

[54] ELECTRONICALLY CONTROLLED LIQUID
FUEL PUMP

3,384,021 5/1968 Perron 417/417
3,556,684 1/1971 Roquette 417/417

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[51] Int. Cl. F04b 17/04

[58] Field of Search 417/417

[56] References Cited

UNITED STATES PATENTS

3,361,069 1/1968 Long 417/417

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[57]

ABSTRACT

An electronically controlled electromagnetic pump in which a central armature passage through the annular magnetic winding serves as the pump passage with valves incorporated in the armature and in the passage. A modular electronic control system incorporating a reed switch has a plug in relationship to the winding with a mounting on the inlet side of the pump around the armature and pump passage.

7 Claims, 2 Drawing Figures

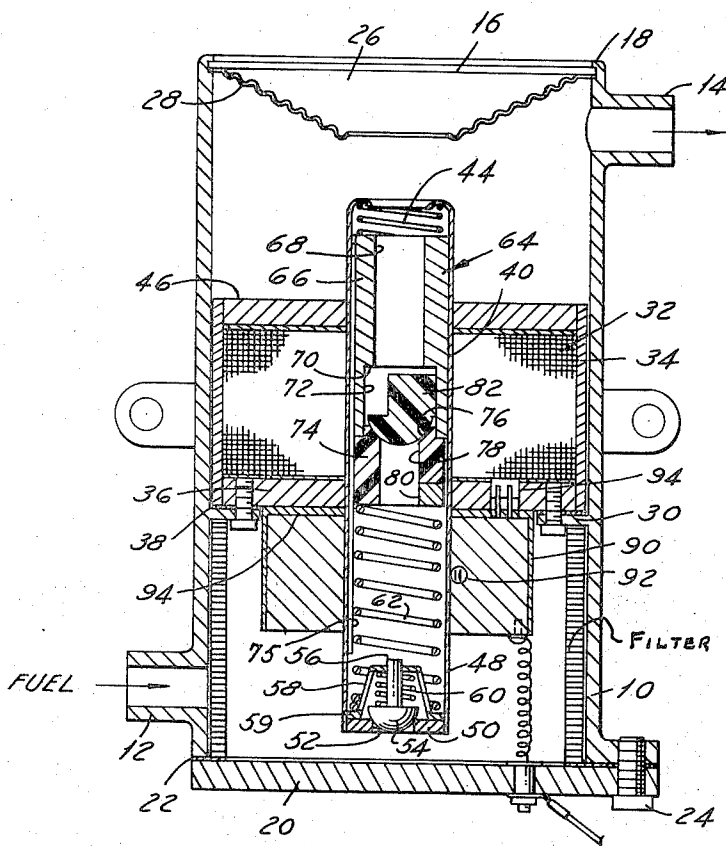


FIG.1

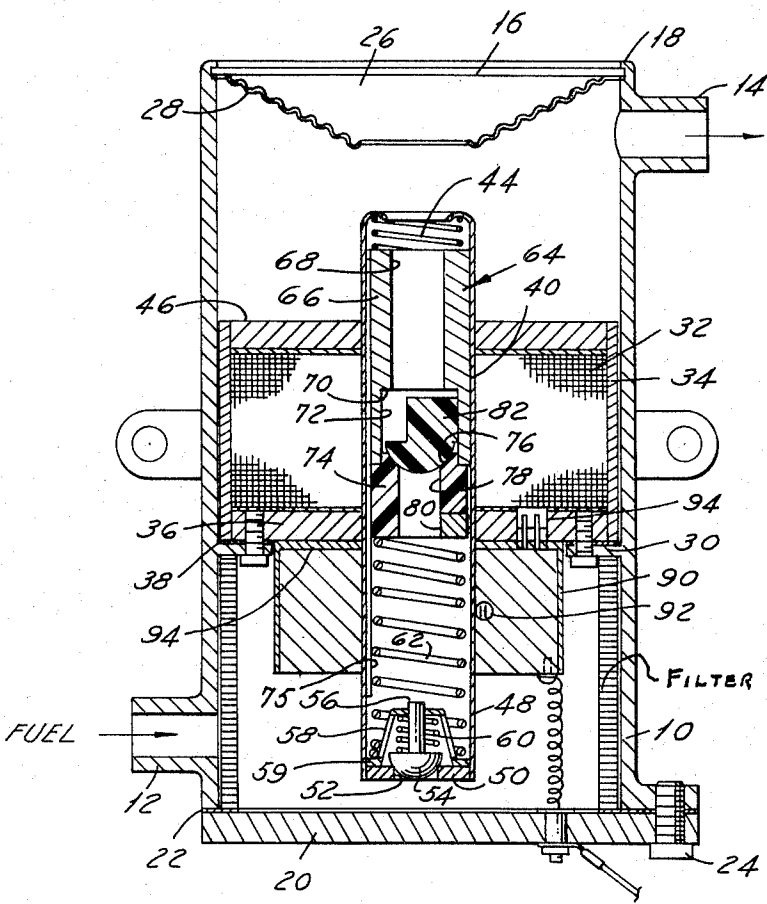
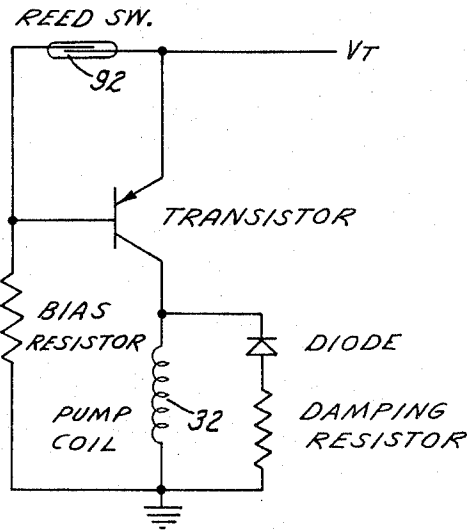


FIG.2



ELECTRONICALLY CONTROLLED LIQUID FUEL PUMP

BACKGROUND OF THE INVENTION

The present invention is intended as an improvement of the liquid fuel pump disclosed in U.S. Pat. No. 3,361,069 to E. D. Long, issued Jan. 2, 1968. The previous construction included a control circuit in the outlet side of the pump unavailable from the removable end plate and thus almost impossible to replace or repair.

With the invention to be disclosed here, the control module is removably installed at the inlet side of the pump in a manner to permit replacement at will. Also, the controlling reed switch is mounted on the inlet side of the armature and responsive to armature movement toward and away from the inlet chamber.

DESCRIPTION OF THE INVENTION

This invention is directed to an Electronically Controlled Liquid Fuel Pump. It is an object of the invention to provide a fuel pump which is less expensive to manufacture, more efficient in operation, and more readily repaired when installed in an automotive vehicle.

DRAWINGS accompany the disclosure and the various views thereof may be briefly described as:

FIG. 1, a vertical section of the pump illustrating the relationship of the parts.

FIG. 2, a circuit diagram illustrating the basic elements of the pump control circuit.

WITH REFERENCE TO THE DRAWINGS: A cylindrical housing 10 has an inlet connection 12 at the bottom of the housing, an outlet connection 14 at the top of the housing, a closure disc 16 at the top held in place by a rolled edge 18, and a bottom closure plate 20 held in place against a sealing gasket 22 by three screws 24, one of which is shown in the drawings.

A booster chamber 26 at the top of the unit is formed by a flexible concave diaphragm 28, the annular edges of which are captured and sealed against a shoulder below the closure disc 16.

On the inner wall of the housing 10 about one third the distance from the bottom, is an annular mount flange 30 on which is supported an annular magnetic solenoid winding 32 housed in a shell 34 having a base 36 sealed against the flange by a gasket 38. There is a tubular shell liner 40 of non-magnetic material such as brass overlying the central opening of the winding and extending above and below the two ends. The top extension is formed inwardly to provide a seat for an armature stop spring 44. On the top of the winding within the shell 34 is a plate 46, which, with plate 36 and shell 34, all formed of magnetic material, completes the solenoid field circuit.

The tubular liner 40 extends downwardly from the solenoid winding to provide a guide tube extension 48 of non-magnetic material stabilized in plate 36. The bottom end of extension tube 48 carries an annular ring 50 which has a central opening 52 to cooperate as a valve seat for a valve 54 having an upwardly extending guide pin 56 guided in a spring housing 58 having a base 59 mounted on ring 50 with an inverted cup shape. The walls of the cup are provided with openings to provide free flow passages for fuel when valve 54 is

open against the closing pressure of coil spring 60 within the cup.

A coil spring 62 is seated at its bottom end on the cup base 59 and at its upper end bears against a pumping armature assembly 64. This assembly consists of a cylindrical iron or steel body 66 having a central passage 68 which is open at the top and which enlarges toward the bottom end at a shoulder 70 to a valve cavity 72. A plastic valve seat insert 74 has a top portion which is press-fitted into the bottom of cavity 72 and which is formed to provide a valve seat 76 around the top of a central passage 78. An insert 80 of permanent magnet (magnetized) material is carried by the plastic insert 74 at a bottom edge to cooperate with a reed switch later to be described. The plastic insert 74 separates the magnet 80 from the iron of the armature which prevents the metal of the armature from robbing the flux field of the magnet. A slot is formed in the outer wall of the armature parallel to the axis to receive and cooperate with a thin guide rod 75 on the inner wall of tubular sleeve 40. This prevents rotation of the armature and thus keeps the insert 80 in a proper orientation for its function.

Within the cavity 72 of armature 66 is a plastic check valve 82 which is axially shiftable in the cavity and shaped to cooperate with valve seat 76. Thus, valve 82 serves as an inlet valve and valve 82 serves as an outlet valve in the armature pump.

The functioning of the armature pump is achieved by a reed-switch circuit contained and sealed within the annular module 90 in a potted arrangement of plastic such as nylon. The reed switch 92 is located near the tube 48 and spaced downwardly from the top of the module 90 in a position to cooperate with the magnetic insert 80 as it moves downwardly in response to the magnetic field of the solenoid winding. The module 90 can be connected to the solenoid lead or leads at connection opening 94.

An actuation circuit similar to that utilized in U.S. Pat. No. 3,361,069 can be incorporated in the module 90 to direct current to the solenoid winding 32. The reed switch 92 is the type that utilizes a pair of conductors in the form of blades of elastic magnetic material having cantilever mounts in the ends of a sealed cylindrical capsule, the free ends of the blades overlapping and normally spaced out of contact. When the switch is placed in a magnetic field with its axis parallel to the path of the flux, the overlapping ends of the magnetic conductors are drawn into contact and the switch is thus closed. The circuitry includes a transistor controlling power to the coil or winding 32 with the reed switch changing state to turn the transistor on and off.

The module 90 is preferably arranged to plug in to winding 32 at 94 so that the module 90, which slips over the tube extension 48, can be readily replaced if malfunction develops in the circuitry. Removable plate 20 provides easy access to module 90 as well as to the valve assemblies and armature assembly. Ring 50 can be removed from tube 48 to provide access to the parts above it.

In FIG. 2, a circuit diagram is shown illustrating the basic elements of the control circuit. The various elements are named in the indicia of the drawings. The pump coil is the solenoid winding 32 and the reed switch is the element 92. In one condition of the circuit, power from the source passes through the transistor

and the solenoid pump coil 32 to energize the solenoid coil thus causing the armature to move against the return spring 62. When the permanent magnet approaches the reed switch 92, it will close this switch and turn off the transistor and thus de-energize the solenoid coil by robbing the bias current. This will cause the armature to return upwardly under the influence of the spring 62. Opening of the reed switch as the magnet 92 retreats will again actuate the transistor circuit to restart the pumping cycle. Thus, the armature, as it moves up and down, will serve as a pump plunger and valves 54 and 82 will open and close to move fuel from the bottom inlet 12 to the top outlet 14 of the pump.

We claim:

1. In an electronically controlled pump of the type having a pump casing provided with a fuel inlet adjacent one end thereof and a fuel outlet adjacent the other end thereof, a solenoid winding, a pump tube centrally of said solenoid winding with one end thereof in fluid communication with said fuel inlet and the other end thereof in fluid communication with said fuel outlet, an armature assembly mounted for axial movement in said tube, bias means yieldably biasing said armature assembly, valves in said tube and said armature assembly, and a control circuit including a reed switch for actuating said solenoid winding, that improvement which comprises said reed switch being mounted adjacent said tube and spaced generally axially from said solenoid winding in fixed relation to said casing, and a permanently magnetized element fixedly carried by said armature assembly for movement therewith to influence said reed switch to change states to de-energize said solenoid winding when said armature has been axially moved with respect to said tube against the bias of said biasing means by energization of said solenoid winding.

2. An electronically controlled pump as defined in claim 1 in which the armature assembly comprises a hollow cylinder of magnetic material providing a central fluid passage, a non-magnetic insert adjacent one end of said cylinder having a passage aligned with that of said hollow cylinder, and a valve seat formed in said

insert, one of said valves being slidably received in said armature assembly to cooperate with said seat, said magnetized element being mounted adjacent the free end of said insert a sufficient distance from said hollow cylinder to avoid any substantial interference with the magnetic field of said magnetized element.

3. An electronically controlled pump as defined in claim 1 in which said control circuit includes a transistor controlling the supply of power to said solenoid winding and said reed switch is included in said control circuit to change the bias of said transistor when said reed switch changes state.

4. In an electronically controlled pump utilizing a solenoid with a yieldably biased armature, that improvement which includes an armature assembly comprising a hollow magnetizable cylinder, a plastic extension on the bottom of said cylinder having a valve seat in a passage aligned with the inside of said cylinder, said plastic extension being affixed to move with said cylinder, a permanently magnetized insert adjacent the bottom of said plastic extension, and a reed switch positioned below said plastic extension to be actuated by said insert when said armature is moved to its down position by solenoid actuation, said reed switch being included in a solenoid control circuit to cut off solenoid power when closed by the proximity of said insert.

5. An electronically controlled pump as defined in claim 1 which also comprises a plug-in module having said reed switch and said control circuit mounted thereon, said module being removably received within said pump casing, said pump casing having an opening providing access to said module, and a cover closing said opening and removably secured to said pump casing.

6. An electronically controlled pump as defined in claim 5 wherein said opening of said pump casing and said cover are adjacent the fuel inlet end of said pump casing.

7. An electronically controlled pump as defined in claim 5 wherein both said reed switch and the components of said control circuit are sealed within said module.

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