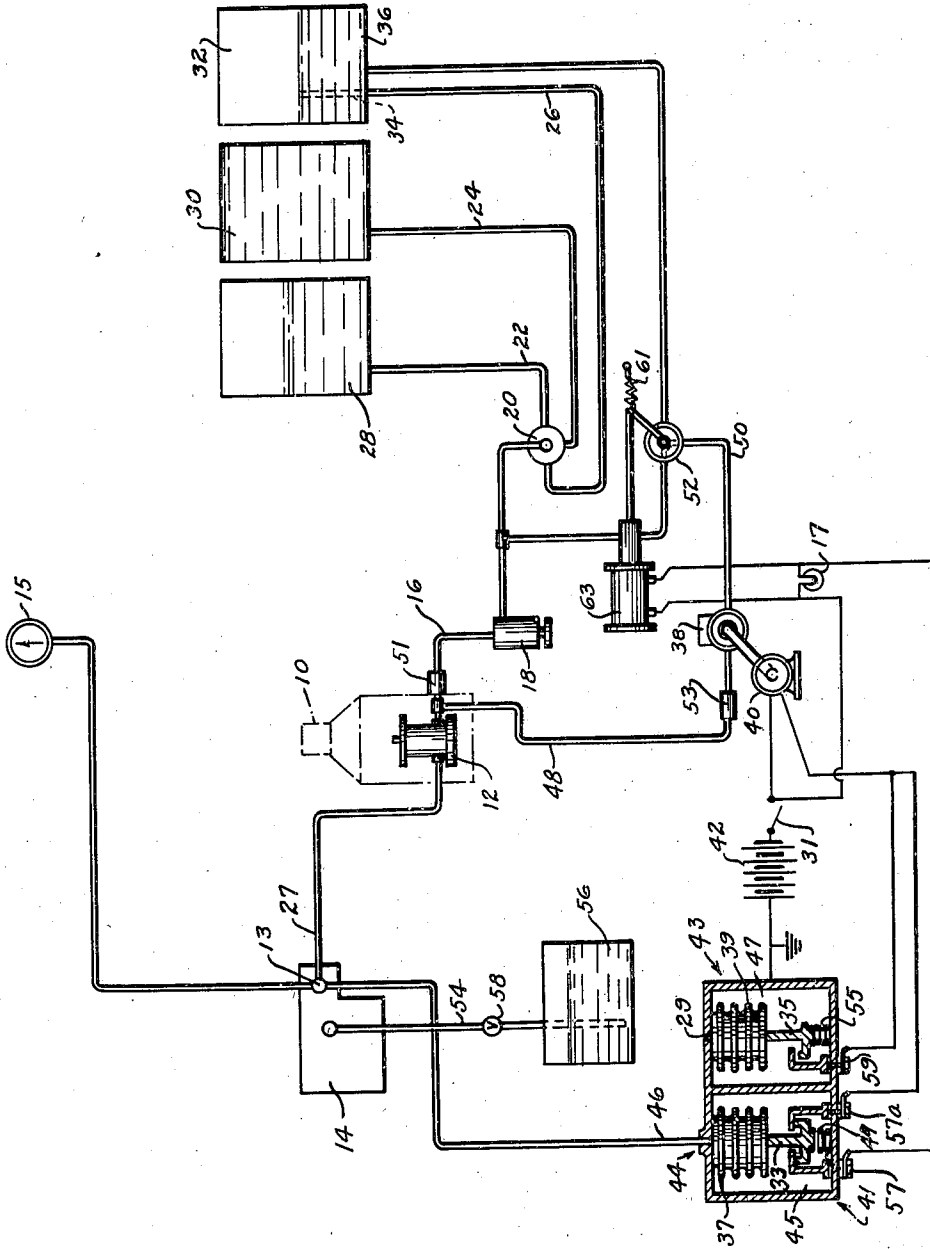


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MULTIPLE TANK FUEL SYSTEM WITH COMBINED  
EMERGENCY AND BOOSTER PUMP TO MAINTAIN  
REQUIRED DISCHARGE PRESSURE  
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# UNITED STATES PATENT OFFICE

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## MULTIPLE TANK FUEL SYSTEM WITH COMBINED EMERGENCY AND BOOSTER PUMP TO MAINTAIN REQUIRED DISCHARGE PRESSURE

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1

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

This invention is a division of our copending application Serial No. 526,794, filed March 16, 1944, now matured into Patent No. 2,459,807, and relates to fuel systems. It is particularly applicable to systems employing a plurality of fuel tanks, such for instance, as the fuel system for an aircraft.

An object of the invention is to provide a fuel system of this character with means to maintain the pressure in the fuel line at its entrance to the carburetor or other fuel metering device substantially constant, while changing the connection which extends from the suction side of the main fuel pump from one tank to the next, as successive tanks are emptied.

Another object is to provide means to indicate when a shift from an empty tank to a full one should be made.

More specifically, an object of the invention is to provide an emergency pump which becomes operative upon failure of the main pump to maintain the desired discharge pressure, and remains operative until the main pump has resumed substantially full discharge capacity.

Multiple tank fuel systems which employ, in addition to the engine pump, an electrically driven emergency pump to maintain the fuel pressure while connection is being made from an empty to a full tank are old in the art. Fuel systems which employ, in addition to the engine pump, an electric booster pump to pump to the suction side of the engine pump, when the fuel cavitates at this point due to reduced atmospheric pressure at high altitude, are also well known in the art. Moreover, it has been proposed to employ in the same fuel system both an emergency pump and a booster pump of the kind above indicated, but, so far as is known to applicants, two or more electrically driven pumps have in these cases been employed to meet these requirements.

It is therefore another object of the invention to so arrange the emergency fuel pump so that it will also serve as a booster pump when the pressure drops at the discharge side of the main pump from cavitation at the suction side, as occurs when a sufficiently high altitude is reached.

Other objects and advantages will become evident upon a consideration of the following description taken in conjunction with the drawing wherein:

2

The single figure of the drawing is a schematic assembly view of the various elements of a fuel system arranged and connected according to the principles of our invention.

Like reference characters refer to like parts throughout the drawing.

Referring now to the drawing, the engine 10 carries a main fuel pump 12 which is operatively connected to the engine to be rotated thereby, and adapted to maintain a given constant fuel pressure at the fuel inlet 13 of the carburetor 14. A gauge 15 and a signal light 17 are provided for indicating when the fuel is being maintained at the desired pressure.

The suction line 16 extends through a strainer 18 to the common outlet of the tank selector cock 20, the several inlets to the tank selector cock being respectively connected by supply pipes 22, 24, and 26, to the tanks 28, 30, and 32. The supply pipes 22 and 24 stop at the bottoms of their respective tanks 28 and 30, but the supply pipe 26 is prolonged so as to extend upwardly into the tank 32 as at 34, so that a reserve quantity of fuel 36 remains in the tank 32 after the pipe 26 has drawn off fuel to the level of the upper end of the part 34. It is of course within the contemplation of the invention to provide a small separate tank for the reserve supply of fuel 36 and where this is done the tank 32 will become just another main fuel tank.

A short discharge conduit 27 connects the discharge side of the pump 12 to the carburetor fuel inlet 13. The emergency fuel pump 38 is driven by an electric motor 40 which receives its operating current from a battery 42 or other appropriate current source. A manual switch 31 may preferably be provided to disconnect the battery from the electric circuits. A duplex pressure responsive switch 44 has one part 41 which electrically connects the battery 42 simultaneously to the motor 40, to a solenoid 63, and to the signal light 17, whenever the pressure at the carburetor fuel inlet 13 falls below the predetermined pressure at which the inbuilt relief valves of the pumps 12 and 38 are set.

The other part 43 of the switch 44 becomes operative at a predetermined altitude to make electrical connection between the battery and the motor 40 only. Parts 41 and 43 have chambers 45 and 47, respectively, which may be filled with air at a predetermined pressure and sealed.

Sealed metal bellows 37 and 39 carry grounded contact members 33 and 35 which are biased by springs 49 and 55, respectively, to engage the insulated contacts 57, 57a, and 59, when the pres-

3

sure within the bellows falls below a predetermined amount. The inside of the bellows 37 is connected by conduit means 48 to the carburetor fuel inlet 13. The inside of the bellows 39 is at all times exposed to the atmosphere through an opening 29.

A discharge line 48 connects the discharge side of the emergency pump 38 into the suction inlet of the engine pump 12, or into the suction lines 16 of the engine pump at a point as near the suction inlet as practicable. A suction line 50 connects the suction side of the emergency pump to the reserve connector cock 52, which is normally constrained by the spring 61 to a position which connects the suction side of the emergency pump 38 to one of the main tanks 28, 30, or 32, but when acted upon by the electromagnetic means 63 will be rotated one quarter turn and thereby connect the suction side of the emergency pump 38 to the reserve fuel supply 36.

The electromagnetic means 63 is energized for connecting to the reserve fuel supply 36 only when a main tank becomes empty and causes a drop in pressure to take place within the bellows 37. The connection to the reserve supply is never made as a result of a drop in pressure within the bellows 39 due to altitude, for in that case the emergency pump 38, in acting as a booster for the engine pump 12, should preferably pump out of the main tank and to the suction side of the engine pump.

A check valve 51 is provided in the engine suction line 16, this valve being biased to prevent the emergency pump 38 discharging back by way of the tank selector cock 20 into one of the tanks 28, 30, or 32. Another check valve 53 may be provided at the discharge side of the emergency pump 38, this valve being biased to retain the head in the line 48 when the emergency pump is not operating. Check valves 53 may, of course, be eliminated if the emergency pump 38 is of a kind which does not permit backward flow through it when it is at rest.

In order that a definite preselected pressure may be maintained at the carburetor fuel inlet, the pumps 12 and 38 may both be provided with an inbuilt relief valve which is adapted to return some of the fuel from the discharge side of the pump to the suction side when the pressure exceeds a predetermined value. The engine pump 12 may preferably also include an inbuilt bypass valve, adapted, when the engine pump 12 is for any reason stopped, to allow fuel to be pumped through it by the emergency pump 38.

In order to more quickly fill the suction line 16 and thereby to reprime the pump 12 after the fuel therein has cavitated due to an empty tank condition, the check valve 51 is provided with a small leakage opening, so that the air or fuel vapor in the line may be expelled by entry of leakage fuel pumped by the emergency pump through the leakage opening at the same time that it is pumping through the engine pump 12 to the carburetor fuel inlet 13. An air eliminator line 54 extends from the carburetor to the bottom of the air eliminator tank 56 which is partially filled with a liquid. A valve 58 in this line 54 permits it to be shut off when that becomes desirable.

The pressure responsive part 41 of the duplex automatic switch 44 may preferably be so made that the switch, when shutting off the motor 40 will respond to a pressure several pounds lower than that at which the relief valve of the pump

4

12 is set. The operation of the fuel system shown is substantially as follows:

Let it be assumed that the engine is stopped, the manual switch 31 is open, the pressure at the carburetor intake 13 has dropped, and the tank selector cock 20 is turned to the position which connects the tank 28, through the supply pipe 22 and suction line 16, to the suction side of the engine pump 12. Under these conditions the contact 33 of the automatic switch 44 will be engaged with the contacts 57 and 57a, the contacts 35 and 59 will be disengaged, and the reserve connector cock 52 will have a suction side of the emergency pump 38 connected to the main tank 28.

If the manual switch 31 is now closed, the emergency pump 38 will be operated to prime the carburetor, and, through the leakage opening in the check valve 51, will fill the suction line 16 of the engine pump 12. The battery 42 is connected to the motor 40, because contacts 33 and 57a of the automatic switch 44 are engaged, and coincidentally the contacts 33 and 57 are engaged to energize the electromagnet 63, whereby the reserve connector cock 52 will be turned so as to have the emergency pump draw from the reserve 36, the signal light 17 being coincidentally lit to indicate what is taking place. It is here noted that whenever the auxiliary pump 38 operates to maintain the prime when the engine pump is not maintaining it, the auxiliary pump will draw from the reserve supply 36, but whenever the auxiliary pump is operating as an altitude booster, it will draw from the main fuel tank.

With the carburetor thus primed, the engine 10 may be started. If it is not immediately started the emergency pump 38 may cycle at intervals. When the engine is started, the engine pump 12 will almost immediately pick up the prime because its suction pipe 16 has been filled through the leakage opening in the check valve 51. As long as the engine pump is operating satisfactorily, the desired pressure at which the inbuilt relief valve of the engine pump 12 is set, will be maintained at the fuel inlet 13 of the carburetor.

When the tank 28 becomes empty it will be a matter of several seconds only until the pump 12 will be drawing some air through the suction line 16 and discharging it into the short conduit 27. When this occurs, the pressure at the fuel inlet 13 will drop almost instantly, and the contacts 33 and 57a of the automatic switch 44 will be engaged, thereby to connect the battery 42 to the motor 40 of the emergency pump 38, and coincidentally the contacts 33 and 57 will engage to light the signal light 17 and energize the coil 63 so as to shift the reserve connector cock one quarter turn anticlockwise from the position shown, whereupon the emergency pump 38 will draw from the reserve 36 and thus will maintain the desired fuel pressure at the carburetor fuel inlet 13.

The emergency pump 38 will take over this function very quickly for the reason that the head in the line 48 is always retained while the emergency pump 38 is idle. The small amount of air in the short conduit 27 and that in the carburetor will be discharged through the air eliminator line 54, while the somewhat larger volume in the line 16 will be driven back by the fuel which is passing through the leakage opening in the valve 51.

While the engine pump 12 is thus preparing to pick up its prime, the emergency pump 38, being

5

of greater capacity than the engine consumption, may cycle several times at intervals of several seconds, that is, the pressure at the fuel intake 13 will reach the desired value and the automatic switch 44 will stop the motor 40. Then as fuel is consumed the pressure will drop at the inlet 13 a matter of several pounds, whereupon the switch 44 will again start the motor 43 to operate the pump 38.

When this cycling is observed on the pressure gauge 15 and signal light 17, the tank selector cock 20 should be turned to connect the tank 39 or any other full tank to the suction side of the engine pump 12. The engine pump will ordinarily pick up its prime in the manner of several seconds and will then alone raise and maintain the pressure at the fuel inlet 13 at the desired value, so that when the part 41 of the switch 44 again operates to shut off the emergency pump, it will remain shut off until the engine pump again fails.

Thus far the operation of the auxiliary pump 38 has been described only with reference to its function for maintaining the carburetor pressure by connecting to, and pumping from, a reserve supply 36 when the main tank from which the engine pump 12 is pumping becomes empty, or when the engine pump 12 is otherwise incapacitated. The function of the auxiliary pump 38 as an altitude booster is as follows:

At a given preselected altitude the part 43 of the automatic switch 44 will engage the contacts 35 and 59 and thus start the emergency pump 38 which this time operates as a booster pump. This booster pump will now pump out of the same main tank from which the engine pump is pumping, the reason being that the coil 63 is not now energized, and no connection is therefore made to the reserve fuel 36. If, however, while the craft is still at the high altitude which requires booster pump operation, the main tank, from which both the main pump 12 and the booster pump 38 are now taking fuel, becomes empty, the engagement of the contacts 33 and 57 of the switch 44 will energize the coil 63 and cause the emergency pump 38 to momentarily draw fuel from the reserve 36 until the tank selector cock 20 can be turned to a full tank.

As soon as this is done and the booster pump 38 and the engine pump 12, operating together, reestablish proper pressure at the carburetor, the bellows 37 of the automatic switch 44 will disengage the contact 33 from the contact 57, whereupon the coil 63 will be deenergized and the spring 61 will break connection to the reserve fuel supply 36, and thereafter both booster and engine pumps will be arranged to draw from the same main tank.

It will, of course, be understood that for simplicity the electromagnetic means 63 for shifting the two-way fuel cock 52 could readily be eliminated and for the same reason the automatic switch mechanism 44 could be supplanted by two common manual switches, if the pilot would then assume the duty of manually throwing the one common manual switch whenever the altimeter registered over a predetermined altitude and would coincidentally turn the two-way cock 52 manually to the position shown in the drawing, if it were not already so turned, and if he would further remember to always throw the other of the two manual switches, and then make sure that the cock 52 was turned one quarter turn

6

from the position shown whenever he used the tank selector cock 20 for shifting from an empty to a full tank. That is, with the automatic feature eliminated, he must always see to it that when altitude boost is needed, he starts the electric pump and connects to a main fuel tank, and when a changeover from one tank to the next is required, that he starts the electric pump, if it is not already running, and connects it to the reserve supply, if it is not already so connected.

It will, of course, also be understood that, while the tank selector cock 20 and the two-way cock 52 are both of the rotating plug type, any type valve which would accomplish the same purpose in each case or any type switch mechanism which would perform the same function as the switch mechanism shown, is considered within the spirit of the invention.

It will be further understood that while the two pressure responsive switches 41 and 43 are built into a single housing 44 two separate pressure responsive switches of any known type which may be suitable, may be employed instead of the double switch shown provided they are connected in like manner.

Having described an embodiment of our invention, we claim:

1. In an aircraft fuel system, the combination of a plurality of main fuel supply tanks, a main fuel pump, conduit means including a tank selector cock for selectively connecting the suction inlet of the main fuel pump to the several tanks one at a time, a check valve in said conduit means between said tank selector cock and said main fuel pump biased to restrict flow from said pump back through said cock, said check valve having a small leakage opening, a reserve fuel supply container, a combined emergency and booster pump, an electric motor for driving said combined emergency and booster pump, a battery, channel means including a two way cock operable from a first to a second position said two-way cock in said second position connecting the suction inlet of the emergency and booster fuel pump through a part of said channel means to the reserve fuel supply container, and operable from the second back to the first position, said two-way cock in said first position connecting the suction inlet of the emergency and booster fuel pump through a part of said channel means into the suction line of the main fuel pump at a point between said check valve and the selector cock, resilient means biasing said two-way cock to the first position, electromagnetic means for operating said two-way cock to the second position, a carburetor, a conduit connecting the discharge side of the main fuel pump to the carburetor fuel inlet, a conduit connecting the discharge side of the booster and emergency fuel pump into the suction line of the main fuel pump at a point between said main fuel pump and said check valve, a second check valve in the discharge line of the booster and emergency fuel pump near its discharge side biased to prevent flow back through said booster and emergency fuel pump, and an automatic electric switch mechanism having one part responsive to a predetermined pressure drop at the carburetor fuel inlet to complete an electric circuit from the battery through the said electric motor and said electromagnetic means, in parallel, and another part responsive to a predetermined drop in atmospheric pressure

to complete an electric circuit from the battery through the said electric motor only.

2. In an aircraft fuel system, the combination of a plurality of main fuel supply tanks, a main fuel pump, conduit means including a tank selector valve for selectively connecting the suction inlet of the main fuel pump to the several tanks one at a time, a check valve included in said conduit means between said tank selector valve and said main fuel pump biased to restrict flow from said pump back through said check valve, said check valve having a small leakage opening, a reserve fuel supply container, a combined emergency and booster pump, an electric motor for driving said combined emergency and booster pump, a battery, channel means including a two position valve, said two-position valve being adapted in one position for connecting the suction inlet of the emergency and booster fuel pump through a part of said channel means to the reserve fuel supply container, and adapted in the other position for connecting the suction inlet of the emergency and booster fuel pump through a part of said channel means into the suction line of the main fuel pump at a point between said check valve and the selector valve, means for moving said two-position valve to one of its positions, means for moving said two-position valve to the other of its positions, a carburetor, a conduit connecting the discharge side of the main fuel pump to the carburetor fuel inlet, a conduit connecting the discharge side of the booster and emergency fuel pump into the suction line of the main fuel pump at a point between said main fuel pump and said check valve, a second check valve in the discharge line of the booster and emergency fuel pump near its discharge side biased to prevent flow back through said booster and emergency fuel pump, and an automatic electric switch mechanism having one part responsive to a predetermined pressure drop at the carburetor fuel inlet to complete an electric circuit from the battery through the said electric motor, and another part responsive to a predetermined drop in atmospheric pressure to complete an electric circuit from the battery through the said electric motor.

3. In an aircraft fuel system, the combination of a plurality of main fuel supply tanks, a main fuel pump, conduit means including a tank selector means for selectively connecting the suction inlet of the main fuel pump to the several tanks one at a time, a check valve included in said conduit means between said tank selector means and said main fuel pump biased to restrict flow from said pump back through said tank selector means, said check valve having a small leakage opening, a reserve fuel supply container, a combined emergency and booster pump, an electric motor for driving said combined emergency and booster pump, a battery, channel means including a two position valve which is movable from its normal position and is adapted to thereby connect the suction inlet of the emergency and booster fuel pump through a part of said channel means to the reserve fuel supply container, electromagnetic means for moving said two position valve away from the normal position, means for returning said two-position valve to the normal position whereby it connects the suction inlet of the emergency and booster fuel pump through a part of said channel means into the suction line of the main fuel pump at a point between said check valve and the tank selector means, a carburetor, a conduit connecting the discharge side of the main fuel pump to the carburetor fuel inlet, a conduit

connecting the discharge side of the booster and emergency fuel pump into the suction line of the main fuel pump at a point between said main fuel pump and said check valve, a second check valve in the discharge line of the booster and emergency fuel pump near its discharge side biased to prevent flow back through said booster and emergency fuel pump, an automatic electric switch responsive to a predetermined pressure drop at the carburetor fuel inlet to complete an electric circuit from the battery through the said electric motor and said electromagnetic means, in parallel, and another switch operable to complete an electric circuit from the battery through the said electric motor only.

4. In an aircraft fuel system, the combination of a plurality of main fuel tanks, a main fuel pump, conduit means including a tank selector for selectively connecting the suction inlet of the main fuel pump to the several tanks one at a time, a check valve included in said conduit means between said tank selector and said main fuel pump biased to restrict flow from said pump back through said selector, said check valve having a small leakage opening, a reserve fuel supply container, a combined emergency and booster pump, an electric motor for driving said combined emergency and booster pump, a battery, channel means including a two position valve, said valve being adapted in one position for connecting the suction inlet of the emergency and booster fuel pump through a part of said channel means to the reserve fuel supply container, electromagnetic means for moving said two way valve to the said one position, said two-position valve being adapted in the other position for connecting the suction inlet of the emergency and booster fuel pump into the suction line of the main fuel pump at a point between said check valve and the selector, means for removing the said two-position valve to the said other position, a carburetor, a conduit connecting the discharge side of the main fuel pump to the carburetor fuel inlet, a conduit connecting the discharge side of the booster and emergency fuel pump into the suction line of the main fuel pump at a point between said main fuel pump and said check valve, a second check valve in the discharge line of the booster and emergency fuel pump near its discharge side biased to prevent flow back through said booster and emergency fuel pump, an electric switch to be operated at a predetermined pressure drop at the carburetor fuel inlet to complete an electric circuit from the battery through the said electric motor and said electromagnetic means, in parallel, and an automatic switch responsive to a predetermined drop in atmospheric pressure to complete an electric circuit from the battery through the said electric motor only.

5. In an aircraft fuel system, the combination of a plurality of main fuel tanks, a main fuel pump, conduit means including a tank selector for selectively connecting the suction inlet of the main fuel pump to the several tanks one at a time, a check valve included in said conduit means between said tank selector and said main fuel pump biased to restrict flow from said pump back through said selector, said check valve having a small leakage opening, a reserve fuel supply container, a combined emergency and booster pump, an electric motor for driving said combined emergency and booster pump, a battery, channel means including a two position valve, said two-position valve being adapted in one position for connecting the suction inlet of the

emergency and booster fuel pump to the reserve fuel supply container, electromagnetic means for moving said two way valve to the said one position, said two-position valve being adapted in the other position for connecting the suction inlet of the emergency and booster fuel pump into the suction line of the main fuel pump at a point between said check valve and the selector, means for moving the said two-position valve to the said other position, a carburetor, a conduit connecting the discharge side of the main fuel pump to the carburetor fuel inlet, a conduit connecting the discharge side of the booster and emergency fuel pump into the suction line of the main fuel pump at a point between said main fuel pump and said check valve, a second check valve in the discharge line of the booster and emergency fuel pump near its discharge side biased to prevent flow back through said booster and emergency fuel pump, an electric switch to be closed at a predetermined pressure drop at the carburetor fuel inlet to complete an electric circuit from the battery through the said electric motor and said electromagnetic means, in parallel, and another electric switch to be closed at a predetermined drop in atmospheric pressure to complete an electric circuit from the battery through the said electric motor only.

6. In an aircraft fuel system, the combination of a plurality of main fuel tanks, a main fuel pump, conduit means including a tank selector for selectively connecting the suction inlet of the main fuel pump to the several tanks one at a time, a check valve included in said conduit means between said tank selector and said main fuel pump biased to restrict flow from said pump back through said selector, said check valve having a small leakage opening, a reserve fuel supply container, a combined emergency and booster pump, an electric motor for driving said combined emergency and booster pump, a battery channel means including a two position valve, said channel means being adapted when said two-position valve is in one of its positions for connecting the suction inlet of the emergency and booster fuel pump to the reserve fuel supply container, and said channel means being adapted when said two-position valve is in the other of its positions for connecting the suction inlet of the emergency and booster fuel pump into the suction line of the main fuel pump at a point between said check valve and the selector, a carburetor, a conduit connecting the discharge side of the main fuel pump to the carburetor fuel inlet, a conduit connecting the discharge side of the booster and emergency fuel pump into the suction line of the main fuel pump at a point between said main fuel pump and said check valve, a second check valve in the discharge line of the booster and emergency fuel pump near its discharge side biased to prevent flow back through said booster and emergency fuel pump, and electric switch means to be closed at a predetermined pressure drop at the carburetor fuel inlet or at a predetermined altitude to complete an electric circuit from the battery through the said electric motor.

7. In an aircraft fuel system, the combination of a plurality of main fuel tanks, a main fuel pump, conduit means including a tank selector for selectively connecting the suction inlet of the main fuel pump to the several tanks one at a time, a check valve included in said conduit means between said tank selector and said main fuel pump biased to restrict flow from said pump back through said selector, a reserve fuel supply

container, a combined emergency and booster pump, an electric motor for driving said combined emergency and booster pump, a battery, channel means including a two position valve, said channel means being adapted when said two-position valve is in one position for connecting the suction inlet of the emergency and booster fuel pump to the reserve fuel supply container, and said channel means being adapted when said two-position valve is in the other position for connecting the suction inlet of the emergency and booster fuel pump into the suction line of the main fuel pump at a point between said check valve and the selector, a carburetor, a conduit connecting the discharge side of the main fuel pump to the carburetor fuel inlet, a conduit connecting the discharge side of the booster and emergency fuel pump into the suction line of the main fuel pump at a point between said main fuel pump and said check valve, a second check valve in the discharge line of the booster and emergency fuel pump near its discharge side biased to prevent flow back through said booster and emergency fuel pump, and electric switch means to be closed at a predetermined pressure drop at the carburetor fuel inlet or at a predetermined altitude to complete an electric circuit from the battery through the said electric motor.

8. In an aircraft fuel system, the combination of a plurality of main fuel tanks, a main fuel pump, conduit means including a tank selector for selectively connecting the suction inlet of the main fuel pump to the several tanks one at a time, a check valve included in said conduit means between said tank selector and said main fuel pump biased to restrict flow from said pump back through said selector, a reserve fuel supply container, a combined emergency and booster pump, an electric motor for driving said combined emergency and booster pump, a battery, channel means including a two position valve said channel means being adapted when said two-position valve is in one position for connecting the suction inlet of the emergency and booster fuel pump to the reserve fuel supply container, and said channel means being adapted when said two-position valve is moved to the other position for connecting the suction inlet of the emergency and booster fuel pump into the suction line of the main fuel pump at a point between said check valve and the selector, a carburetor, a conduit connecting the discharge side of the main fuel pump to the carburetor fuel inlet, a conduit connecting the discharge side of the booster and emergency fuel pump into the suction line of the main fuel pump at a point between said main fuel pump and said check valve, and electric switch means adapted to be closed at a predetermined pressure drop at the carburetor fuel inlet or at a predetermined altitude to complete an electric circuit from the battery through the said electric motor.

9. In an aircraft fuel system, the combination of a plurality of main fuel tanks, a main fuel pump, conduit means including a tank selector for selectively connecting the suction inlet of the main fuel pump to the several tanks one at a time, a valve included in said conduit means between said tank selector and said main fuel pump for restricting flow from said pump back through said selector, a reverse fuel supply container, a combined emergency and booster pump, an electric motor for driving said combined emergency and booster pump, a battery, channel means including a two position valve said channel means

11

being adapted when said two-position valve is in one of its positions for connecting the suction inlet of the emergency and booster fuel pump to the reserve fuel supply container, and adapted when said two-position valve is in the other of its positions for connecting the suction inlet of the emergency and booster fuel pump into the suction line of the main fuel pump at a point between said restricting valve and the selector, a carburetor, a conduit connecting the discharge side of the main fuel pump to the carburetor fuel inlet, a conduit connecting the discharge side of the booster and emergency fuel pump into the suction line of the main fuel pump at a point between said main fuel pump and said restricting valve, and electric switch means adapted to be closed at a predetermined pressure drop at the carburetor fuel inlet or at a predetermined altitude to complete an electric circuit from the battery through the said electric motor.

10. In an aircraft fuel system, the combination of a plurality of main fuel tanks, a main fuel pump, means for selectively connecting the suction inlet of the main fuel pump to the several tanks one at a time, means between said selecting means and said main fuel pump for restricting flow from said pump back through said selecting means, a reserve fuel supply container, an auxiliary pump, an electric motor for driving said auxiliary pump, a battery, a two position valve operable to one position for flow connecting the suction inlet of the auxiliary pump to the reserve fuel supply container, and returnable to the other position for flow connecting the suction inlet of the auxiliary pump into the suction line of the main fuel pump at a point between said restricting means and the selecting means, a carburetor, conduit means connecting the discharge side of the main fuel pump to the carburetor fuel inlet, conduit means connecting the discharge side of the auxiliary pump into the suction line of the main fuel pump at a point between said main fuel pump and said restricting means, and electric switch means to be closed at a predetermined pressure drop at the carburetor fuel inlet or at a predetermined altitude to complete an electric circuit from the battery through the said electric motor.

11. In an aircraft fuel system, the combination of a main fuel supply receptacle, an engine driven fuel pump having its suction side connected to said main fuel supply receptacle, means for restricting backward flow from said pump to said receptacle, a reserve fuel supply container, an electrically driven auxiliary fuel pump, means for

12

selectively connecting the suction side of said auxiliary pump either to said reserve fuel supply container or to said main fuel supply receptacle, a carburetor, the discharge side of the main fuel pump being connected to said carburetor and the discharge side of the auxiliary fuel pump being connected to the suction side of the main fuel pump at a point between said main fuel pump and said restricting means, and electric switch means for starting and stopping said auxiliary pump.

12. In an aircraft fuel system, the combination of a main fuel tank, an engine pump having its suction side connected to said main fuel tank, means for restricting backward flow from said pump to said tank, a reserve fuel container, an auxiliary pump having means at its suction side for connecting it either to said reverse fuel container or said main fuel tank, a fuel metering means, the discharge side of the engine pump being connected to said fuel metering means and the discharge side of the auxiliary fuel pump being connected to the suction side of the main fuel pump between said engine pump and said restricting means, and means for starting and stopping said auxiliary pump.

13. In an aircraft fuel system, the combination of a fuel tank, a main fuel pump having its suction side connected to said fuel tank, a reserve fuel container, an auxiliary pump, selective means for connecting the suction side of said auxiliary pump either to said reserve fuel container or said fuel tank, a fuel receiving means, the discharge side of the main fuel pump being connected to said fuel receiving means and the discharge side of the auxiliary pump being connected to the suction side of the main fuel pump, and means for starting and stopping said auxiliary pump.

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