

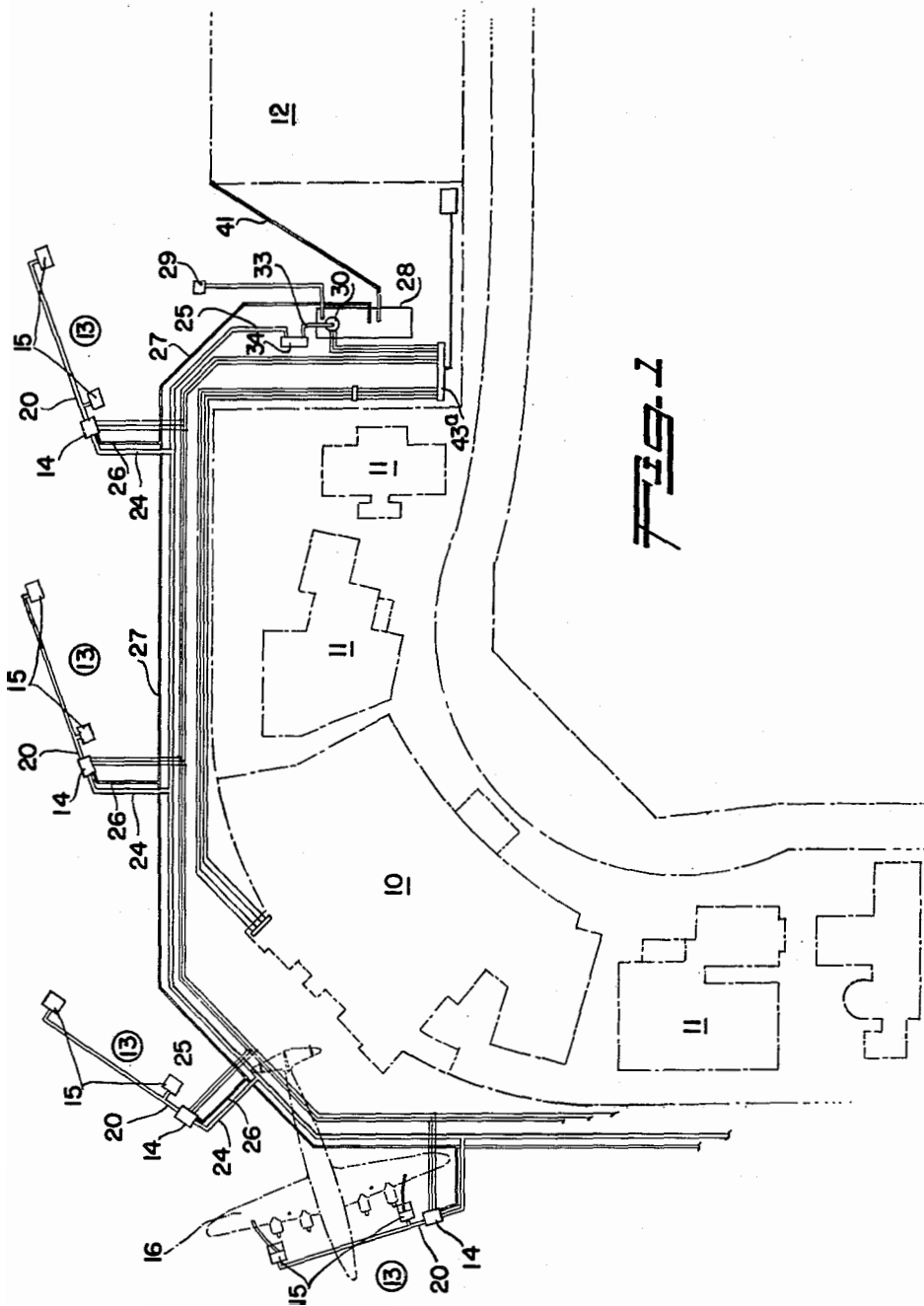
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MULTIPLE REFUELING SYSTEM

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2 Sheets-Sheet 1



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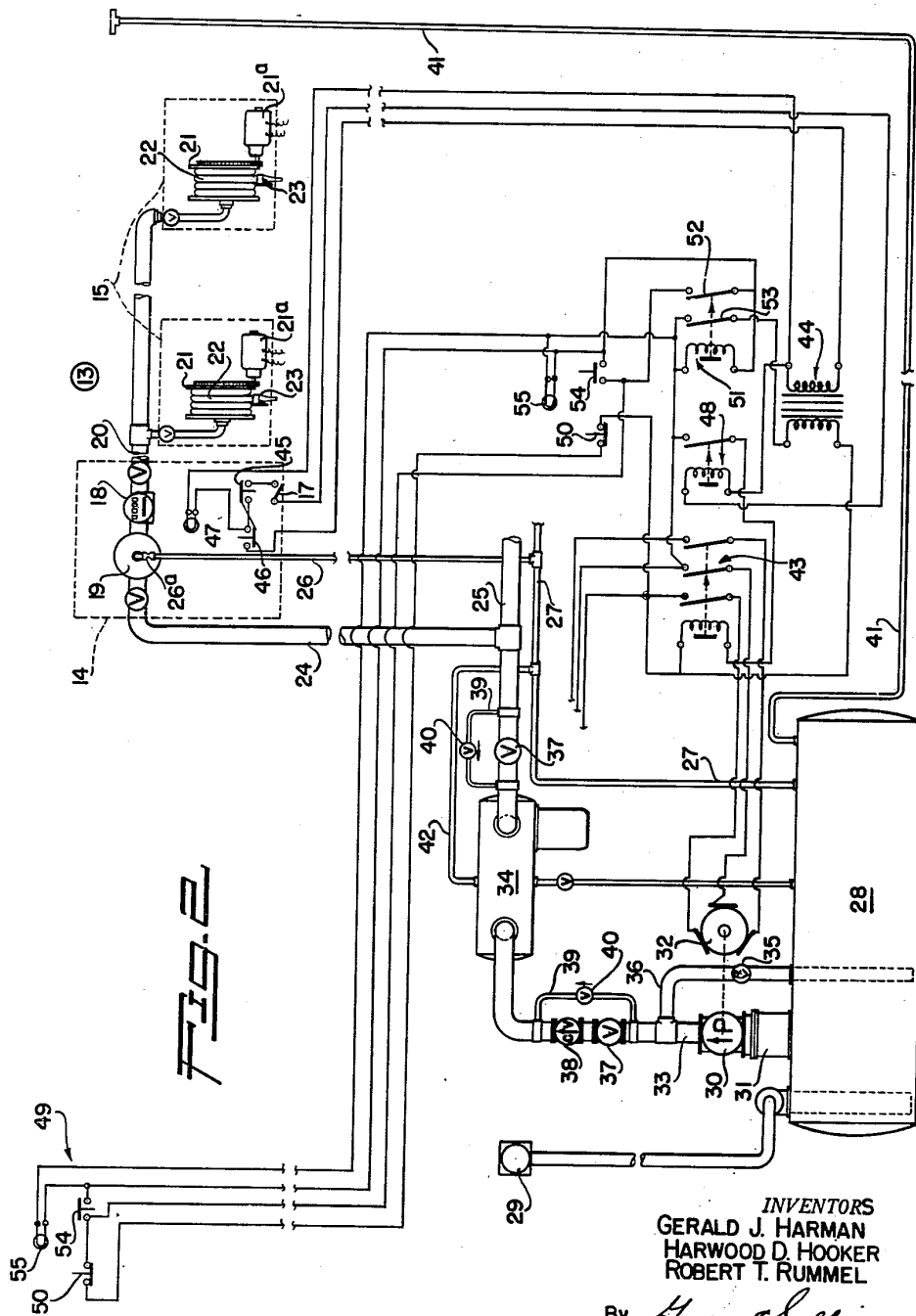
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MULTIPLE REFUELING SYSTEM

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8 Claims. (Cl. 222-26)

This invention relates to a multiple station fuel servicing system for simultaneously refueling a number of separate vehicles, airplanes, or the like.

While the invention is equally useful in connection with refueling ground vehicles, the embodiment chosen to illustrate the invention involves airplane refueling wherein a fuel meter and hose reels are installed in flush pits for the sake of airplane maneuverability at the loading stations. In multiple station fuel servicing systems as now used each station is equipped with individual fuel delivery pumps turned on at the time the fuel delivery hose and nozzle are picked up for delivering fuel into a tank or receptacle. Thus each delivery hose and nozzle constitutes a complete service unit operating independently of any other similar unit. It is, accordingly, an important object of this invention to provide a multiple station refueling system wherein all stations are supplied from a common pumping unit that is started from any of the individual stations, and in which overriding master controls can render all the individual stations inoperative at will, as in the case of fire, spillage, unauthorized operation, or when it is desired to shut down the entire group of individual stations.

It is also an object of this invention to provide an improved refueling system wherein a plurality of fuel dispensing stations are supplied by a single fuel line from a common fuel storage and pumping location, the pump being capable of being started from any of the dispensing stations, and fuel being retained in said common line at all times but being under working pressure therein only when the pump is operating. With this arrangement the line from the single pump up to and through the several dispensing hoses remains at all times filled with fuel to avoid breathing and evaporation losses, while fuel cannot be drawn therefrom until the pump is started.

It is another object of this invention to provide a multiple station refueling system of the type described wherein several individual stations are supplied from a common tank and pump, where each station is provided with start and stop controls for the common pump, operating through a separate circuit in turn controlled by an overriding master control system arranged to disconnect said station control system. Such a novel and advantageous system permits individual control at each refueling station, while the master system can shut down all of the refueling stations but cannot itself restart the system, as one or more of the station controls must call for the delivery of fuel before the common pump is restarted.

It is a further object of this invention to provide a multiple station refueling system of the type described wherein the individual stations are controlled at individual metering pits, with the controls rendered inoperative by closure of the pits so that the central tank pump cannot inadvertently be left running after completion of an individual refueling operation.

Other objects and features of the invention will be readily understood from the following detailed description of a typical preferred form of the invention wherein

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reference will be made to the accompanying drawings in which:

Figure 1 shows an airport terminal layout wherein several airplane loading stations are each arranged with refueling stations supplied from a single source of fuel, embodying the features of this invention; and

Figure 2 is a layout of the fuel lines and control wiring to a larger scale than in Figure 1.

As shown in Figure 1, the layout of Lockheed Air Terminal at Burbank, California, has been chosen to illustrate the installation of this invention. The terminal comprises a central passenger terminal building 10 with adjacent service and office buildings 11 on either side, with one end of a hangar building 12 indicated at the left. Airplane loading stations 13 are spaced around the right side and top of the terminal building at intervals to permit maneuvering airplanes into loading position at any station, without interference with airplanes at either adjacent station.

Each loading station 13 is provided with a flush fuel metering pit 14 and two spaced flush hose reel pits 15 so positioned as to permit simultaneous fueling of the wing tanks on each side of an airplane 16 indicated at one station in Figure 1. The use of flush pits is to prevent interference with airplane maneuverability, and the pits are provided with hinged covers (not shown) so that the airplane wheels can pass thereover when the pits are not open for use in the refueling operation. The opening of the covers closes a switch 17 rendering a control circuit operative, as will later be described.

The meter pit contains a meter 18 to measure the flow of fuel, and an air and vapor separator and filter 19 for assuring that the meter measures only clean liquid fuel. A pipe 20 leads from the meter 18 to hose reels 21 in each of the reel pits 15, which reels carry suitable lengths of hose 22 ending in standard fuel nozzles 23 having valves (not shown) controlling the actual delivery of fuel at the point of delivery of the fuel into the airplane tanks. Each reel 21 has an electric motor 21^a to assist in rewinding the hose onto the reel at the termination of the refueling operation. For accuracy in measurement of the fuel delivered from the meter 18, pipe 20, and hoses 22 remain full of fuel at all times. The meter is supplied fuel through a branch pipe 24 connected into a main fuel line 25 common to all stations, and the air and vapor separator and filter 19 has a vent line 26 leading to a vent return line 27 also common to each station. The vent line 26 contains a small orifice 26^a to bleed off a small quantity of fuel which carries the air and vapor from the top of the separator and filter.

Fuel is supplied to the main fuel line 25 from a large fuel tank 28 with a filler line 29 extending to a location convenient for transferring bulk fuel thereto as from tank trucks or tank cars. Fuel is pumped from the tank 28 by a vertically mounted multi-stage turbine pump 30 extending into the tank through a collared dome 31, the pump being intermittently driven by an electric motor 32. The pump 30 delivers fuel through a pipe 33 to a fuel-water separator 34 mounted above the tank 28, the separator in turn delivering fuel to the main fuel line 25 serving the several refueling stations. A pressure regulating valve 35 in a bypass or return line 36 around the pump limits the maximum fuel pressure developed by the pump, shut off valves 37 are located on both sides of the separator 34 and a check valve 38 is located in the line 33 between the pump and separator, the check valve being provided to prevent the main fuel line and separator emptying back into the fuel tank 28 when the pump is not operating. A small bypass line 39 around the valves 37 and 38 contains a pressure relief or check valve 40 that is arranged to relieve expansive pressures in the separator 34 and fuel line 25 when the pump 30 is not operating,

since the fuel in the long main line is subject to expansion and contraction with temperature variations.

The main vent line 27 leads back to the tank 28, and the tank 28 in turn is vented through a line 41, shown in Figure 1, as extending up a corner of the adjacent hangar building 12 to obtain sufficient elevation. The separator 34 is also connected to the vent line 27 by a pipe 42. It should be noted that all of the fuel piping including the storage tank, meters and reels, are underground installations, only the separator 34 and tank vent 41 extending thereabove.

Referring now to the electrical control circuit, the pump motor 32 is started when desired by a remotely controlled magnetic starter system involving a three phase relay 43 in a control box 43^a adjacent the pump location. Control of the start and stop function is through a second circuit energized by a transformer 44 also in the control box. Power to the motor 32 is a three wire three phase circuit, one phase of which is also used to energize the transformer, which provides low voltage for the second circuit having start and stop switches 45 and 46 located in the meter pit of each refueling station. These switches are of the push button type so that pushing the button of the start switch 45 closes both switches, due to an interconnecting linkage, and pushing the button of the stop switch opens both switches. When switch 46 is closed it lights an indicator light 47 to indicate that the start switch 45 is closed. The switch 46 is pushed to simultaneously open both switches 45 and 46 to both stop the motor and to extinguish the signal light. When any starting switch 45 is closed with the transformer 44 energized, a single pole relay 48 is closed to energize the magnetic starting relay 43 with line voltage.

Since several airplanes may be refueled at the same time it should be noted that the pump is started for the first one and successive added starts have no effect, as the several station controls operate in parallel so that the pump remains in operation until the last stop button is pushed.

Energization of the transformer 44 is controlled by an overriding master control that may conveniently be duplicated at a central operations office station 49 and at the pump control box. Each location is provided with a stop switch 50 which when opened deenergizes a two pole relay 51, one pole 52 of which supplies the power side of the transformer 44, thus rendering the start and stop controls at the meter pits inoperative and releases the magnetic starter 43 to stop the motor 32. The other pole 53 of the relay 51 normally holds the relay closed, but when the stop switch 50 is opened the relay coil is deenergized and the relay 51 opens both poles 52 and 53. Since the relay 51 is deenergized by momentarily breaking the holding circuit at the stop switch 50, a momentary contact reset switch 54 is provided to reenergize the relay 50 which then locks itself in holding position through its pole 53 and reenergizes the transformer 44 through its pole 52 thus rendering the meter pit controls reoperative to start and stop the pump 32. Indicator light circuits 55 are provided at the master controls to show that the pit controls are operative. It will be noted that the master overriding controls operate to completely disconnect the pit controls, rendering them inoperative and thus opening the pump circuit, but that the pump can only be restarted from the pits after the pit circuits have been rendered operative again. Thus the master control in the operations office can be used to shut down the entire system in the event of accident or fire without leaving live circuits in the pits. Moreover the use of a transformer to supply the pit circuits permits use of low voltages for the operating circuits, while high voltages are used for the power circuit to the pump and master controls. For example, 440 volts three phase can be used for power, which is reduced at the transformer to a safe 30 volts for the control circuits.

In the operation of the multiple refueling station system of this invention, the main fuel line 25, branch lines

24, meters 18, hoses 22 and separator 34 are maintained full of fuel by the check valve 38 when the pump 30 is not in operation. Pressure is bled off therefrom, when the pump stops by the bypass lines 39. When an airplane is parked in position at one of the loading stations and is to be refueled, the meter and hose reel pits 14 and 15 are opened, the hoses 22 pulled out and the hose nozzles 23 inserted in the airplane tanks. An operator in the meter pit 14 then pushes the start switch button 45 which causes the pump 30 to start and build up pressure in the main fuel line 25. Fuel delivery into the airplane tanks is controlled by the fuel nozzles 23. When the desired amount of fuel has been delivered to the airplane tanks the fuel nozzles 23 are closed and the operator at the meter pit 14 then pushes the stop switch button 46 to shut down the pump. The hoses 22 are then wound back on the reels 21 with the aid of the reel motors 21^a and the pit covers closed to facilitate maneuvering of the airplane.

Several airplanes may refuel simultaneously at different stations in which case the first station will start the pump and at successive stations the starting switches 45 will close in parallel therewith so that the first station to shut down will not stop the pump 30, which remains in operation until the stop switch 46 at the last station to shut down is operated.

The stop switch 50 at the master control may be operated at any time to release the relay 51, the pole 52 thereof then breaking the circuit to the transformer 44 to render the station stop and start circuits inoperative and thus stop the pump 30 by releasing the magnetic starter relay 43. To reestablish the station controls, the reset switch 54 at the master control is momentarily closed to reenergize the relay 51 which then locks in the transformer 44 through the relay pole 53.

It will thus be seen that we have invented an improved multiple station refueling system wherein fuel delivery is controlled at each station but all stations are supplied from a single storage and pumping station operative only when energized at the refueling stations, with an overriding master control detenergizing the refueling station controls at will.

Having described only a typical form of the invention we do not wish to be limited to the specific details herein set forth, but wish to reserve to ourselves any variations or modifications that may appear to those skilled in the art and fall within the scope of the following claims.

We claim as our invention:

1. A multiple station refueling system comprising a fuel storage tank, a pump drawing fuel from the tank, a main distribution line connected to the pump to directly receive fuel therefrom and having the individual stations connected thereto, a master fuel-water separator interposed between the pump and the main distribution line, pump starting and stopping controls at each refueling station, and a master pump control arranged to stop the pump and deactivate the station controls.

2. A multiple station refueling system as defined in claim 1 including means to deactivate each individual station controls when not in use.

3. A multiple station refueling system as defined in claim 1 wherein a check valve is disposed between the pump and separator to keep said line full of fuel when the pump is not in operation, and means arranged to relieve pressure in said line due to expansion of the fuel therein when the pump is not in operation.

4. A multiple station refueling system as defined in claim 1 wherein the pump is driven by an electric motor operating on line voltage and the pump starting and stopping controls operate on a lower voltage from a transformer energized from the line voltage through the master pump control.

5. A multiple station refueling system as defined in claim 1 wherein the separate refueling stations are each provided with start or stop controls for the pump which

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controls are connected in parallel whereby the pump can be started at any station and will continue to operate until the stop control at the last station in use is operated.

6. A multiple station refueling system as defined in claim 1 wherein the individual stations each have dual fuel dispensing hose lines and fuel nozzles, connected to a common meter, and the flow of fuel is controlled at the fuel nozzles.

7. A multiple station refueling system as defined in claim 1 wherein the pump discharge line to the separator is equipped with a bypass to the tank, and a pressure regulating valve in said bypass to recirculate the fuel when the pump is operating but no fuel is being drawn from the main distribution line.

8. In a multiple refueling station system served by a central storage tank and motor driven pump, the com-

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bination of a pump control system comprising individual pump stop and start controls at each station, a magnetic starter relay responsive to said start and stop controls for the pump motor, manually operable overriding master stop and reset controls in the motor circuit, and a transformer energized by said reset control for energizing the start and stop controls at each station.

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