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PUMP

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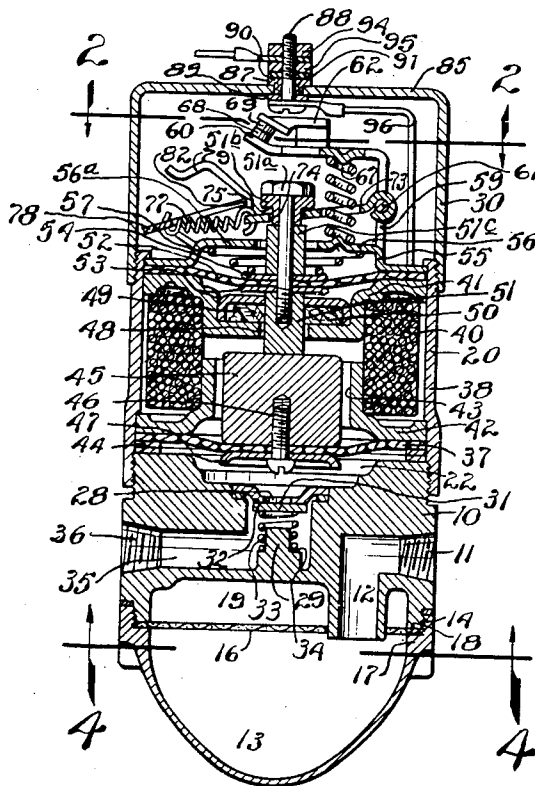


Fig. 1

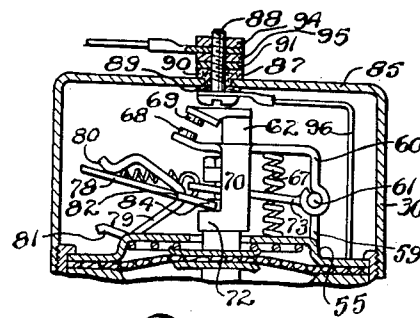


Fig. 3

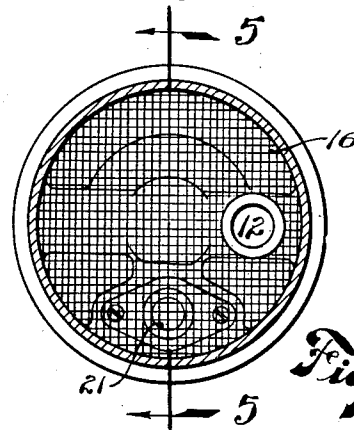


Fig. 4

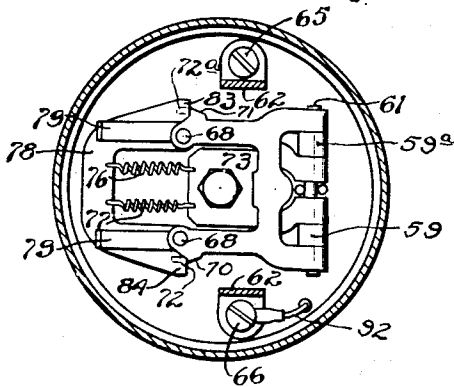


Fig. 2

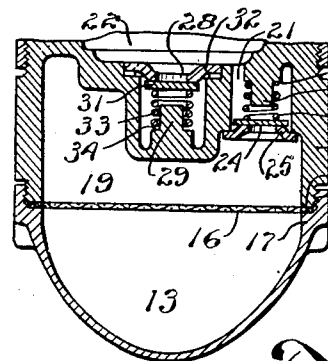


Fig. 5

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## UNITED STATES PATENT OFFICE

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## PUMP

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This invention relates to fuel pumps of the electrically operated type. Pumps of this type are used for many purposes, as for instance, conveying liquid fuel from the supply tank to the carburetor of an internal combustion engine.

Since a primary requirement in fuel pumps is absolute certainty and safety of operation, any features which tend toward improvement in these respects are of great and fundamental importance. As all fuels are more or less volatile, an immediately obvious hazard of electric pump usage arises from the possible leakage of gasoline liquid or fumes from the pumping compartment to the arcing electrical units. It is a primary object of the present invention to prevent any access of fuel or fumes to any sparking units.

Another problem in this type of pump is to maintain a uniform and certain length and duration of the magnetic suction stroke, as unless such a uniform length and steady character of stroke is maintained the pumping mechanism has a tendency to flutter and fail to operate. It is necessary to keep the electrical circuit controlling the magnetic unit closed for the duration of a fully completed suction stroke and then to open it positively. It is therefore an important object to provide a switch mechanism which will accomplish the "making" of the circuit at the end of the spring actuated delivery stroke and the "breaking" of the circuit at the end of the suction stroke, thereby governing exactly the length and certainty of the aforementioned suction stroke.

The pump herein shown and described is of the diaphragm type, and while the substitution of a metal bellows or other expansible unit is contemplated as a possible variation in construction, it is nevertheless an object to provide a construction such that the cloth type diaphragm found so practical and economical in mechanical pumps may also be practical for use in electrical-ly operated units.

For purposes of facility of assembly and service it is a further object to provide a separable construction for the reciprocating parts of the mechanism in order that a unit, such as for instance the expansible pumping unit, may be disassembled for service without disturbing the assembly of other units.

The above and further objects will appear more fully from the following detailed description and by reference to the accompanying drawing, wherein—

Fig. 1 is a vertical cross section of the assembled pump unit showing the inlet and outlet,

and the pump chamber as well as the electro-magnetic and switch mechanism;

Fig. 2 is a section taken on the line 2—2 of Fig. 1 and shows the top view of the switch mechanism;

Fig. 3 is a section similar to Fig. 1 but includes only the switch section and shows said switch in the opposite position from that shown in Fig. 1;

Fig. 4 is a section on line 4—4 of Fig. 1 and shows the inlet and the screen provided above the filter bowl at the bottom of the pump;

Fig. 5 is a section on line 5—5 of Fig. 4 and shows the pump chamber as well as the inlet and outlet check valves.

Referring now to the construction illustrated in the drawing and shown particularly in Fig. 1, the pump construction selected for illustration is composed of three main portions, namely, a fuel unit casting 10, an electro-magnetic unit 20 and a switch unit 30. The fuel unit casting 10 has an inlet 11 suitably threaded for a supply line fitting, not shown, and which inlet continues into a conduit 12 which opens into a filter bowl 13 attached to the fuel unit casting 10 as shown at 14. Between the filter bowl 13 and the fuel unit casting 10, there is provided a screen 16 and gasket which are clamped between the flange 17 of the filter bowl 13 and a mating edge 18 on the fuel unit casting 10.

As shown in Fig. 5, a chamber 19 is enclosed by the fuel unit casting 10 shown here as above the screen 16 and from this chamber 19 there is provided an inlet passage 21 to a main pump chamber 22. An inlet check valve 23 comprising a valve disk 24 is located in the inlet passage and is held against a seat 25 by a spring 26 supported on a pedestal 27. It will be noted that this check valve allows flow into but not out of the main pump chamber 22. As shown in both Figs. 1 and 5 an outlet passage 28 leads from the main pump chamber 22 and is provided with a check valve 29 which allows flow only outward from the main pump chamber. The check valve 29 is made up of parts similar to those of the inlet valve, i. e., valve disk 31, seat 32, spring 33 and pedestal 34. The outlet passage 28 continues in a passage 35 which leads to an outlet 36 provided with threads for connection to a fuel supply line, not shown.

Between the fuel unit casting 10 and the magnetic unit 20 there is a diaphragm 37 which closes one end of the pump chamber 22, and it is the reciprocating flexure of this diaphragm which provides the necessary changes in the volume of the pump chamber 22, to cause fuel to

enter through the passage 21 when the diaphragm moves outwardly of the pump chamber and then to pass out through the outlet passage 28 when the diaphragm moves inwardly of said chamber.

The magnetic unit 20 is housed in an annular casing 38 preferably provided at one end thereof with any suitable means to secure it to the fuel unit casting 10. Within this casing 38 is contained an electromagnetic winding 40, between a magnet stop member 41 and a shell member 42 with an annular flange 43 projecting into the electromagnet core toward the stop 41 but affording a substantial gap therebetween. The shell member 42 also serves to clamp the main diaphragm 37 against the adjacent end of the fuel unit casting 10, a suitable gasket 44 being interposed between the parts 10 and 42.

A magnet plunger 45 preferably of cylindrical shape is secured to the main diaphragm 37 by a screw 46 and flanged washer 47. The plunger 45 is of such size as to operate within the annular flange 43 of shell member 42 with ample clearance.

The stop 41 of the magnetic unit is provided with a central opening 48 in the base of a cup shaped recess 49 in which is pressed felt packing 50 surrounding a switch shaft 51 which projects through the opening 48 and merely rests or abuts against the plunger 45 so that the diaphragm 37 with the plunger 45 attached may be removed for service without disturbing the parts associated with the shaft 51. A secondary diaphragm 52 is shown as located at the other end of the magnetic unit 20 and is secured at its center to the shaft 51 between a pair of flanged washers 53 and 54 clamped upon the diaphragm by means of screw 51a and the shaft parts 51b and 51c. The secondary diaphragm 52 is also clamped adjacent to its outer edge between the magnet stop 41 and a switch base member 55. The base member 55 affords a supporting base for the switch unit 30 and is preferably shaped at the center to form on the under side retaining lugs 56, 56a for one end of the delivery stroke actuating spring 57. The other end of spring 57 acts against the flanged washer 54 and thereby exerts pressure through the shaft 51 and tends to urge the shaft and the main diaphragm 37 and secondary diaphragm 52 in a direction inwardly of the pumping chamber 22 to perform the delivery or outflow stroke of the pump as will presently be more fully described.

Consideration will now be given the detailed parts of the switch unit 30 which are mounted upon the base member 55. A pair of brackets 59, 59a are formed on the base member 55 and support a swinging switch contact carrying member 60 pivoted on a pin 61 while a fixed switch contact carrying member 62 (see Figs. 1 and 2) is secured to base member 55 by screws 65 and 66, insulating washers (not shown) being interposed between the member 62 and base member 55. Contact points 68 on the swinging switch contact carrying member 60 are held normally against contact points 69 of fixed member 62 by a spring 67. The swinging switch contact carrying member 60 has two projecting arms 70 so shaped as to provide a pair of L-shaped ends 72, 72a as shown at 72 in Fig. 3. Pivottally mounted on the pin 61 carried by brackets 59, 59a is an actuating arm 73 which has a hole 74 of such size as to fit loosely in slot 75 in the switch shaft 51. It is apparent that the actuating arm 73 will be swung upon the pivot pin 61 in accordance with the movements of the

shaft 51 by the above described mechanism. To the end of the actuating arm 73, two springs 76 and 77 are connected, with their opposite ends secured to a switch flapper member 78, the inner end of which is held by said springs 76, 77 into the notch 82 of V-shaped bracket 79, the notch 82 at the point of the V thus providing a pivoting point for the switch flapper member 78; stops 80 and 81 for limiting the movement of the flapper 78 being provided adjacent the outer legs of the V-shaped brackets. The switch flapper member is preferably U-shaped, as shown best in Fig. 2, so that there are projecting ends 83 and 84 adapted to contact the L-shaped ends 72, 72a respectively of the switch contact carrying member 60, as best shown in Fig. 3.

Considering Figs. 1 and 3 with the last described mechanism, it will be apparent that when the plunger 45 and switch shaft 51 start to move from the position shown in Fig. 1, the actuating arm 73 will be swung upon its pivot to move the springs 76 and 77 therewith and when the latter are sufficiently off center they will cause the switch flapper member 78 to snap from the position shown in Fig. 1, i. e., resting against stop 81, to the position shown in Fig. 3, i. e., resting against the stop 80. When this snap over occurs, the ends of the switch flapper member 78 are caused to strike the L-shaped portions 72, 72a of the projecting arms 70 and 71 on the swinging switch contact carrying member 60 and cause a definite breaking of the contact points 68 away from 69, which were normally held in contact by the pressure of the spring 67.

The switch unit 30 may be provided with a suitable cover or housing 85 secured to the casing 38 by suitable means.

A suitable binding post 87 comprising a bolt 88 is secured to, but insulated from, the cover 85 by means of conventional fibre insulations 89 and 90 provided with conventional washers 91, as well as two nuts 94 and 95. A suitable electrical connection 96 to the magnet winding 40 is provided from the inner end of the binding post 87 as shown. The opposite end 92 of the magnet winding may be connected to the insulated fixed switch contact carrying member 62 and thereby provide for carrying the circuit from the winding 40 to the contact points 69 and thereby to the contact points 68, when the switch unit is in the closed position, the remainder of the switch unit being on the grounded side of the circuit.

The operation of the device is as follows:

In the initial position of the parts as shown in Fig. 1 with the switch shaft 51 and the diaphragm 37 in the position they would occupy at the extreme limit of a pumping or delivery stroke, the switch will have just been actuated to close the circuit to the magnet winding, the switch contacts 68 and 69 being held together by the action of the spring 67 upon the swinging switch contact carrying member 60 so that the electrical circuit will be closed to energize the electromagnet winding 40 and will therefore exert a force upon the plunger 45 to move the same inwardly of the magnet coil in accordance with the well known operation of devices of this character. As the plunger 45 moves, it carries with it the main diaphragm 37, the switch shaft 51 and all of the units connected thereto. This means that the diaphragm 37 will move outwardly of the pump chamber to cause a definite increase in the volume of said chamber 22 and set up a suction therein which will cause fuel which has

been allowed to enter through the inlet 11 and conduit 12, to be sucked through the screen 16 into the chamber 19 and thence into the pump chamber 22 through the passage 21, the check valve 23 in this passage opening automatically to allow such entry.

With the above described movement of the switch shaft 51, the actuating arm 73 because of its engagement with the slot 75 in said switch shaft 51 is swung upon its pivot and as the shaft 51 is swung upon its pivot and as the shaft 51 nears the end of its stroke, the position of the actuating arm 73 and springs 76, 77 will be sufficiently past center to cause snap over of the switch flapper member 78 upon its fulcrumed engagement with the notch 82 from a position against stop 81 to a position against stop 80. During this change the ends 83, 84 of the flapper 78 will strike against the L-shaped portions 72, 72a of the switch contact carrying member 60 and thereby positively move the contact 68 out of engagement with contact 69, thus cutting off the electrical circuit to the magnet winding 40. When this occurs the spring 57 becomes operative to cause the switch shaft to be forced in a direction to perform a delivery stroke moving the plunger 45 and main diaphragm 37 also and decreasing the volume of the pump chamber 22, thus causing the fuel drawn therein by the preceding suction stroke to be forced out through outlet passage 28, through check valve unit 29. The fluid then flows through the passage 35 and out the outlet 36 into the supply line not shown. As the switch shaft 51 starts its delivery stroke, the actuating arm 73 moves with it and near the end of the outflow stroke the flapper member 78 will snap over from position against stop 80 to position against stop 81, thereby relieving the pressure at 72 and 72a which held the swinging contact carrying member 60 in its open circuit position, shown in Fig. 3. This allows the spring 67 to again push the contacts 68 and 69 together and start the cycle all over again. It is important to note that the construction of the switch and associated parts is such that the "making" of the circuit occurs only at a predetermined point in the delivery or outflow stroke and the "breaking" of the circuit occurs only at a predetermined point in the suction stroke, the making and breaking each being effected to prevent objectionable arcing, and the circuit being held definitely closed until the completion of a desired suction stroke and open until the completion of a desired pumping stroke, respectively.

In following through the above described cycle of operation it is to be remembered that the provision of a spring or other resilient means to actuate the pump for a delivery stroke makes it possible for the pump to regulate itself to varying demand for fuel or other liquid pumped. This comes about from the fact that when the pump has built up a pressure in the supply line, i. e., the line connected to the outlet 35, the delivery stroke actuating spring 57 will move the main diaphragm 37 against the pressure in the supply line only when the pressure is less than that exerted by the spring. Therefore the pump will cease operating when the pressure in the line builds up to an amount in excess of the spring pressure. It will thus be apparent that the operation of the pump will depend upon the demand for fluid at the place of use. While it is understood that the use of a pump with spring actuated delivery stroke is not broadly new, however, this feature combined with the switch and magnetic means herein disclosed provides an

electrically operated pump which can be successfully used in a line whose demand for liquid may be greatly varying over a considerable period of time. This pump, so installed, will adapt itself to the maintenance of a predetermined pressure in the line regardless of flow and will pump intermittently as required. Furthermore, it will use current only when actually effecting a suction stroke which is always a relatively quick one, while with small demand the delivery stroke may be relatively of long duration. This feature of using current only on the suction stroke is accomplished by the construction of the switch mechanism, since as long as the pressure in the line is sufficient to overcome the spring 57, the shaft 51 will be held in a position such that the switch flapper member 78 will maintain the position shown in Fig. 3 therefore holding contact point 68 separated from point 69 and maintaining an open circuit. However, as soon as the line pressure drops sufficiently to allow the diaphragm 37 and the shaft 51 to move toward the end of the delivery stroke, then the switch parts will snap over to the position shown in Fig. 1, i. e., with switch contacts closed which immediately completes the circuit to the magnetic unit and starts a suction stroke, at the completion of which the pump then performs a delivery stroke in accordance with the pressure in the supply line as previously described.

It is to be noted that the construction of the magnetic unit is such that the plunger 45 is moved inwardly of the coil with a minimum tendency to pull to one side or the other because of the inwardly projecting annular flange 43 on the shell member 42. This flange provides for a small gap between itself and the stop 41, which is not provided in the conventional plunger electromagnet between outer metal shell and stop. With the short stroke required for pumping action the small gap is sufficient and the additional metal serves to straighten and concentrate the magnetic lines of force in the axial direction so that the tendency for side pull on the plunger is reduced to a minimum. This feature is very important with this type of pump since it overcomes necessity for elaborate bearings and allows the use of a cloth type diaphragm if desired, but if a marked side pull were present such a construction would be impossible.

Although a particular pump construction has been used to illustrate the principles of the invention, it is apparent that various changes and modifications might be made without departing from the novel and basic features of construction which constitute the invention. For instance, in order to make use of the sealed compartment with secondary diaphragm and switch means illustrated, the position of said switch unit is not necessarily limited to that shown. Also the location of parts such as the filter bowl and screen in the position shown, although considered a very practical construction, might not be combined with the pump in all installations. Other obvious variations and modifications will be apparent to those skilled in the art as indicated by the scope of the following claims.

I claim:

1. In an electrically operated pump comprising, a pumping unit, a switch unit for controlling said pumping unit and a switch operating member movable with said pumping unit to control the strokes thereof, sealing means secured and movable with said switch operating member and

interposed between said switch unit and said pumping unit whereby said switch unit is sealed against leakage from said pumping unit to said switch unit.

2. In an electrically controlled pump, a pumping unit, a switch mechanism located separate from said pumping unit, pump actuating means controlled by said switch mechanism, a switch operating member movable with said pump actuating means, and sealing means secured to and movable with said switch operating member and interposed between said switch unit and said pumping unit whereby said switch unit is sealed against liquid or fume leakage from said pumping unit to said switch unit.

3. In an electrically operated reciprocating pump, reciprocating electrical means for actuating said pump, a switch unit for controlling the reciprocation of said electrical actuating means, a switch operating member mounted for reciprocation with said pump, and a sealing diaphragm secured to said switch actuating member and interposed between said switch unit and said pump thereby to seal said switch unit against liquid or fume leakage from said pump.

4. In an electrically operated pump having a pumping unit, a magnetic unit and a switch unit for actuating and controlling said pumping unit, a main diaphragm for inducing pumping action which also forms a dividing wall between said pumping and magnetic unit, and a secondary reciprocating diaphragm forming a dividing wall between said magnetic unit and said switch unit.

5. In an electrically operated reciprocating pump, electrical means for actuating said pump, a switch unit separate from said electrical means for controlling the actuation of said electrical means, a main pumping diaphragm forming a dividing wall between said pump and said electrical means and a secondary reciprocating diaphragm forming a dividing wall between said switch unit and said electrical means.

6. A pump comprising, a head, inlet and outlet check valves for controlling flow through said head, a casing secured to one side of said head providing a compartment therein, magnetic means enclosed in said compartment, a reciprocating pumping element operated by said magnetic means and cooperating with said inlet and outlet check valve for providing pumping action, a second casing secured to said first mentioned casing providing a compartment therein, electrical switch means for controlling said magnetic

means located in said compartment of said second casing, a member mounted for reciprocation with said pumping element for operating said switch means, and sealing means secured to said member and between said casing members thereby to seal said magnetic means from said electrical switch means.

7. In an electrically operated pump, a main diaphragm the reciprocation of which induces a suction stroke in one direction and a delivery or outflow stroke in the opposite direction, a plunger secured to said diaphragm and projecting therefrom, means normally urging said plunger and said diaphragm in a direction to produce a delivery or outflow stroke of said pump, an electro-magnet winding providing power to actuate said plunger, switch means normally maintaining an electrical circuit through said winding to thereby actuate said plunger and said main diaphragm to induce a suction stroke of said pump, a shaft movable with said plunger and contacting said switch means to actuate the latter to open the electrical circuit at the end of said suction stroke and means including a secondary sealing diaphragm secured to said shaft to form a compartment enclosing said switch means to isolate said switch compartment from the other parts of the pump.

8. An electrically operated pump having a pump chamber, a pumping element located in said chamber, switch means for controlling the strokes of said pumping element, sealing means for isolating said switch means from said pump chamber, and a member secured to and extending through said sealing means from said switch means and making abutting contact with said pumping element, whereby said pumping element may be disassembled without disturbing said switch means or said sealing means.

9. An electrically operated pump of the type employing a reciprocating pumping unit, a switch for controlling the strokes of said pumping unit having arcing contact points, switch operating means movable with said pumping unit and operatively associated with said switch unit to operate the latter at the ends of the reciprocations of said pump characterized by a member associated with said pumping unit to reciprocate therewith and projecting toward said switch unit, and sealing means secured to said member for isolating said switch unit from said pumping unit to form a fluid-tight and fume-tight seal between said pumping unit and said switch unit.

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