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FLOW INTERRUPTING MEANS

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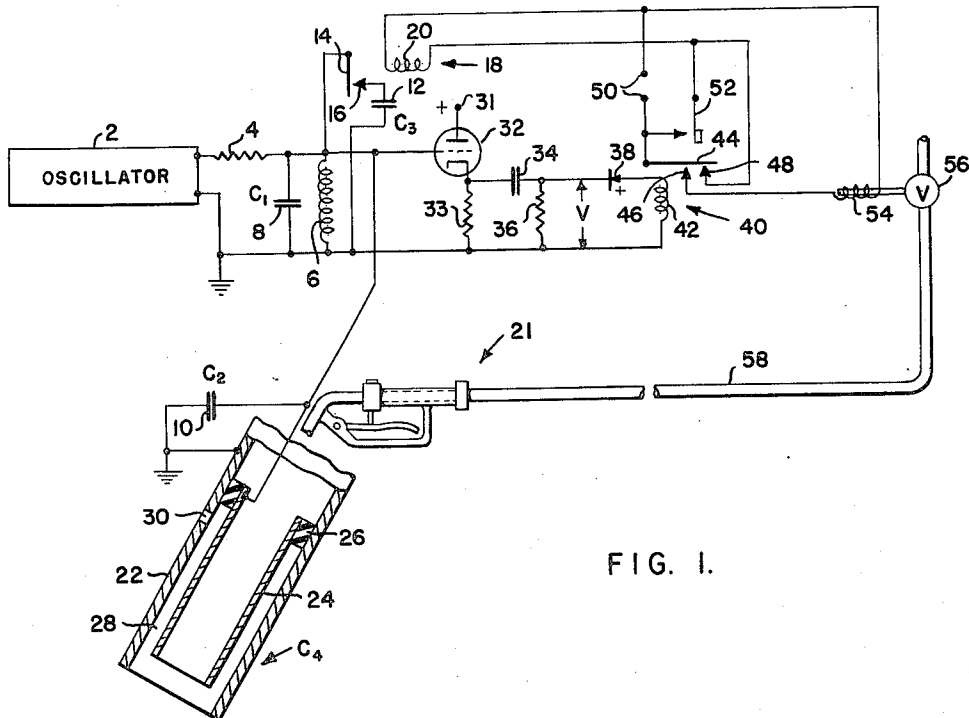


FIG. 1.

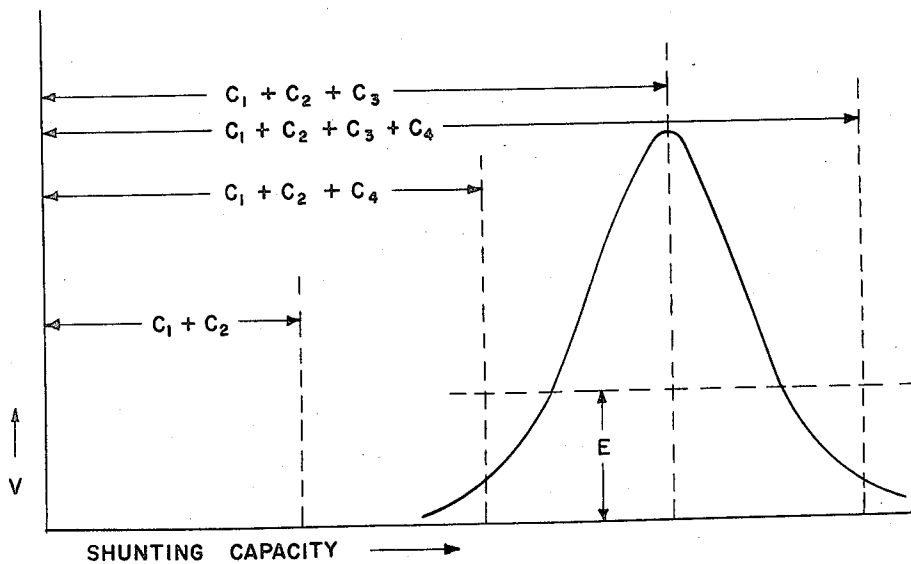


FIG. 2.

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FLOW INTERRUPTING MEANS

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8 Claims. (Cl. 141—210)

This invention relates to flow interrupting means and particularly to the interruption of flow of gasoline to the tank of a vehicle when the tank is filled.

It has been recognized that it would be desirable to provide a device which would automatically close off the flow of fuel to a vehicle when the tank was filled, such a device not only permitting an attendant to perform other services during the filling of the tank but even eliminating the possibility that inattention might result in overflow of high inflammable fuel. Numerous devices have been proposed for performing this function, but they have generally been unacceptable, and may not be used according to law in many localities, because of the possibility that some malfunction might result in spillage of the fuel. Electrical devices of this sort have particularly been discarded because of the danger of ignition due to sparking in cases of accident.

It is the general object of the present invention to provide means for cutting off flow upon the filling of a tank which is of such nature that any accidental disturbance of the system from its proper operation will effect flow cut-off. Furthermore, while the apparatus is electrical, all portions of the circuit in the vicinity of the tank are isolated from any electrical currents which could possibly effect sparking capable of producing ignition. In the vicinity of the tank the currents are only low voltage high frequency currents of such type as is known to offer no danger of ignition.

Further objects of the invention, particularly relating to details of construction and operation, will become apparent from the following description, read in conjunction with the accompanying drawing, in which:

Figure 1 is a diagram showing a preferred embodiment of the invention and illustrating in a fragmentary section a modified filling nozzle; and

Figure 2 is a diagram showing a plot of a voltage and serving to illustrate the nature of the operations involved.

There is illustrated at 2 an oscillator which may be of any convenient form arranged to generate high frequency current at low voltage. The frequency here used is not critical but is desirably in the radio frequency range consistent with the use of low capacitances for tuning and safety from the standpoint of production of any sparks which might possibly produce ignition in case of accident. The frequency may, for example, be about 100 kilocycles per second. The output of the oscillator need only be in the range of a few volts, and this output is delivered to a voltage divider comprising a resistor 4 in series with a tunable circuit comprising the inductance 6 in parallel with capacitance provided variably by a group of capacitances including a capacitor 8 shunted across the inductance 6 at a position adjacent thereto, a capacitor 10 associated with the fuel delivery nozzle, a capacitor 12, and

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a capacitance which is provided by the level of fuel rising between conductors at the portion of the nozzle which is inserted in the fuel tank. The capacitances in the order given will be considered to have the respective values C_1 , C_2 , C_3 and C_4 . As will appear, under varying conditions of the operation these capacitances are selectively paralleled and serve for the variable tuning of the parallel resonant circuit including the inductance 6.

The capacitor 12 which is located adjacent to the inductance 6 is arranged to be switched into the circuit by the engagement of the movable contact 14 with the fixed contact 16 of a relay 18 provided with the energizing winding 20. A generally conventional delivery nozzle 21, adapted to be manually controlled, has its delivery tube 22 modified from conventional construction as shown in the enlarged section. At its delivery end the nozzle tube is associated with the cylindrical tube 24 mounted therein by an insulating ring 26, there being as a result of this mounting an annular space 28 which ordinarily contains air as the dielectric between the tubes 22 and 24. A vent 30 is provided at the upper end of the annular space 28 so that when the tank becomes filled fuel may rise in the space 28 to provide, by reason of its higher dielectric constant, an increase of capacitance between the tubes 22 and 24. The capacitance value C_4 may be regarded as the capacitance which is added as the fuel rises in the annular space. When air is present in this space it may be considered that the small capacitance existing between the tubes is part of the capacitance designated C_2 including as part thereof the capacitance of the capacitor 10.

The signal from the ungrounded end of inductance 6 is delivered to a cathode follower comprising the triode 32 having its anode connected to a positive supply terminal 31, which may be a terminal in the conventional power supply of the oscillator 2, and its cathode connected to ground through the resistor 33. (It may be here noted that the oscillator as well as the cathode follower may, if desired, be powered directly by alternating current, the positive half cycles providing the anode supplies; or, if transistors rather than tubes are used, the power supply may be direct or alternating and provided in conventional fashion.)

The signal from the cathode of triode 32 (or a signal from a corresponding transistor arrangement) is delivered to an RC circuit comprising the capacitor 34 and resistor 36 which has a sufficiently low time constant that at the ungrounded terminal of resistor 36 any component at power supply frequency is sufficiently small to be negligible. The component of the signal at the frequency of the oscillator, however, will have a voltage V approximating the voltage of the signal component appearing at the grid of the triode. At maximum, this voltage may be of the order of a few volts. Rectification is effected by a diode 38 to provide through the winding 42 of a relay 40 an energizing direct current for this relay. The capacitor 34 blocks direct current, and the diode 38 is polarized as shown so that even if direct current leakage occurred through the capacitor 34 it would be blocked by the diode from the relay.

The movable contact 44 of the relay 40 is arranged to engage, when the relay is energized, a pair of fixed contacts 46 and 48. Power supply terminals 50 which may be supplied through a transformer with low voltage alternating current at power frequency are connected respectively to the movable contact 44 and one terminal of the relay winding 20. A push button switch 52, used for starting operation, is arranged for the momentary ener-

gization of relay 18 through the connection of the other terminal 50 with the other terminal of the relay winding 20. It will be noted that the engagement of movable contact 44 with fixed contact 48 shunts the switch 52. The fixed contact 46 is connected to one end of a solenoid 54, the other end of which is connected to the terminal 50 remote from the movable contact 44. The solenoid 54 is arranged, when energized, to open a valve 56 in the fuel supply line 58 running to the nozzle. The valve 56 is closed except when the solenoid is energized, and the arrangement is such that failure of power will prevent flow.

The supply of fuel may be, as usual, from a motor driven pump provided with a by-pass for recirculating flow when the valve 56 (or 21) stops delivery.

Referring to Figure 2, there is shown therein a plot of the voltage V against the total capacitance shunting the inductance 6, the curve corresponding to the resonance curve of the parallel inductance-capacitance circuit. The circuit is initially adjusted so that the peak of this curve corresponds to a capacitance value shunting the inductance 6 provided by the capacitances C_1 , C_2 and C_3 , with air in the annular space 28. Initial adjustment may be made by adoption of suitable fixed capacitors with adjustment of oscillator frequency, or by choosing a fixed frequency and adjusting one of the capacitors 8 or 12. It will be necessary for the voltage V to exceed some value such as E to provide a sufficient direct current through the winding 42 to energize the relay 40.

The operation is as follows:

Assuming that the oscillator is operating, but a delivery operation has not been started, the total capacitance across the inductance 6 will be $C_1 + C_2$, the latter being assumed to include, as stated above, the capacitance between the tubes 22 and 24 when the dielectric between them is air. As will be noted from Figure 2, the circuit is then far off resonance, and the voltage V is much less than the voltage E required to energize relay 40. No conditions of circuit failure involving short circuit or open circuit could at this time produce energization of the relay 40 to effect opening of valve 56. Under these conditions, of course, the manual valve in the nozzle would also normally be closed.

To start a delivery operation, the attendant must push the button to close switch 52 (with which may be associated the usual pump motor starting switch). Closing this switch 52 energizes relay 18 closing the contacts at 14 and 16 to add the capacitor 12 across the inductance 6. The total capacitance then tuning the resonant circuit is $C_1 + C_2 + C_3$, and the voltage V will then be at or near its peak value, providing a direct component through the relay winding 42 to energize relay 40. This occurs almost immediately after closure of switch 52, and the movable contact 44 by engagement with fixed contact 48 shunts the switch 52 so that the conditions initially obtained are maintained. At the same time, the solenoid 54 is energized to open the valve 56, so that flow of fuel into the tank may be initiated by opening of the nozzle valve. It may now be assumed that the outlet tube of the nozzle is inserted in the tank and the nozzle valve is opened and latched in usual fashion so that flow will continue without operation or attention on the part of the attendant.

Flow of fuel into the tank will then continue until the tank becomes filled and fuel rises into the annular space 28 as permitted by the venting of air from this space through the vent opening 30. This introduces a continuous rise of capacitance C_4 until it reaches a critical value at which the total capacitance $C_1 + C_2 + C_3 + C_4$ reaches such value that the voltage V drops to a value such as illustrated in Figure 2 effecting deenergization of relay 42. When this occurs the movable contact 44 is released deenergizing the solenoid 54 to effect closing of valve 56 under its normal spring action, and at the same time contact 48 is disengaged to deenergize relay 18 thus opening the contacts at 14 and 16 to remove capacitance C_3 from

the circuit. The removal of the capacitance C_3 leaves in parallel the capacitances C_1 , C_2 and C_4 . As will be noted from Figure 2, the total capacitance thus provided is on the other side of the peak and corresponds to a value of V which is insufficient to reenergize the relay 40. The valve 56 accordingly remains closed. Restarting cannot then be effected so long as fuel remains in the space 28 even if the switch 52 is closed. Start of flow can only be effected after removal of the nozzle from the filled tank so as to drain from the space 28 the fuel therein. Since this involves action on the part of the attendant, there is no danger of any accidental restarting of the flow. Mere withdrawal of the nozzle will not restart the flow until the switch 52 is again closed.

Since the solenoid 54 can be energized only when the correct capacitance exists across the inductance 6 to tune it near resonance, it is substantially impossible that any changes which may occur in the circuit would produce flow at such a time as the nozzle valve would also be open. All portions of the circuit except the solenoid 54 and the connections at the nozzle may be enclosed in a housing so as not to be subject to change or to sticking of relays because of accumulated dirt. A short circuit in the wiring leading to the nozzle would reduce the voltage V to zero. An open circuit would remove both capacitances C_2 and C_4 , and the removal of C_2 alone will prevent operation whether or not C_4 is present. The capacitor 10 is chosen to insure this and further serves to prevent any possible sparking at the nozzle, though, as already indicated high frequency sparking at the low voltages involved would not produce ignition. An open circuit in the inductance 6, in view of the presence of capacitor 8, would involve a value of V less than the critical value for operation E . Any failure of the oscillator, the cathode follower, or any relay contact or coil will prevent flow. It will thus be evident that the arrangement is such that an extremely high degree of safety is present.

It will be evident that various details of the system may be changed without departure from the invention as defined in the following claims.

What is claimed is:

1. In combination, a delivery conduit for a liquid, means associated with and movable with the delivery end of said conduit providing a capacitance arranged to receive delivered liquid as a dielectric, a resonant circuit including said capacitance as a tuning element, means for exciting said resonant circuit, and means receiving an output from said circuit arranged to interrupt flow of liquid through said conduit upon entry of delivered liquid into said capacitance.

2. In combination, a delivery conduit for a liquid, means associated with and movable with the delivery end of said conduit providing a capacitance arranged to receive delivered liquid as a dielectric, a resonant circuit including said capacitance as a tuning element, means for exciting said resonant circuit, means for including a second capacitance in said resonant circuit, and means receiving an output from said circuit arranged to initiate flow of liquid through said conduit upon the inclusion of said second capacitance in said resonant circuit and arranged to interrupt flow of liquid through said conduit upon entry of delivered liquid into said capacitance.

3. A combination according to claim 2 in which the last mentioned means effects removal of said second capacitance from said resonant circuit concurrently with said interruption of flow.

4. A combination according to claim 2 in which said means for including the second capacitance in said resonant circuit comprises a manually actuable switch for initiating said inclusion and the last mentioned means retains the second capacitance in said resonant circuit until it interrupts the flow.

5. A combination according to claim 1 in which a level of output exceeding a predetermined minimum is re-

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quired to the last mentioned means to maintain the flow of liquid.

6. A combination according to claim 2 in which a level of output exceeding a predetermined minimum is required to the last mentioned means to maintain the flow of liquid. 5

7. A combination according to claim 3 in which a level of output exceeding a predetermined minimum is required to the last mentioned means to maintain the flow of liquid. 10

8. A combination according to claim 4 in which a level of output exceeding a predetermined minimum is re-

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quired to the last mentioned means to maintain the flow of liquid.

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