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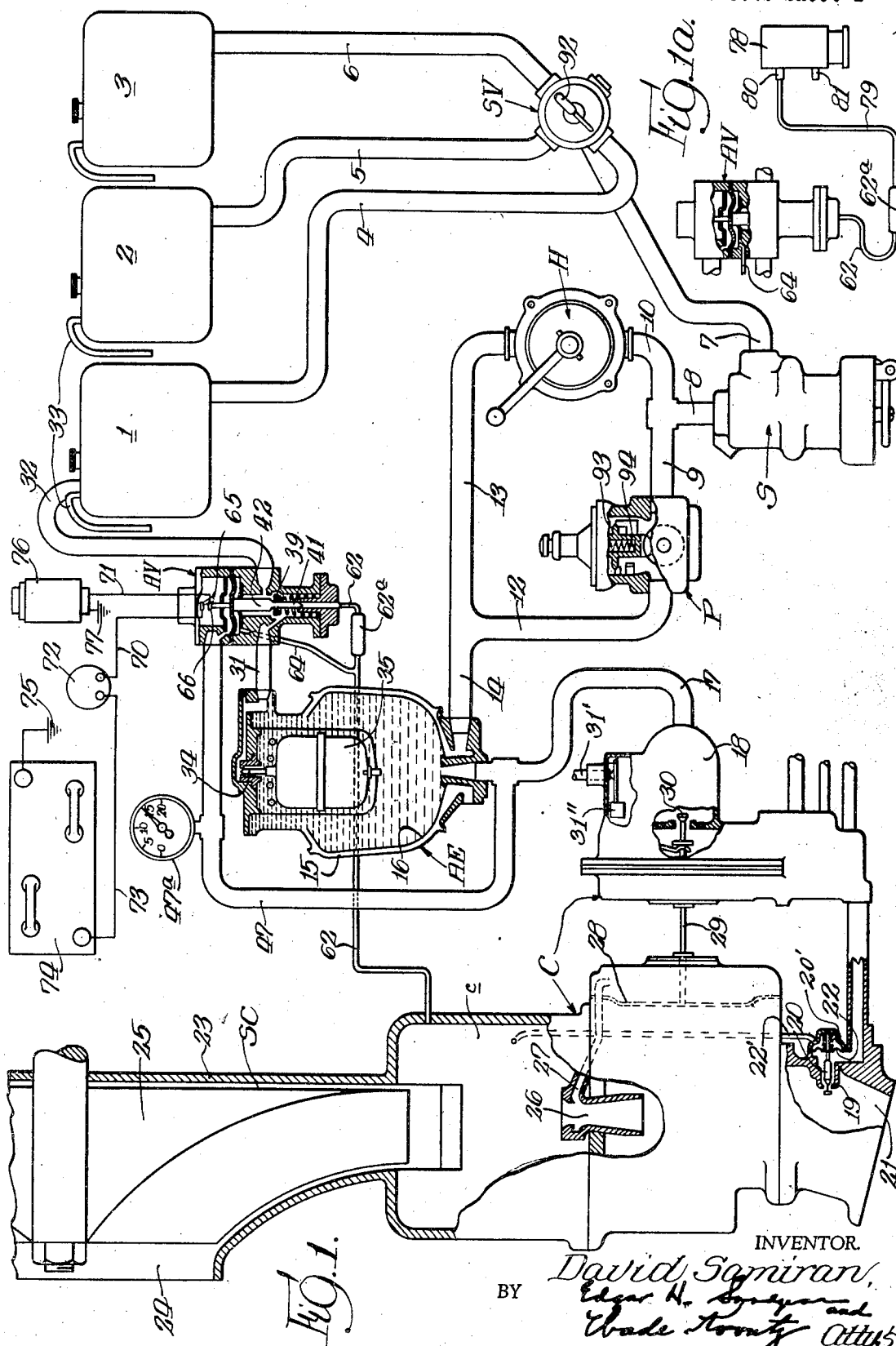
'D. SAMIRAN

2,334,220

FUEL SYSTEM

Filed Dec. 13, 1940

3 Sheets-Sheet 1



Nov. 16, 1943.

D. SAMIRAN

2,334,220

FUEL SYSTEM

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3 Sheets-Sheet 2

Fig. 2.

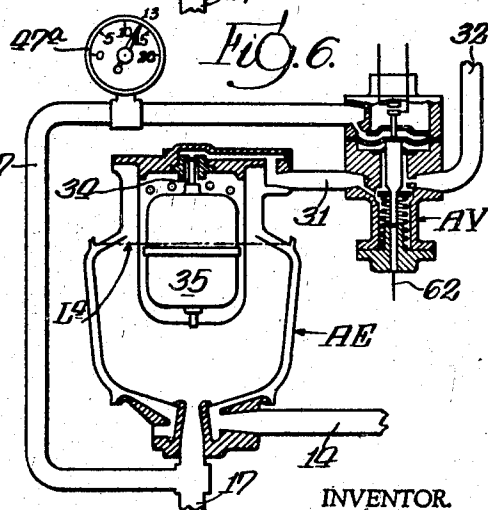
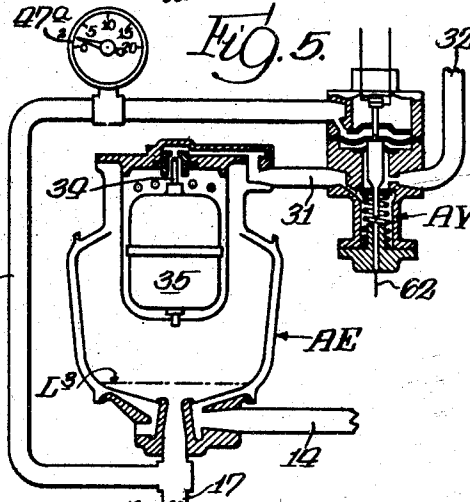
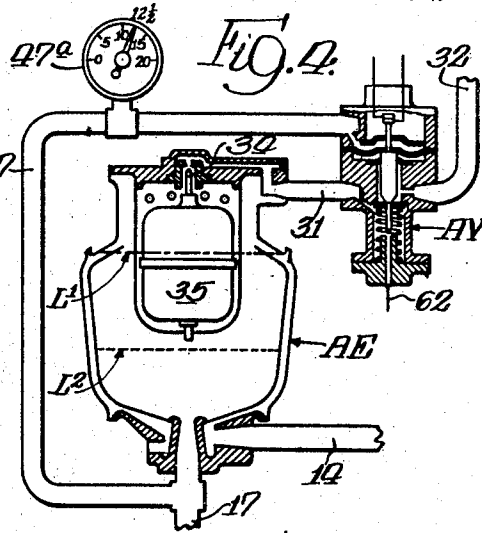
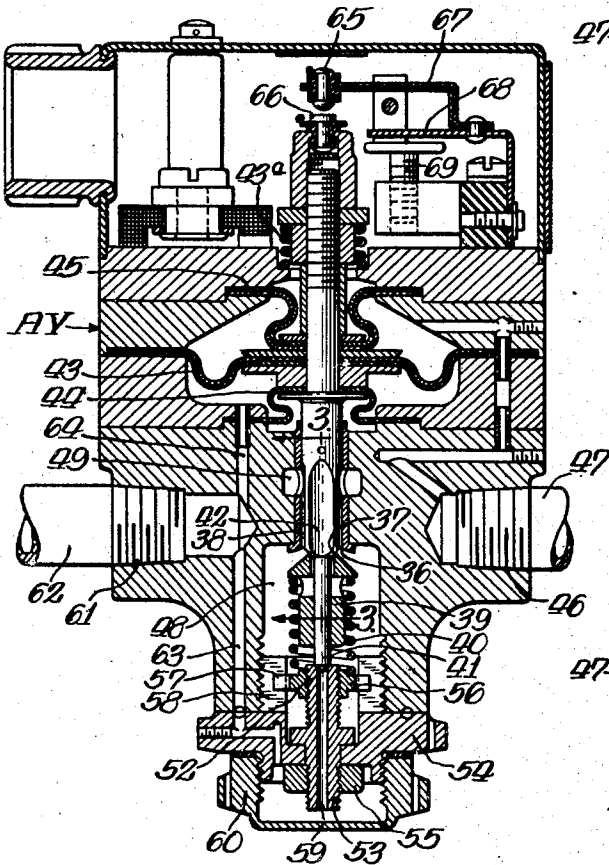
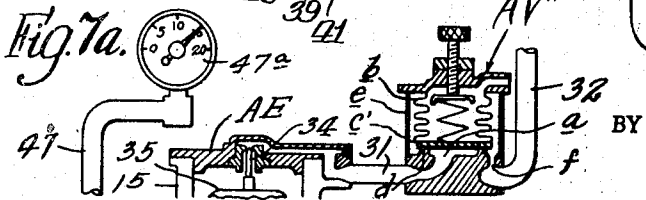
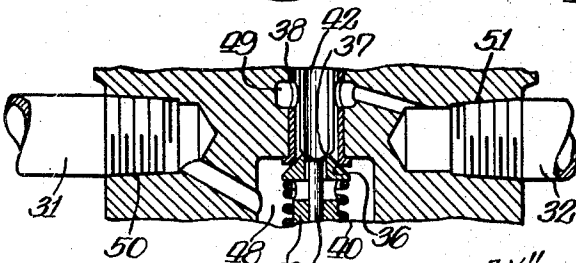


Fig. 3.



INVENTOR.

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Nov. 16, 1943.

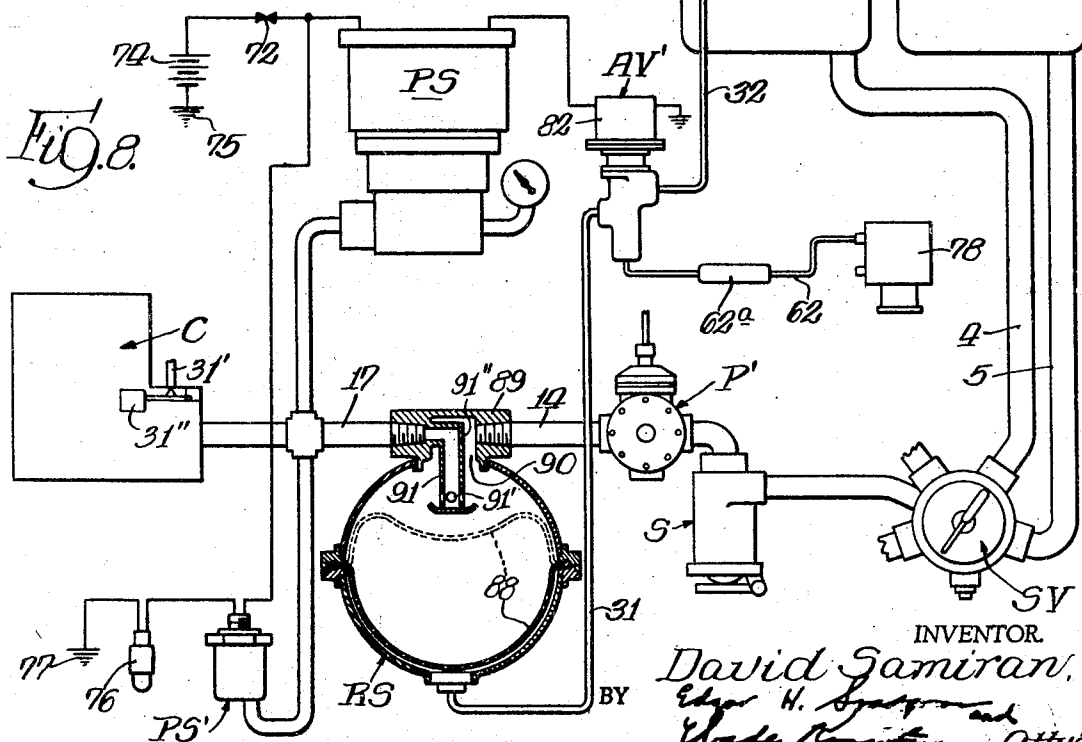
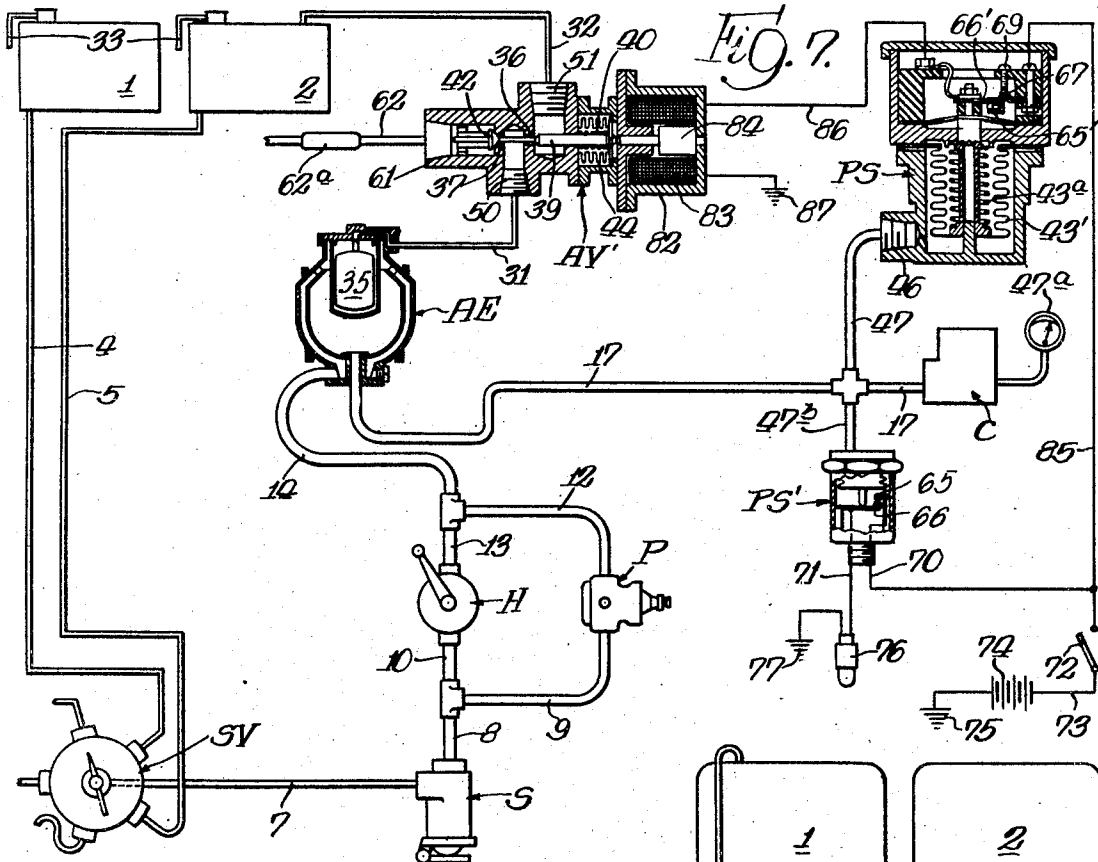
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2,334,220

FUEL SYSTEM

Filed Dec. 13, 1940

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,334,220

FUEL SYSTEM

David Samiran, Fairfield, Ohio

Application December 13, 1940, Serial No. 370,027

22 Claims. (Cl. 158—36)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

My present invention relates to a fuel system of the type wherein a high pressure carburetor is supplied with fuel through a selector valve from a plurality of fuel tanks.

One object of the invention is to provide a system wherein the failure of fuel from one of the selected tanks will not cause faltering of the supply of fuel to the carburetor, a reserve supply of fuel being provided between the fuel pump and the carburetor for this purpose, and automatic mechanism being provided to displace the fuel from the reserve chamber with a pressure sufficient to properly operate the carburetor during the change-over period from an empty tank to one containing fuel.

Another object is to provide a system of the general character above mentioned wherein an air eliminator (for eliminating air and vapor from the fuel supplied to the carburetor), such as the type shown in my copending application Serial No. 335,646, filed May 16, 1940, and having a reserve fuel chamber may be utilized to displace the reserve fuel therefrom during the change-over period by providing an air pressure control valve in connection with the air eliminating vent of the air eliminator.

Another object is to provide a fuel system wherein air pumped by the fuel pump after the fuel from one tank fails may be utilized as the means to displace the reserve supply of fuel with sufficient pressure to operate the carburetor, although at a pressure somewhat lower than normal, with an immediate return of the pressure to normal when fuel is subsequently received by the fuel pump from another fuel tank.

Still another object is to provide a system for supplying fuel continuously to a high pressure carburetor during momentary fuel failure from the primary supply source, which provides supplemental fluid pressure for the displacing operation of the fuel from the reserve chamber when air is pumped to the reserve chamber by the fuel pump.

A further object is to provide a modification of the system wherein a reserve fuel chamber receives fuel initially from the fuel pump before such fuel passes to the carburetor, and such chamber is arranged for displacement of the fuel therefrom at carburetor operating pressure whenever the fuel pressure drops as a result of failure of fuel to the fuel pump.

Still a further object is to provide a warning signal which becomes operative at a fuel pressure below normal, but such pressure being slightly above that which obtains in the fuel reserve chamber when air instead of fuel is pumped thereto, such warning signal thereby immediately indicating any increase in fuel pressure as caused by a subsequent supply of fuel to the fuel pump and before the pressure in the fuel delivery line reaches normal.

Further objects and advantages of my present invention will become apparent after a perusal of the following description when taken in connection with the accompanying drawings, it being clearly understood that said drawings are by way of illustration and example only and are not to be taken as in any way limiting the spirit or scope of the invention. It is further understood that the spirit and scope of my present invention is to be limited only by the prior art and by the terms of the claims appended hereto.

With reference to the drawings, wherein similar characters designate similar parts throughout the several views:

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

Figure 1a is a diagrammatic view of an air pressure control valve of my system showing a slight modification with respect to Figure 1;

Figure 2 is a vertical sectional view through an air pressure control valve which is an important unit of the system;

Figure 3 is a sectional view on the line 3—3 of Figure 2;

Figures 4, 5 and 6 are diagrammatic views of a reserve fuel chamber and the air pressure control valve of my fuel system showing different steps in the operation thereof;

Figure 7 is a diagrammatic view of a modified system in which I provide an electrically operated air pressure control valve;

Figure 7a is a fragmentary view of another modification, and

Figure 8 is another diagrammatic view showing a further modification, particularly with respect to the reserve fuel chamber.

On the accompanying drawings, the fuel system shown in Figure 1 includes a high pressure carburetor C to which fuel is normally supplied by a fuel pump P. The fuel pump P is adapted to receive fuel from a selector valve SV, which valve is connected with a plurality of fuel tanks indicated at 1, 2 and 3.

The selector valve SV has a plurality of inlets communicating by means of conduits 4, 5 and 6

with the tanks 1, 2 and 3. The valve SV may be manually operated or may be automatically operated, as disclosed in my copending application Serial No. 348,969, filed July 31, 1940. The selector valve includes an outlet conduit 7 leading through a strainer S to the intake of the pump P by means of conduits 8 and 9. A branch conduit 10 also leads to the intake of a hand pump H adapted to be operated manually in case of fuel failure. The fuel pump is suitably driven as from the engine of an airplane or other structure in which the fuel system is used.

Outlet conduits 12 and 13 lead from the pumps P and H through a conduit 14 to an air eliminator AE. The air eliminator AE includes an outer bowl 15 and an inner bowl 16, with the conduit 14 communicating with the space between the bowls. Accordingly fuel entering through the conduit 14 must rise around the bowl 16 and overflow its upper edge before entering the bowl 15 which serves the purpose of holding a reserve supply of fuel.

An outlet pipe 17 leads from the bottom of the bowl 16 to an intake housing 18 of the carburetor C. The carburetor C includes a jet or nozzle structure having a nozzle tip 19 and a needle valve 20 normally seated in the nozzle to prevent fuel flow into the fuel mixture passageway 21 of the carburetor leading to the intake manifold of the engine. The needle valve 20 is spring seated with the spring set so that fuel pressure on a diaphragm 22 will open the jet whenever the fuel pressure exceeds a predetermined pressure. Present type high pressure carburetors begin to operate at about six pounds' pressure. The chamber 20' is communicatively connected with the intake manifold at the input side of the carburetor through a conduit 22' to maintain the spring pressure on the diaphragm constant with relation to the intake manifold pressure.

The carburetor C also includes a vent 31' controlled by a float 31'' and further includes a supercharger SC having a casing 23 provided with an intake 24 and a rotor 25 suitably driven from the airplane engine. The supercharger SC delivers air at substantially constant sea level pressure to a chamber c at the input side of the carburetor, the supercharged air passing around and through a venturi 26 to the fuel mixture passageway 21. The pressure through the venturi 26 is communicated by a passageway 27 to a control diaphragm 28 operable through a stem 29 to control a valve 30 within the housing 18. The valve 30 in turn meters the flow of fuel to the jet 19.

The air eliminator AE includes a vent passageway 31 leading through a vent conduit 32 to the space in one of the fuel tanks, such as 1, above the fuel therein. The tanks are also provided with vent tubes 33 leading to atmosphere.

For normally controlling the flow of eliminated air through the conduits 31 and 32, the air eliminator AE has a float operated vent valve 34, the float of which is indicated at 35. The float 35 is responsive to the level of fuel in the inner bowl 16 of the air eliminator.

Interposed between the conduits 31 and 32, I provide an air pressure control valve AV which will now be described in detail. The valve AV comprises a valve body having therein a first valve seat 36 and a second valve seat 37. The valve seat 36 is formed in a stationary sleeve 38, while the valve seat 37 is formed in a floating sleeve 39. The sleeve 38 is adapted to seat against

the seat 36 under the bias of a spring 40. A valve stem 41 extends through the sleeve 38 and has an enlarged part 42 adapted to be seated against the seat 37.

Connected with the portion 42 of the valve stem 41 is an actuating diaphragm 43. The space below the diaphragm 43 is sealed by a sealing diaphragm 44 and the space above the diaphragm 43 is sealed by a sealing diaphragm 45. The space between the diaphragms 43 and 45 is subjected to fuel pressure introduced into an inlet 46 of the body of the valve AV from a conduit 47 leading to the fuel delivery line 17 from the air eliminator AE to the carburetor C. The fuel pressure from the conduit 47 tends to force the diaphragm 43 downwardly against the action of a spring 43a. A pressure gauge 47a may be located in the line 47 if desired. Fuel pressure at the normal operating pressure for the carburetor C (for instance about fifteen pounds) acts upon the top of the diaphragm 43 with sufficient force to keep the valve sleeve 38 off the seat 36 to thereby permit free flow of air from a chamber 48 within the valve AV to a second chamber 49 therein. The chamber 48, as shown in Figure 3, communicates with an inlet 50, while the chamber 49 communicates with an outlet 51. The inlet 50 is connected to the conduit 31, while the outlet 51 is connected to the conduit 32.

The lower end of the valve stem 41 under normal fuel pressure seats against a valve seat 52 formed in a sleeve 53. The sleeve 53 extends through and is gasketed relative to a head 54 on the lower end of the body of the valve AV. A lock nut 55 normally retains the sleeve 53 against rotation.

A nut 56 is threaded on the inner end of the sleeve 53 and serves as a follower for the spring 40, the spring being interposed between this follower and the head of the sleeve 39. The nut 56 is provided with a pair of lugs 57 slidable in slots 58 to prevent rotation of the nut but permit axial movement thereof relative to the sleeve 53 when the sleeve is rotated for the purpose of adjusting the tension of the spring 40. Such rotation is possible after the lock nut 55 is loosened and a screwdriver may then be associated with a slot 59 in the lower end of the sleeve for effecting such adjustment. A closure nut 60 is provided for the head 54 after adjustment has been made.

The valve stem 41 controls the introduction of pressure into the chamber 48 from an inlet 61 of the valve AV, which inlet is connected by a conduit 62 to the high pressure side of the supercharger SC. A check valve 62a is preferably located in the conduit 62, opening toward the inlet 61. A passageway 63 is provided in the body of the valve AV for communicating pressure in the inlet 61 to the interior of the sleeve 53. A second passageway 64 leads from the inlet 61 to the space between the diaphragms 43 and 44 to compensate the operation of the air pressure control valve AV when the airplane engine is supercharged. In the event that it is not supercharged, then the space between the diaphragms 43 and 44 would be open to atmosphere and the passageway 63 would be closed to prevent escape of air pressure from the chamber 48.

The air pressure control valve AV further includes a signal switch having circuit controlling contacts 65 and 66. The contact 65 is carried by a bimetal element 67 anchored to a bracket 68. The contact 66 is carried by the upper end of

the valve stem 41. The point of contact making and breaking with respect to the position of the valve stem 41 may be adjusted by means of an adjusting screw 69. This screw 69 is effective to bend the bracket 68 upwardly to a greater or less degree as desired, depending on the position of the contact 66 in relation to the position of the valve member 39 during operation of the system, as will be hereinafter described.

The contacts 65 and 66 are connected with wires 70 and 71. The wire 70 extends from a control switch 72, to which current is supplied by a wire 73 from a battery 74 or any suitable source of current supply. One side of the battery is grounded as at 75. The wire 71 connects with one side of a warning signal light 76, the other side of which is grounded at 77.

In Figure 1a, I show a slight modification wherein the valve sleeve 53 is supplied with supplementary fluid pressure, such as air under pressure from a pump 78 of the vacuum system of the airplane. The check valve 62a is connected by a conduit 79 with the pressure connection 80 of the pump 78 instead of to the supercharger SC. The pressure connection 80 is normally utilized for operating the wing de-icers, and the pump 78 is usually of the vacuum type with its vacuum connection at 81 connected with the various navigating instruments for operating them. The pump 78 is usually engine-driven.

In Figure 7, I show a modified system wherein a solenoid operated air pressure control valve AV' and a fuel pressure responsive switch PS take the place of the valve AV in Figure 1. Some of the parts in Figure 7 are similar to those in Figure 1 and accordingly bear the same reference numerals. The parts which are different, or in addition to Figure 1, will now be described specifically.

A solenoid casing 82 is mounted on the body of the valve AV' and encloses a solenoid coil 83. An armature or plunger 84 is adapted when the coil 83 is energized to force the stem 39 against the seat 36 and the valve 42 away from its seat 37, against the tension of the spring 40.

For energizing the solenoid coil 83, the bellows 43' of the fuel pressure responsive switch PS is expanded by the spring 43a which brings the slidably movable contact 66' into engagement with the stationary contact 65' carried by the compensating bimetal 67.

The switch PS is supplied with current for operating the solenoid coil 83 through wires 85 and 86 and a ground connection at 87.

Since the switch PS is provided for the purpose of operating the valve AV' and it is desirable to have a signal lamp operate at a slightly higher pressure, a second fuel pressure responsive switch PS' is provided, having make and break contacts 65 and 66, set for closure at a slightly higher pressure than the switch PS. The pressure switch PS' is set so that make and break of the contacts therein takes place within the range of change in pressure with change in the nature of the fluid (air or fuel) supplied by the pump to the air eliminator. That is to say, if the pump is pumping fuel and, by reason of the depletion of the fuel in one of the tanks with which the pump is communicatively connected, a change of fluid supply takes place—that is, air is fed—then there will result a drop in pressure in the line from the pump to the point of ejection of the fuel from the carburetor into the manifold by reason of the fact that the rate of supply of volume of air is insufficient to main-

tain the pressure in the line between the pump and the carburetor previously established by the rate of volume supply of fuel. Likewise, when the pump again begins to pump fuel, there will be an increase in the rate of supply of fluid volume, with a consequent small increase in pressure which, according to practical demonstration, is about one-half of one pound. It is desired to take advantage of this small change in pressure to indicate the instant when there is a change from air to fuel supplied by the pump so that there will be practically no delay in signalling to the pilot that the fuel cock is in registry with a fuel-containing tank. The signal lamp 76 is connected in the circuit by the wires 70, 71 and the ground connection 77.

In Figure 7a I show a modified system within which the pressure control valve AV'' takes the place of the valve AV in Figure 1 with the air vent 31' provided in the carburetor C as in Figure 1.

The air pressure control valve AV'' is predeterminedly adjusted to limit the pressure in the air vapor eliminator to a value at which it is desired to feed the fuel from the air eliminator to the carburetor. If the pressure in the air eliminator which is communicatively connected to the air chamber a of the pressure control valve exceeds the desired value—say about twelve pounds—then the bellows b and valve c carried thereby will leave the seat d of the air pressure control valve housing e to permit the escape of air through outlet f and tube connection 32, to tank 1. When the air pressure is below twelve pounds and at such value that fuel no longer is contained within the air vapor eliminator and the line connecting the air vapor eliminator to the carburetor, then the air will escape through the air vent 31' in the carburetor. This condition will take place either when the supply of fuel from the primary source fails or when the supply of fuel is first supplied from the source to the carburetor.

In Figure 8, I show another modification wherein instead of using the air eliminator AE as a reserve fuel chamber I provide a reserve chamber RS having lower and upper compartments separated by a diaphragm 88. Most of the parts in this figure are similar to those already described and accordingly bear the same reference numerals. Additional parts begin with reference numeral 89, which indicates a fitting on the top of the reserve supply chamber RS into which the conduit 14 from the pump P extends and from which the fuel delivery line 17 extends to the carburetor C. The conduit 14 initially discharges fuel into the upper compartment of the chamber RS, from a cavity 90 in the fitting 89, and after such compartment is nearly full then the fuel enters an outlet pipe 91 and flows through the conduit 17. The entering fuel drives the diaphragm 88 to its lowermost position shown by solid lines, the air under the diaphragm being displaced through the pipe 31 and an air pressure control valve AV', of the kind shown in Figure 7, to the tank 1 by way of the conduit 32. The conduit 32 may lead to atmosphere, but I preferably connect it with one of the fuel tanks so that in the event of breakage of the diaphragm 88 the fuel will be returned to the tank instead of being wasted.

The valve AV' has its inlet 61 connected by the conduit 62 to a suitable source of fluid pressure, such as the pump 78, so that when needed fluid pressure may be introduced through the conduit

31 to the lower compartment of the reserve supply chamber RS for displacing fuel from the chamber. Such displacement results in upward movement of the diaphragm 88 as to the dotted position illustrated, the fuel being transmitted to the carburetor through the openings 91' and the air or vapor being transmitted through the opening 91''.

Practical operation

Referring first to Figures 1, 4, 5 and 6, Figure 1 shows the position of the parts during normal operation. The air eliminator AE is substantially filled with fuel, due to the air having been eliminated from the fuel. During the air eliminating period the float valve 34 will be opened whenever there is insufficient fuel in the air eliminator to render the float 35 buoyant. At such time there is of course the presence of air above the fuel in the eliminator, and such air passes outwardly through the conduit 31 and the valve AV to the conduit 32 and then into the fuel tank 1. The valve AV is open at its first seat 36, as shown in Figures 1 and 2, to permit free elimination of the air. The fuel is being delivered at fifteen pounds' pressure to the carburetor C and accordingly the jet 19-20 is open, as it requires but six pounds' pressure to effect opening thereof. The pressure of the fuel is maintained at the desired figure by means of a by-pass or relief valve 93 in the pump P. The valve 93 operates against the bias of a spring 94 which may be set for the desired pressure. The selector valve SV is set for the fuel pump P to receive fuel from the tank 1, as evidenced by the position of the control handle or indicating blade 92 thereof.

When the fuel supply in the tank 1 is depleted, the fuel pump P will start pumping air from the tank 1. The pump P is unable to maintain as high a pressure when pumping air as it does when pumping fuel, and in actual experience I have found that there is a pressure drop of about two and one-half pounds. This drop is indicated on the pressure gauge 47a in Figure 4 and it will be noted that the air entering the air eliminator AE has displaced the fuel in the eliminator to the level indicated at L¹.

When the diaphragm 43 reached a pressure slightly above twelve and one-half pounds (for instance, thirteen pounds), the contact 66 engaged the contact 65 so as to light the warning signal 76. In this way, the pilot is apprised of the fact that fuel from the tank he has been using has failed and he can thereupon turn the selector valve SV to another tank. If said other tank contains fuel, such fuel will be immediately supplied to the fuel pump P and by it to the air eliminator AE, resulting in the fuel pressure rising in a short time (the duration depending upon the amount of fuel remaining in the chamber of the air eliminator at the time when the change from one tank to another takes place) to its normal pressure (fifteen pounds). As the fuel pressure rises above twelve and one-half pounds, the valve 39 is unseated from the seat 36 to again permit normal air elimination from the air eliminator, and at approximately thirteen pounds' pressure the contact 66 disengages the contact 65 to indicate to the pilot that he is receiving fuel from the new source selected by the position of the selector valve. Thus, within about two seconds after the selector valve has been repositioned, the pilot knows that the new fuel tank contains fuel and he can thereafter forget about the selector valve until such time as the warning signal 76 flashes on again.

If the warning signal 76 remains lighted longer than two seconds after the pilot has repositioned the selector valve, he knows that the new fuel tank does not contain fuel but the supply of fuel at a pressure sufficient to operate the carburetor does not falter because air is still being pumped by the pump P into the air eliminator to displace the fuel therefrom at the twelve and one-half pounds' pressure. The air for fuel displacement may be supplemented by additional air from the supercharger SC through the conduit 62 and the check valve 62a whenever such air pressure is in excess of the pressure within the air eliminator and the lower end of the valve stem 41 is off the seat 52 as a result of a drop in the fuel pressure from normal, as illustrated in Figure 4. The fuel level, for instance, might be displaced to the level L² and then built up again after the pilot repositions the selector valve SV from the fuel tank 2, for instance, to the fuel tank 3. If the fuel tank 3 contains fuel, then pressure will be immediately built up to extinguish the warning signal 76 and thereafter position the parts of the valve AV as shown in Figure 2, so that normal elimination of air from the air eliminator AE under control of the float 35 and the float valve 34 will occur.

If the fuel tank 3 does not contain fuel, then the level of the fuel may recede as to the line L³ in Figure 5. In such event, some air is forced to the carburetor and the pressure quickly drops as, for instance, to two pounds. Such pressure is insufficient for opening the needle valve 20 of the carburetor jet and accordingly there is no further advantage in supplying fuel to the carburetor, since it cannot be forced from the jet and atomized. It is then desirable to quickly eliminate air from the air eliminator AE and the valve AV is accordingly constructed so that the excessively low pressure of two pounds will permit the spring 43a to overcome the spring 40, due to the low pressure on top of the diaphragm 43, and thereby open the valve AV at the second seat 37. The chamber 48 is now in communication with the chamber 49 along the enlarged bore in the head of the sleeve 39 surrounding the stem 41, so that the air in the air eliminator and that air which is subsequently pumped into it may readily escape through the conduits 31 and 32. If the engine has faltered and stopped, the hand pump H can be operated for pumping fuel from the next fuel tank to which the selector valve SV is turned, so that the engine can be started and the air eliminator again filled with fuel from the fuel pump P.

Finally, when fuel is supplied to the air eliminator, the level of the fuel may rise, as to the line L⁴ in Figure 6, by the time the pressure gauge gets up to thirteen pounds. The signal switch 65-66 will be opened at thirteen pounds immediately after the sleeve valve 39 leaves the seat 36 for permitting air elimination under control of the float valve 34 in the normal manner.

In the operation of the fuel system shown in Figure 7, substantially the same operating steps take place as described in connection with Figures 1, 4, 5 and 6. The only difference is that the valves 39 and 42, instead of being directly operated from the fuel pressure responsive diaphragm 43 of Figure 2, are operated by energization of the solenoid coil 93 under control of the pressure switch PS. The warning signal 76 of Figure 7 is then controlled by the pressure switch PS', the two switches being set for operation at twelve and one-half and thirteen pounds, respectively. The results obtained are the same in either case. The pressure control valve AV'

of Figure 7 does not have any equivalent for the second valve and seat 42—37 of Figure 2 to permit air elimination when the fuel pressure goes down to two pounds, so that the float valve of the air eliminator AE must take care of eliminating the excess air.

In the operation of the modification of my system shown in Figure 8, it is obvious that a failure of fuel will operate the pressure switch PS the same as in Figure 7 for operating the solenoid controlled air pressure control valve AV' and thereby permitting the introduction of fluid pressure from the line 62 through the conduit 31 to the lower compartment of the reserve supply chamber RS below the diaphragm 88 therein. This will effect movement of the diaphragm as to the dotted position illustrated for displacing the reserve fuel from the chamber RS. Such an arrangement is particularly desirable in connection with a pump P' of the type which is inefficient in pumping air after the fuel supply falls. Where the type of fuel pump that can pump air is used, then fluid pressure from the line 62 supplements such air and suitable provision would have to be made for eliminating the air, such as an eliminator built into the carburetor or located between the reserve supply chamber RS and the carburetor.

My system takes advantage of the possibility of the fuel pump pumping air into the air eliminator for the purpose of displacing fuel to the carburetor at a pressure sufficient to operate the carburetor. It also takes advantage of the few pounds' drop in pressure in the fuel system as a result of the fuel failing and the pump thereby pumping air, and utilizes such drop as a means to first operate a warning signal and then condition the air eliminator so that its normal air eliminating operation is discontinued so that the fuel pump can keep up the desired pressure for displacing the reserve fuel from the air eliminator. One advantageous result of such a system is that the pilot is immediately notified of fuel failure so that he can operate his selector valve and, within the space of about two seconds, know whether or not there is fuel in the new tank to which the selector valve has been set. If the indicator light goes out, he knows that further fuel is being received by the fuel pump, whereas if it stays on longer than two seconds he knows that it is necessary to turn the selector valve to another position. Thus, valuable time is saved between the failure of fuel from one tank and the pick-up of fuel from another tank that contains fuel. Faltering of the engine is also delayed while the reserve supply of fuel has been used, so that the selector valve may be turned through a series of several tanks before the engine will begin to falter.

Some changes may be made in the construction and arrangement of the parts of my device without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims any modified forms of structure or use of mechanical equivalents which may be reasonably included within their scope without sacrificing any of the advantages thereof.

I claim as my invention:

1. In a fuel system for a high pressure carburetor, a plurality of fuel tanks, a fuel pump, a selector valve between said tanks and said pump for providing communication between one of said tanks and said pump, a fuel delivery line from the discharge side of said fuel pump to a normally closed and fuel pressure opened jet of the

carburetor, an air eliminator in said fuel delivery line including a float operated air eliminating vent communicating with one of said tanks, and means for rendering said vent inoperative in the event of fuel failing from said one of said tanks, said means comprising an air pressure control means for said vent and having a pressure responsive actuating element responsive to the pressure of fuel from said air eliminator, which, upon predetermined drop in pressure in said fuel delivery line of said carburetor as caused by said fuel pump receiving air operates said means for rendering said vent inoperative, and, upon subsequent rise of fuel pressure resulting from repositioning said selector valve to communicate with another tank containing fuel, operates said means to again render the vent operative.

2. A fuel system for a high pressure carburetor comprising a plurality of fuel tanks, a fuel pump, a selector valve between said tanks and said pump and connecting one of the tanks with the pump, a fuel delivery line from the discharge side of said pump to a normally closed and fuel pressure opened jet of the carburetor, an air eliminator in said fuel delivery line including a float operated air eliminating vent, means for closing said vent in the event of fuel failing at the intake of said fuel pump, said means comprising an air pressure control valve in the vent having an actuating element responsive to the pressure of fuel from said air eliminator, which, upon predetermined drop in pressure thereof below normal and above the pressure required to open said carburetor jet as caused by said fuel pump receiving air moves said actuating element and said element closes said valve, and subsequent rise of fuel pressure resulting from change of said selector valve to another tank containing fuel again moves said actuating element and said element opens said valve, and a signal device responsive to fuel pressure of a degree intermediate normal pressure and the pressure of the fuel resulting from said fuel pump pumping air.

3. In a fuel system for a high pressure carburetor, a fuel pump, a fuel line from the discharge side of said pump to a normally closed and fuel pressure opened jet of the carburetor, an air eliminator in said fuel line, said air eliminator including a float operated air eliminating vent and means for rendering said vent inoperative in the event of fuel failing at the intake side of said fuel pump, said means having an actuating element responsive to the pressure of fuel from said air eliminator and connected with said vent for rendering it operative and inoperative whereby predetermined drop in pressure in said fuel delivery line as caused by failure of fuel to said fuel pump operates said means for rendering said vent inoperative and subsequent rise of fuel pressure again operates said means oppositely and thereby renders the vent operative.

4. A fuel system for a high pressure carburetor comprising a fuel pump, a fuel delivery line from said fuel pump to a pressure opened jet of the carburetor, a chamber in said fuel delivery line adapted to initially receive a reserve supply of fuel from said fuel pump before the fuel is delivered to the carburetor, a valve responsive to a drop in fuel pressure to a predetermined degree below normal operating pressure to open and thereby permit introduction of fluid pressure to said reserve chamber, such fluid pressure building up to displace the fuel from said reserve chamber, said valve responding to subse-

quent build-up of fuel pressure to normal and thereby assuming its initial position opened another way and thereby permitting escape of the fluid pressure from the reserve chamber, and signal means responsive to the fuel pressure and operable at a pressure slightly exceeding said predetermined degree below normal operating pressure.

5. A fuel system for a carburetor or the like comprising a fuel pump, a fuel delivery line from the discharge side of said fuel pump to a normally closed and pressure opened jet of the carburetor, a reserve fuel chamber in said fuel delivery line adapted to initially receive a reserve supply of fuel from said fuel pump before the fuel is delivered to the carburetor, and a valve responsive to a drop in fuel pressure to a predetermined degree below normal operating pressure and above the pressure required to open said jet, to open one way and thereby build up fluid pressure to said reserve fuel chamber to displace the fuel therefrom, said valve, upon responding to subsequent build-up of fuel pressure to normal assuming its initial position opening the other way and thereby permitting escape of the fluid pressure from the reserve chamber.

6. A fuel system for a carburetor or the like comprising a fuel pump, a fuel delivery line from the discharge side of said fuel pump to a normally closed and pressure opened jet of the carburetor, a reserve fuel chamber in said fuel delivery line having a first compartment adapted to initially receive a reserve supply of fuel from said fuel pump before the fuel is delivered to the carburetor, said reserve fuel chamber having a second compartment and a diaphragm separating said compartments, and means responsive to a drop in fuel pressure below normal operating pressure and above the pressure required to open said jet to introduce fluid pressure to said second compartment to displace the fuel from said first compartment to said carburetor under a pressure sufficient to operate it, said means being reversible to initial position upon subsequent build-up of fuel pressure to normal and permitting escape of the fluid pressure from said second compartment.

7. In a fuel system for a high pressure carburetor, a fuel pump, a fuel delivery line from the discharge side of said fuel pump to a normally closed and fuel pressure opened jet of said carburetor, a reserve fuel chamber in said fuel delivery line, an air pressure control valve connected with said chamber and having a pressure responsive actuating element responsive to the pressure of fuel, said fuel pump, upon receiving air, effecting displacement of fuel from said chamber at a pressure sufficient for operation of said carburetor jet by pumping air thereto, and means for eliminating air from said fuel delivery line when said fuel pump subsequently receives fuel from a new source.

8. In a fuel system of the character described, a fuel pump, a fuel delivery line from the discharge side of said fuel pump to a normally closed and fuel pressure opened jet of a carburetor, an air eliminator in said fuel delivery line, said air eliminator including a float operated air eliminating vent and means for closing said vent, said means comprising an air control valve having an actuating element responsive to the pressure of the fuel from said air eliminator, said control valve, upon a predetermined drop in pressure in said fuel delivery line, closing said valve and admitting fluid pressure to said air

eliminator to supplement air delivered thereto by said fuel pump as a result of fuel failing at the intake side of said pump.

9. In a fuel system for high pressure carburetors, a fuel pump, a fuel delivery line from the discharge side thereof to the jet of the carburetor, a reserve chamber in said fuel delivery line, said chamber including a vent, a valve connected with said vent and operable to closed position upon predetermined pressure drop in the fuel delivered from said reserve chamber, and means operable by closure of said vent to supply air from said fuel pump to said reserve chamber to displace the contents thereof under sufficient operating pressure to said carburetor until a further supply of fuel is furnished to said fuel pump and the fuel pressure as a result thereof rises to normal in said fuel delivery line.

10. In a fuel system for high pressure carburetors, a fuel pump, a fuel delivery line from the discharge thereof to the jet of the carburetor, said jet requiring predetermined fuel pressure introduction to effect opening thereof, an air eliminator in said fuel delivery line and including a float operated vent, means for rendering said vent inoperative upon said fuel pump receiving air, said means comprising an air control valve series-connected with said vent, and pressure responsive means for opening said air control valve, said pressure responsive means being responsive to fuel pressure in said fuel delivery line whereby predetermined drop in the fuel pressure therein will close said valve, said valve being opened by said pressure responsive means as it responds to a further decrease of fuel pressure to another predetermined degree as a result of excessive air delivery to said air eliminator and being reclosed by said pressure responsive means responding to fuel pressure rise caused by fuel delivery to the carburetor when such rise of fuel pressure is to a degree intermediate said another predetermined degree and said first mentioned predetermined degree.

11. A fuel system for high pressure carburetors comprising a plurality of fuel tanks, a fuel pump, a selector valve between said tanks and said pump and connecting one of the tanks with the pump, a fuel delivery line from the discharge side of said fuel pump to the jet of said carburetor, said jet requiring predetermined fuel pressure introduction to effect opening of said jet, an air eliminator in said fuel delivery line and including a float operated vent, means for rendering said vent inoperative upon said fuel pump receiving air, said means comprising an air pressure control valve in series with said vent, and means for operating said valve, said last means being responsive to fuel pressure and connected with said valve to open it upon the fuel rising to normal operating pressure, and to close it upon predetermined drop in the fuel pressure, and, upon further decrease of fuel pressure, again opening it for permitting elimination of air from said eliminator when the pressure of the fuel to the carburetor is too low to be discharged from the jet thereof.

12. A fuel system of the character disclosed comprising a plurality of fuel tanks, a fuel pump, a selector valve between said tanks and said pump and connecting one of the tanks with the pump, a fuel delivery line from the discharge side of said fuel pump to the jet of a carburetor, which requires predetermined fuel pressure introduction to effect its opening, an air eliminator in said fuel delivery line and including a float

operated vent, means for closing the line from said vent upon said fuel pump receiving air, said means comprising an air pressure control valve in series with said vent, a solenoid for operating said valve, and a pressure responsive switch for controlling said solenoid, said switch being responsive to fuel pressure and, upon predetermined drop thereof, closing to thereby energize the solenoid of said valve.

13. In a fuel system of the character disclosed, a fuel pump, a fuel delivery line from the discharge thereof to the jet of a carburetor which requires predetermined fuel pressure introduction to effect opening of said jet, an air eliminator in said fuel delivery line and including a float operated vent, a valve series-connected with said vent, and means for opening said valve, said means being responsive to fuel pressure in said fuel delivery line and, upon predetermined drop in the fuel pressure therein, closing said valve, said valve being opened by said means as a result of excessive air delivery to said air eliminator by further decrease of fuel pressure to another predetermined degree less than the degree of pressure required to open said jet, said valve being reclosed by said means upon subsequent fuel delivery to the carburetor effecting rise of fuel pressure to a degree intermediate said another predetermined degree and said first mentioned predetermined degree and being reopened by said means upon the fuel attaining normal operating pressure.

14. In a fuel system for a high pressure carburetor, a fuel pump, a fuel delivery line from the discharge side of said fuel pump to a normally closed and fuel pressure opened jet of said carburetor and an air eliminator in said fuel delivery line, said air eliminator including a float operated air eliminating vent, an air pressure control valve connected therewith and having an actuating element responsive to the pressure of fuel from said air eliminator to close said valve upon predetermined drop in pressure in said air eliminator as caused by said fuel pump receiving air, subsequent rise of fuel pressure acting on said fuel pressure responsive actuated element to cause it to again open said valve, said valve including a signal device operable by the valve assuming its position in response to said fuel pressure responsive actuated element responding to such predetermined drop in pressure in said fuel line, subsequent rise in pressure in said fuel line as a result of said fuel pump receiving fuel from a new source positioning said actuating element for opening said valve and for rendering said signal device immediately inoperative.

15. In a fuel system for a high pressure carburetor, a fuel pump, a fuel delivery line from the discharge side of said fuel pump to a normally closed and fuel pressure opened jet of said carburetor, an air eliminator in said fuel delivery line, said air eliminator including a float operated air eliminating vent, an air pressure control valve having a pressure responsive actuating element responsive to fuel from said air eliminator, and, upon predetermined drop in pressure in said fuel line as caused by said fuel pump receiving air, opening said valve, said air pressure control valve having connection with an auxiliary source of fluid pressure supply operable to supplement air pumped to said air eliminator by said fuel pump and thereby aid in maintaining sufficient pressure on the fuel in said air eliminator to feed reserve fuel in the eliminator to said carburetor and retain the jet thereof open.

16. In a fuel system, a fuel pump, a fuel delivery line from the discharge thereof to a carburetor which requires predetermined fuel pressure for operation, an air eliminator in said fuel delivery line and including an air eliminating vent, means for rendering said vent inoperative upon said fuel pump receiving air, said means being responsive to predetermined drop of fuel pressure in said fuel delivery line, said vent being rendered again operative by further decrease of fuel pressure as a result of excessive air delivery to said air eliminator to another predetermined degree less than the degree of pressure required to operate said carburetor, said means responsive to fuel pressure including a signal device operable upon such predetermined drop in pressure in said fuel line, a subsequent rise in pressure in said fuel line as a result of fuel being received from a new source by said fuel pump rendering said signal device immediately inoperative.

17. In a fuel system for carburetors, a fuel pump, a fuel delivery line therefrom to a carburetor which requires predetermined fuel pressure introduction to effect operation thereof, an air eliminator in said fuel delivery line and including a float operated vent, means for rendering said vent inoperative upon said fuel pump receiving air, said means comprising a valve series-connected with said vent, pressure responsive means for opening said valve, said pressure responsive means being responsive to predetermined drop in the fuel pressure in said fuel delivery line to close said valve, said valve being opened by said pressure responsive means responding to further decrease of fuel pressure to another predetermined degree less than the degree of pressure required to open said jet, said air pressure control valve including a signal device operable upon such predetermined drop in pressure in said fuel line affecting said pressure responsive means, a subsequent rise in pressure in said fuel line as a result of fuel being received from a new source by said fuel pump, affecting said pressure responsive means and thereby again rendering said device immediately inoperative and opening said valve to permit said vent to function in its normal air eliminating capacity.

18. In a fuel system for high pressure carburetors, a fuel pump for delivering fuel to the jet of the carburetor, said jet requiring a predetermined fuel pressure to effect its opening, an air eliminator in the fuel delivery line and including a float operated vent, means for rendering said vent inoperative upon said fuel pump receiving air, said means comprising a valve series-connected with said vent, means responsive to fuel pressure for opening said valve with predetermined drop in the fuel pressure effecting closure of said valve, said valve being opened by further decrease of fuel pressure to another predetermined degree less than the degree of pressure required to open said jet and being reclosed upon fuel delivery to the carburetor effecting a subsequent rise of fuel pressure, said air pressure control valve having connection with an auxiliary source of fluid pressure and operable to admit supplemental air in addition to air pumped to said air eliminator by said fuel pump and thereby aid in maintaining sufficient pressure on the fuel in said air eliminator to feed the reserve fuel therefrom to said carburetor and retain the jet thereof open.

19. In a fuel system for high pressure carburetors, a fuel pump for delivering fuel to the jet of the carburetor, said jet requiring a predeter-

mined fuel pressure to effect its opening, an air eliminator in the fuel delivery line and including a float operated vent, means for rendering said vent inoperative upon said fuel pump receiving air, said means comprising a valve series-connected with said vent, means responsive to fuel pressure for opening said valve with predetermined drop in the fuel pressure effecting closure of said valve, said valve being opened by further decrease of fuel pressure to another predetermined degree less than the degree of pressure required to open said jet and being reclosed upon fuel delivery to the carburetor effecting a subsequent rise of fuel pressure, said air pressure control valve having connection with an auxiliary source of fluid pressure and operable to admit supplemental air in addition to air pumped to said air eliminator by said fuel pump and thereby aid in maintaining sufficient pressure on the fuel in said air eliminator to feed the reserve fuel thereof to said carburetor and retain the jet thereof open, said air pressure control valve including a signal device operable upon such predetermined drop in pressure in said fuel line, a subsequent rise in pressure in said fuel line as a result of fuel being received from a new source by said fuel pump again rendering said signal device immediately inoperative and reopening said valve.

20. In a fuel system of the character disclosed, a fuel pump, a fuel delivery line from the discharge side of said fuel pump to a normally closed and fuel pressure opened jet of a carburetor or the like, an air eliminator in said fuel delivery line, said air eliminator including a float operated air eliminating vent to atmosphere and means for rendering said vent inoperative and for introducing fluid pressure into said air eliminator to displace the fuel therefrom at a pressure sufficient to operate said carburetor in the event of fuel failing at the intake side of said fuel pump, said means comprising an air control valve having a pressure responsive actuating element responsive to the pressure of the fuel in said fuel delivery line, said pressure responsive actuating element, upon responding to a drop in pressure in said fuel delivery line to a degree between normal and that pressure required to operate said carburetor, closing said valve to atmosphere and opening it from a source of fluid pressure to said air eliminator.

21. A fuel system for high pressure carburetors comprising a fuel tank, a fuel pump, a fuel delivery line connecting the tank with a carburetor having a jet requiring predetermined fuel pressure introduction to effect opening thereof, an air eliminator in said fuel delivery line and including air eliminating vent means, a pressure drop actuated valve, having a first valve and seat for closing said vent means when the pressure in the fuel delivery line drops due to said fuel pump receiving air, said pressure drop actuated valve having a second valve and seat for opening said vent means when the pressure of the fuel to the carburetor drops further and is too low to be discharged from the jet thereof.

22. In a fuel system for a high pressure carburetor, a fuel pump, a fuel delivery line from the discharge side of said fuel pump to a normally closed and fuel pressure opened jet of said carburetor, an air eliminator in said fuel delivery line, an air eliminating vent, said air eliminator including a valve communicating with said air eliminating vent, and means for rendering said vent inoperative in the event of fuel failing at the intake side of said fuel pump, said means comprising an air pressure control valve also communicating with said vent and having a pressure responsive actuating element responsive to the pressure of fuel from said air eliminator whereby predetermined drop therein, as caused by said fuel pump receiving air, operates said actuating element and said air pressure control valve to a position which renders said vent inoperative, and subsequent rise of fuel pressure operates said actuating element and said air pressure control valve to a position which again renders the vent operative, a signal device operable by said air pressure control valve when it renders said vent inoperative, said signal device being immediately inoperable by said air pressure control valve when it renders said vent again operative, said air pressure control valve having connection with an auxiliary source of fluid pressure supply and operable to supplement the air pumped to said air eliminator by said fuel pump when said vent is inoperative, and thereby aid in maintaining sufficient pressure on the fuel in said air eliminator to feed the reserve fuel therein to said carburetor to retain the jet thereof open.

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