to actuate said valve.

23. The invention defined by claim 22 including means for regulating the flow of fuel through

the conduit, and means for controlling the regulating means in accordance with suction.

24. The invention defined by claim 22 including a thermostat adapted to urge the valve in the closing direction upon an increase in engine temperature.

25. The invention defined by claim 22 including temperature responsive means for controlling said valve; and means responsive to engine charging pressure for regulating the flow of fuel through the conduit.

26. In a priming device for supplying fuel to an internal combustion engine: an inlet and first and second outlets; a valve for controlling the outlets; yielding means urging the valve to a position whereat one of the outlets is closed; and electrical means for urging the valve to a position whereat the other outlet is closed.

27. The invention defined by claim 26 wherein there is means for intermittently energizing the solenoid for varying the quantity of fuel supplied through the outlet in accordance with engine speed.

28. The invention defined by claim 26 wherein there is means adapted to be responsive to engine charging pressure for regulating the fuel flow through said other outlet.

29. The invention defined by claim 26 wherein there is means for intermittently energizing the electrical means whereby the number of times said means is energized will increase with engine speed; and means for regulating the flow of fuel through the other outlet in accordance with manifold vacuum.

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The following references are of record in the file of this patent:

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Number	Name	Date
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