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AIRPORT FUELING SYSTEM

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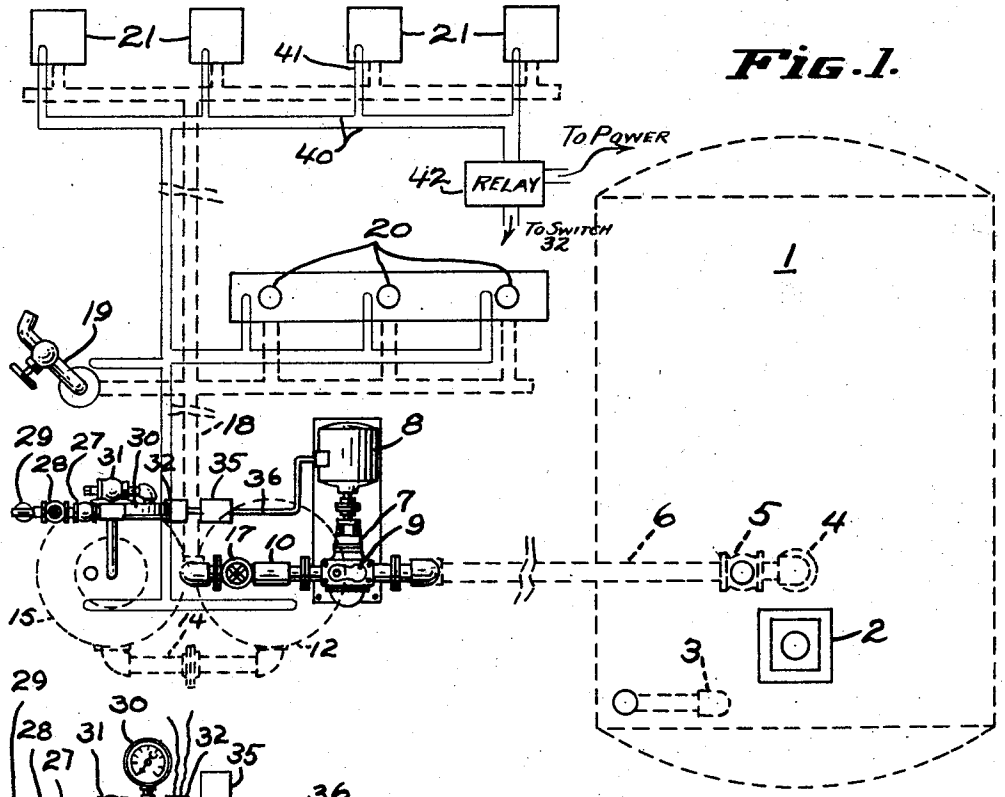


Fig. 1.

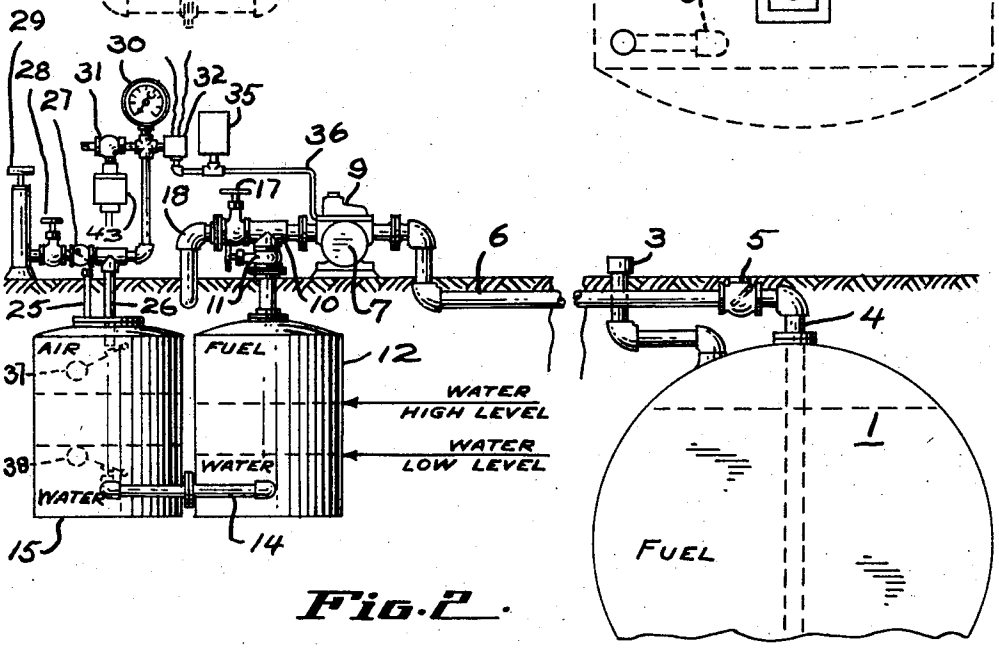


Fig. 2.

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AIRPORT FUELING SYSTEM

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7 Claims. (Cl. 103—6)

My invention relates to airport fueling systems and more particularly to an airport fueling system which is ideally adapted for use in time of war. The system maintains the main storage supply of gasoline or other fuel under safe conditions where it is incapable of flooding the field as might be the case with full pressure systems which are usually dependent on an outside water supply for delivery pressure. This supply may at any time be subject to failure in case of attack.

Among the objects of my invention are: To provide an airport fueling system having maximum safety; to provide an airport fueling system in which the main fuel supply is never under pressure; to provide an airport fueling system wherein means are provided for compensating for varying delivery rates; to provide an airport fueling system that can be electrically operated either from public service power mains, or from a local auxiliary power supply; to provide an airport fueling system having a main supply maintained at atmospheric pressure, with a small auxiliary supply maintained under pressure for emergency use; to provide an airport fueling supply embodying a pump and pump bypass, together with means under normal circumstances for utilizing the pump without the use of the bypass; to provide an airport fueling system wherein a small amount of emergency fuel is maintained under air pressure with means to prevent air being absorbed by the fuel while under pressure, and to provide a simple, safe and efficient fuel supply for airports, designed to withstand attack.

My invention possesses numerous other objects and features of advantage, some of which, together with the foregoing, will be set forth in the following description of specific apparatus embodying and utilizing my novel method. It is therefore to be understood that my method is applicable to other apparatus, and that I do not limit myself, in any way, to the apparatus of the present application, as I may adopt various other apparatus embodiments, utilizing the method, within the scope of the appended claims.

In the drawing:

Fig. 1 is a top plan view of one preferred form of my invention, with the portions of the apparatus normally above the ground shown in solid lines, and with the portions of the apparatus normally below ground shown in dotted lines.

Fig. 2 is a side view of the system shown in Fig. 1 with the preferred ground line indicated.

In many airport fueling systems in use today, the main fuel supply tank containing for example, highly inflammable fuel such as airplane gasoline of high octane rating, is placed under water pressure from the local water supply mains with gasoline outlets led to fuel pits or island outlets for example, scattered over the field. In case of attack for example, or bombing attack of the airfield, these systems are subject to two distinct failures. The first failure may be due to loss of pressure in the water supply mains by breakage thereof, and thus no fuel can be delivered to the fuel outlets. However, another and more serious objection can be raised to such systems in that bombs may open the fuel pit outlets while the water pressure is still on the main tank, thus leading to flooding of the field with large quantities of fuel and ignition thereof. Furthermore, when main storage tanks are placed under water pressure, filling of these tanks after they are empty is slow, as the water must be discharged therefrom. As the tanks are being filled the system becomes inoperative.

My present invention includes a fueling system wherein the main storage tank or tanks can be deeply buried and maintained at atmospheric pressure, so that they may be filled any time without interfering with the operation of the fueling system. A pump is utilized to remove the fuel from the main storage by suction. I am aware that suction pumps have been utilized to take fuel from main storage tanks before, but they have not proved satisfoctory for airport use because of the varying demand imposed upon the pump due to the fact that none or all of the fuel outlets may be in use at one time. Under such conditions, the pump has to be designed to be able to supply all of the fuel pit outlets. When only one of the outlets is being utilized, it has been customary heretofore to utilize a pump bypass to return the excess outlet fuel to the pump inlet. Under these conditions, however, fuel pumps heat up and high-test gasoline for example, becomes hot and introduces gasoline vapor into the pipes. In general such a system is not satisfactory except when a substantially constant demand is being made upon the pump.

In my present invention the only use of such a bypass is as a safety feature in case of failure of other features of my invention later to be described. Furthermore, my invention contemplates the maintenance of a relatively small amount of fuel, under air pressure in a separate tank with the fuel however, being separated from the air by a water column to prevent absorption of air by the fuel, inasmuch as it has been found that high-test gasoline for example, will absorb up to 25% of air when the two are placed in con-

tact under pressure. A certain amount of fuel is therefore maintained as an auxiliary supply in all cases so that in spite of pump failure, this auxiliary supply is always available for use. Furthermore, the amount held in the auxiliary supply is sufficiently small, so that even if the fuel pit outlets were to be opened by bombing, for example, the amount of fuel liberated will not be sufficient to cause a serious conflagration. Under these circumstances I am able to utilize the air pressure against the auxiliary fuel supply as a buffer and filter for absorbing changes in demand on the system, and also utilize the variation of air pressure due to the change in demand, to control the operation of the pump so that the pump need only operate in accordance with the demand as reflected upon the auxiliary supply.

Other safety features are provided so that there will be maximum opportunity for the system to remain in operation under attack. Even though the system be damaged by attack, the system is so protected that the main fuel supply is prevented from flooding the field and the auxiliary fuel supply is sufficiently small to confine any conflagration as a result of the escape thereof to a minor peril.

My invention in detail may be more fully understood by direct reference to the drawing.

A main fuel tank 1 may be buried in the ground to any desired depth. If desired this main fuel storage tank may take the form of a number of separate interconnected tanks. In any event a filling stem 2 is provided extending to the surface of the ground which may also be utilized as a gauge stem. A vent 3 is also provided. A suction outlet 4 is provided, first passing through a check-valve or foot-valve 5 into an inlet pipe 6 of ample size connected to a positive displacement pump 7 preferably positioned above the ground for proper service, driven by a motor 8. This motor 8 may be, for example, under normal conditions operated by the local power supply mains and as is quite customary at airports, a local auxiliary power supply may be utilized for motor 8 with automatic switch-over if desired along with the other electrical appurtenances of the airport so that there will be no interruption in motor service in case of attack and failure of the mains.

The pump 7 is preferably provided with a bypass of any conventional type which is capable of operating at predetermined pressure, indicated by the numeral 9.

The pump discharge is connected by means of pipe 10 through a hand valve 11 to an auxiliary tank 12, this auxiliary tank being preferably buried in the ground and connected at the bottom thereof by connecting pipe 14, to a second auxiliary tank 15 also buried beneath the ground. Tanks 12 and 15 are preferably of substantially the same cubical content, and are preferably placed beneath the ground with their bottoms on the same plane.

Outlet pipe 10 also connects through a main outlet valve 17 to a field pipe line 18 preferably passing beneath the ground to various field outlets as may be exemplified by a tank loading stem 19, island outlets 20 for example, having a capacity of 25 gallons each or more, and a plurality of fuel pit outlets 21 having for example a capacity of 35 to 100 gallons each.

The top of tank 15 is provided with a water fill stem 25 and an upwardly extending air pipe 26, the latter branching above ground to pass in one direction through a check-valve 27, a hand valve 28, to a hand operated air-injector 29. The other branch of air pipe 26 passes to a pressure gauge 30, also to a safety valve 31 and to an air pressure operated switch 32, connected to the electric current supply as indicated above. Pressure switch 32 is set to close at, for example, 25 pounds pressure, and open at 60 pounds. The circuit under the control of pressure-operated switch 32 passes through a motor starter 35, and then through wires 36 to motor 8.

Auxiliary tanks 12 and 15 are preferably of about 300 gallons capacity and are capable of withstanding 100 pounds pressure. Each of these tanks is preferably filled about half full of water. Tank 15 is preferably provided with an upper float-valve 37 controlling the outlet of the tank into pipe 26, and also a second float valve 38 at the bottom thereof controlling the inlet from pipe 14. Both of these float-valves are indicated diagrammatically in dotted lines. Top float-valve 37 is arranged so that it will close if the water level should by accident or otherwise reach the top of the tank, and the bottom valve 38 is arranged so that this valve will close should the water level become too low at the bottom of the tank. The water in the tanks serves as a means of separating the fuel in tank 12 from the air in tank 15, and the fuel in tank 12 is prevented from ever entering tank 15.

In operation, after the tanks 12 and 15 have been filled with water as described, the manually operated air injector 29 is operated until the hand on the pressure gauge 30 shows the minimum pressure required to operate the pressure switch 32. The system is now ready to perform and the current from the mains or other supply may be connected. The pump then starts, due to the action of the pressure switch, and the pump will continue to transfer fuel from the main storage tank 1 to the auxiliary storage tank 12, and will at the same time deliver fuel out to the field lines if any are open. Should any of the field lines be in service and should they take the full capacity of the pump, the pump will continue to operate until some of the lines are shut off. Under these conditions the excess fuel will then fill tank 12, pushing the water from tank 12 into tank 15 through connection 14 until the pressure gauge indicates the maximum pressure desired in tank 15, in which case the pressure switch 32 will shut off the pump. Should some of the fuel lines still be operating they will continue to obtain fuel by delivery from tank 12 until the pressure in tank 15 reaches the minimum value at which time the pressure switch 32 will again start the pump, and repeats the performance. Thus, under normal conditions no fuel will be bypassed by pump 7 inasmuch as the bypass 9 will be adjusted to operate only at pressures above those normally encountered in the normal operation of the system.

The numerous safety devices described above have an important bearing on the operation of the system. For example, the safety valve 31 is only for operation when and if through misunderstanding or otherwise, the air injector 29 is operated when unnecessary, or is operated so long as to raise the pressure in the tank 15 to too high a value. The float-valve 37 at the top of tank 15 will operate only if pressure switch 32 fails to shut off the pump after the pressure in tank 15 has reached its preset maximum. Under these conditions, outlet pipe 26 will be closed to passage of liquid and excess pressure will be set up upon pump 7. Only under these conditions will the bypass operate, and the system will still operate as a

straight pump bypass system until the pressure switch 32 has been serviced. Float-valve 38 at the bottom of the tank 15 will only operate if the power line should fail or be deliberately disconnected. If such is the case and a fuel outlet is still dispensing, the pressure in tank 15 will lower the water level in tank 15 and thereby force water into tank 12, forcing fuel from tank 12 into the fuel outlet at the outlying station until the water level in tank 15 reaches float-valve 38. This float-valve will then close and will not permit any more water to be discharged. No more fuel can be delivered. Thus, there is at all times in tank 12 an amount of fuel available for use as long as pressure remains in tank 15, even though the remainder of the system is disrupted. However, the amount of fuel held in tank 12, which may be for example under maximum pressure about 200 gallons, is not sufficient to cause an extensive conflagaration in case the system fails and one or more of the fuel outlets on the field are rendered open by attack, or for that matter by accident. Thus, the system is fully protected against accident, and is also protected against forcing the entire contents of the main storage tanks onto the field in case of open fuel outlets. Even though the tank 1 is so injured as to break it open and make it available for a conflagration, the fire will be confined to the neighborhood of the buried tanks only, and obviously the main storage tank may be placed at some outlying location where such a fire could not be dangerous to other structures.

If desired, there is one other contingency that may be taken into account from a safety point of view. It is the possibility that one or more of the field outlets 19, 20 or 21 may be bombed open while the current supply to motor 8 is still intact. Under many circumstances, of course, there will be opportunity for operators of the airport to cut off the current supply to the pump in case of attack. However, the possibility might occur that the current supply could not be cut off. If, under there conditions, one or more of the field outlets 19, 20 and 21 were bombed open then the motor and pump might operate to force fuel from tank 1 onto the field through the open outlets until the main storage tank 1 was emptied. This would, of course, flood the field and might cause a conflagration.

In case it is desired to avoid such a possibility, protection can be obtained by providing a continuously energized circuit 40 having series loops 41 extending to a position adjacent each outlet 10, 20 and 21. This circuit may follow the entire extent of the outlet piping of the pump 8 including, for example loops over tanks 12 and 15. The current in circuit 40 may be utilized to hold a relay 42 closed, to connect the main current supply to switch 32. Upon failure of current to pass through any part of circuit 40, relay 42 will open and prevent current from the current supply reaching switch 32.

Under these conditions, if any of the outlets 19, 20 or 21, or any part of the pump outlet piping, is bombed sufficiently to open either the outlets or the pipe, the circuit 40 will be opened at the same time, thus automatically cutting off current to motor 8 and preventing any further operation of the pump 7. The maximum amount of fuel that can then be forced onto the field is the amount held under pressure in tank 12. If, in individual installations it is felt that even this amount of fuel is too much to be released upon the field, a pressure release solenoid valve 43 can be utilized as indicated in Fig. 2, to open safety valve 31 and release the air pressure in tank 15 to the atmosphere upon failure of any part of circuit 40, thereby placing the fuel in tank 12 under atmospheric pressure and preventing this fuel from being forced into any broken outlet.

While I have described my pump as being driven by an electric motor I wish it to be understood that an internal combustion engine can be substituted therefore, with pressure switch 32 controlling the starting and stopping of this engine.

Thus I have provided a system which has maximum safety, not only as to disposition of parts and method of dispensing the fuel, but which also maintains the fuel in main storage tanks at atmospheric pressure, so that they can be filled at any time. At the same time the system maintains a small auxiliary amount of fuel available in case of complete failure of power supply.

I claim:

1. In an airport fueling system which includes a main fuel supply tank, a pump for taking fuel from said tank by suction, field outlets supplied by said pump, and a motor driving said pump; a pair of auxiliary tanks connected together adjacent the bottom thereof, each of said tanks having an amount of water therein, a connection from the top of one of said auxiliary tanks to the outlet of said pump, means for maintaining air under pressure over the water in the other auxiliary tank, and electrical means for controlling said motor in accordance with the pressure of said air.

2. In an airport fueling system which includes a main fuel supply tank, a pump for taking fuel from said tank by suction, field outlets supplied by said pump, and a motor driving said pump; a pair of auxiliary tanks connected together adjacent the bottom thereof, each of said tanks having an amount of water therein, a connection from the top of one of said auxiliary tanks to the outlet of said pump, an air pipe connected to the top of said other auxiliary tank, means for maintaining air under pressure over the water in said latter tank, and a pressure switch operated by pressure in said air pipe and connected to control said motor.

3. In an airport fueling system which includes a main fuel supply tank, a pump for taking fuel from said tank by suction, field outlets supplied by said pump, and a motor driving said pump; a pair of auxiliary tanks connected together adjacent the bottom thereof, each of said tanks having an amount of water therein, a connection from the top of one of said auxiliary tanks to the outlet of said pump, an air pipe connected to the top of said other auxiliary tank, means for injecting air into said air pipe to a predetermined pressure, and a pressure switch operated by pressure in said air pipe and connected to control said motor.

4. In an airport fueling system which includes a main fuel supply tank, a pump for taking fuel from said tank by suction, field outlets supplied by said pump, and a motor driving said pump; a pair of auxiliary tanks connected together adjacent the bottom thereof, each of said tanks having an amounts of water therein, a connection from the top of one of said auxiliary tanks to the outlet of said pump, an air pipe connected to the top of said other auxiliary tank, means for maintaining air under pressure over the water in said latter tank, a pressure switch operated by pressure in said air pipe and connected to control said motor, and means for preventing water from entering said air pipe.

5. In an airport fueling system which includes a main fuel supply tank, a pump for taking fuel from said tank by suction, field outlets supplied by said pump, and a motor driving said pump; a pair of auxiliary tanks connected together adjacent the bottom thereof, each of said tanks having an amount of water therein, a connection from the top of one of said auxiliary tanks to the outlet of said pump, an air pipe connected to the top of said other auxiliary tank, means for maintaining air under pressure over the water in said latter tank, a pressure switch operated by pressure in said air pipe and connected to control said motor, means for preventing water from entering said air pipe, and means for preventing air from passing from one tank to the other through said bottom connection.

6. Apparatus in accordance with claim 1 wherein a normally closed electrical circuit follows the pump supply lines to said field outlets, and means operable by interruption of said circuit for de-energizing said motor, and for releasing the air pressure over said water.

7. An airport fueling system comprising a fuel supply tank; a field outlet for said system having fuel connection with said tank; a motor-driven pump in said connection for pumping fuel from said tank to said field outlet; means responsive to pressure in said system on the discharge side of said pump for determining normal operating periods of said pump motor and pump; and an electric circuit controlling the flow of operating energy to said pump motor subject to said pressure-responsive means, said electric circuit being disposed along said fuel connection to said outlet.

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