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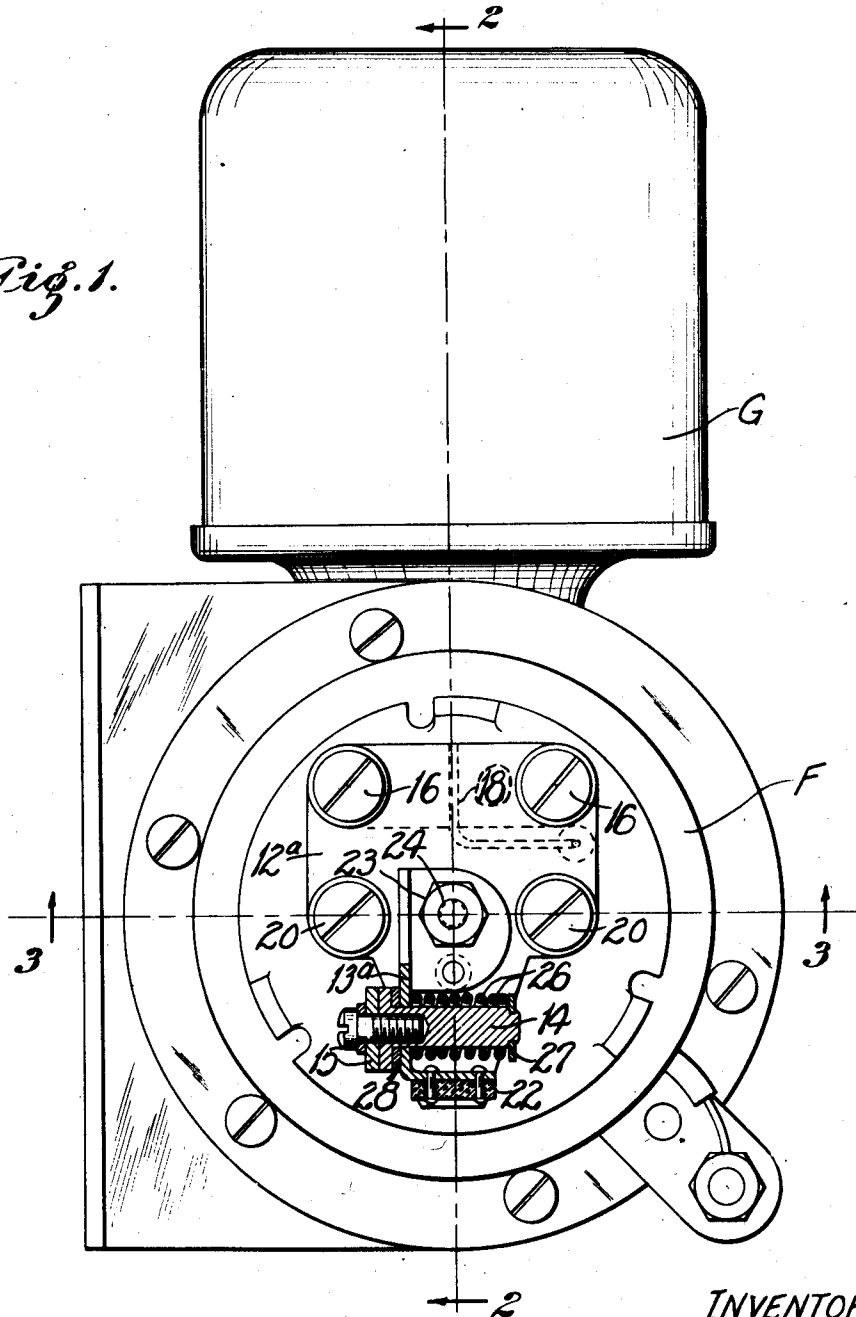
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LIQUID FUEL PUMPING APPARATUS

Filed Feb. 27, 1925

3 Sheets-Sheet 1

Fig. 1.



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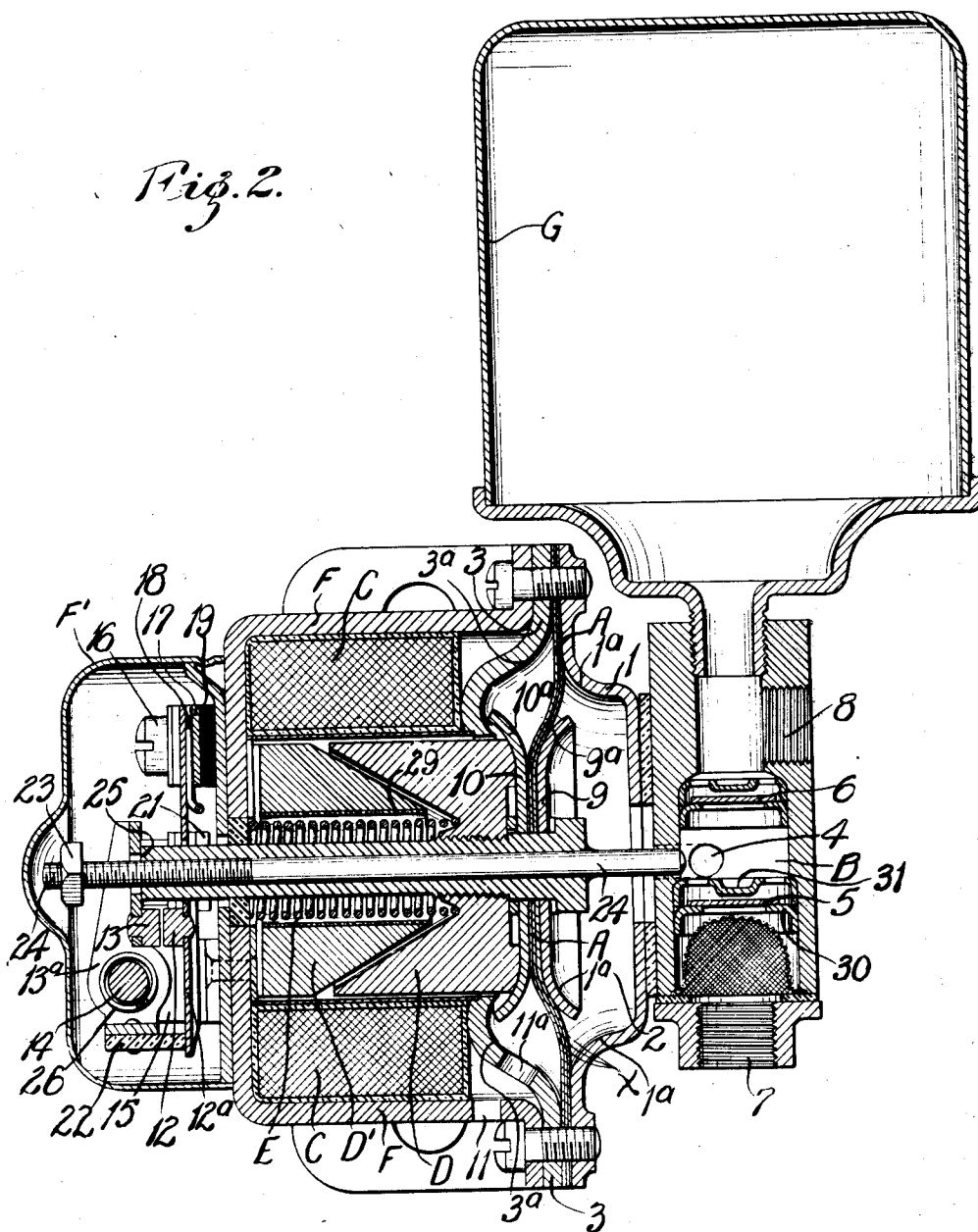
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LIQUID FUEL PUMPING APPARATUS

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3 Sheets-Sheet 2



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LIQUID FUEL PUMPING APPARATUS

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3 Sheets-Sheet 3

Fig. 3.

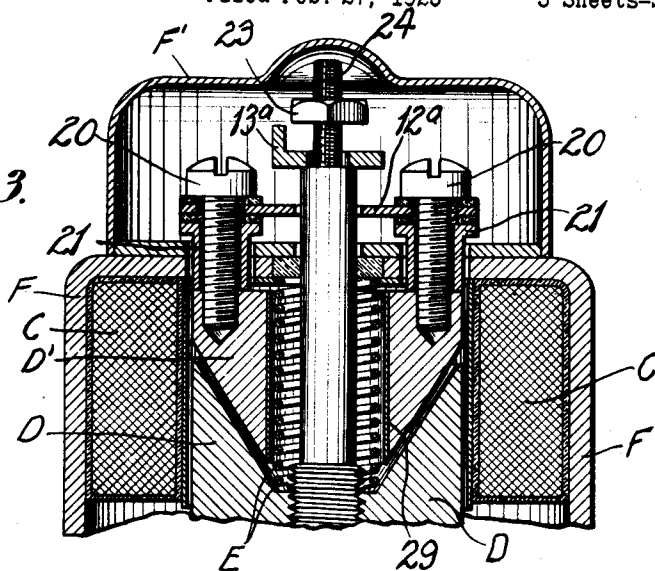
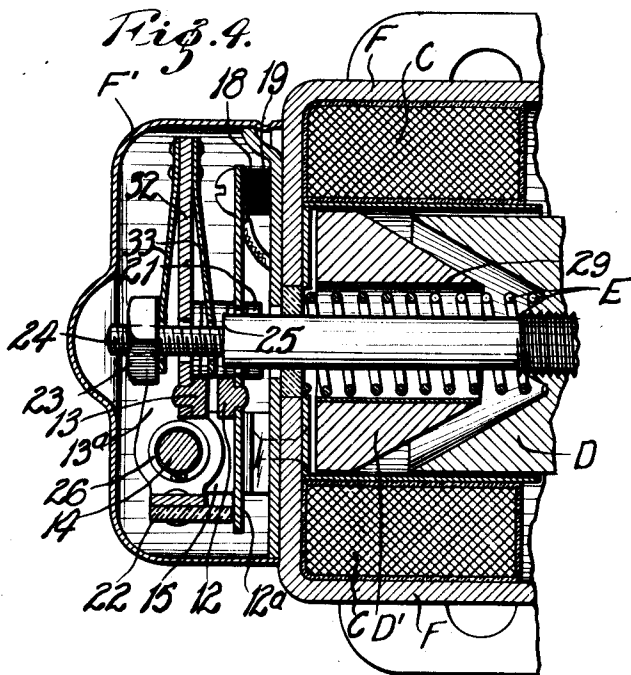


Fig. 4.



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UNITED STATES PATENT OFFICE.

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LIQUID-FUEL-PUMPING APPARATUS.

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This invention relates to diaphragm pumps of the type in which an automatic, intermittent switch is used to open and close an electric circuit so as to cause an electrically-operated mechanism to flex the diaphragm of the pump back and forth.

One object of my present invention is to provide an electrically-operated diaphragm pump of novel construction in which the contacts of the intermittent switch are clamped together with sufficient pressure, when the circuit is closed, to insure the current flowing through said contacts, even though the contacts are formed of tungsten or other material which is of such a nature that the faces of the contacts are apt to become coated with a substance that sets up a resistance to the flow of the current.

Another object is to provide an electrically-operated diaphragm pump which is provided with a novel means for causing the pressure of the contacts of the intermittent switch upon each other to be increased when the energizing circuit is closed and for maintaining said increased pressure while the movable element of the diaphragm operating mechanism is moving under the influence of the magnetic force produced by the flow of the electric current through the coil of said mechanism.

And still another object is to provide an efficient apparatus of simple design for drawing liquid fuel from a source of supply and feeding it to an internal combustion engine or to a carburetor associated with such an engine. Other objects and desirable features of my invention will be hereinafter pointed out.

Figure 1 of the drawings is an end elevational view of a liquid fuel pumping apparatus constructed in accordance with my invention.

Figure 2 is a vertical sectional view, taken on the line 2—2 of Figure 1.

Figure 3 is a horizontal sectional view through a portion of the apparatus, taken on the line 3—3 of Figure 1; and

Figure 4 is a vertical sectional view, illustrating a slight modification of my invention.

In the form of my invention shown in Figures 1 to 3, inclusive, A designates the diaphragm of an electrically-operated diaphragm pump, which is preferably composed of a plurality of layers x of fabric treated to render it impervious to water, gasoline and the like without making it brittle or inflexi-

ble. The diaphragm A is arranged in opposed relation to a rigid, cup-shaped member 1 so as to form a pumping chamber 2, and the peripheral edge portion of the diaphragm is gripped between the member 1 and an opposed clamping member 3, said diaphragm being gripped by said members in such a way that it is taut, but is capable of moving towards and away from the stationary wall 1 of the pumping chamber, so as to draw liquid fuel into the pumping chamber from a source of supply, and thereafter force said fuel out of said chamber to an internal combustion engine or to a carburetor associated with such an engine. The pumping chamber 2 is connected by one or more ports 4 with a valve passageway B equipped with an inlet valve 5 and a discharge valve 6. When the pump is in operation liquid fuel is drawn from a source of supply through a conduit that is connected to an inlet 7 at the lower end of the valve passageway B and is discharged from said passageway through a conduit that leads from an outlet 8 at the upper end of said passageway.

The diaphragm A is flexed back and forth by an electrically-operated mechanism consisting of a solenoid comprising a coil C and a core provided with an air gap and comprising movably mounted members arranged at opposite sides of said air gap. In the form of my invention herein illustrated the core is composed of two members or core pieces D and D'. A coiled expansion spring E that is interposed between said core pieces exerts pressure on the core piece D in a direction tending to move it outwardly, or to the right, away from the core piece D', and the center portion of the diaphragm A is rigidly connected to the core piece D, which, for convenience, I will refer to as the actuating member of the core. Preferably, the center portion of the diaphragm A is gripped between two members 9 and 10 that are rigidly connected to the actuating member D of the core and which are provided at their peripheral edges with oppositely-flared surfaces 9^a and 10^a that constitute supporting surfaces for the diaphragm, in its two extreme positions, which prevent the diaphragm from being subjected to sharp bends and strains tending to disrupt it adjacent the point where it is gripped by the members 9 and 10. The members 1 and 3 which grip the peripheral edge portion of the diaphragm are also preferably provided with oppositely-flared diaphragm

supporting surfaces 1^a and 3^a that prevent the diaphragm from being subjected to sharp bends or destructive strains adjacent the point where it is gripped by said members.

5 As shown in Figure 2, the solenoid is encased in a metal housing F that is attached to the members 1 and 3, and ventilating openings 11 and 11^a are formed in said housing and in the member 3, respectively, so as to establish atmospheric pressure on the outside of the diaphragm.

The electric circuit that is used to energize said solenoid is provided with two switches, one a manually-operated switch (not shown) that is adapted to be moved into its closed position when it is desired to set the pump in operation, and the other an automatically-operating, intermittent switch that opens and closes said circuit intermittently so as to cause the actuating member D of the core to reciprocate and thus flex the diaphragm A back and forth. Said intermittent switch is arranged inside of a removable cap piece or cover F' on the end wall of the housing F, and comprises two contacts 12 and 13 carried by members 12^a and 13^a. The contact carrying member 13^a is herein illustrated as a lever that is oscillatingly mounted on a horizontally-disposed support 14 carried by a stationary bracket 15 attached to the end wall of the housing F, and the contact carrying member 12^a consists of a spring or flexible element mounted in such a way that one end of same is capable of moving slightly back and forth for a purpose hereinafter described. In the form of my invention herein illustrated the contact carrying member 12^a consists of a plate having its upper end secured by screws or other suitable means 16 to the end wall of the housing F and provided at its lower end with a reduced portion or tail piece, as shown in Figures 1 and 2, interposed between the end wall of the housing F and the support 14 for the lever 13^a and capable of moving slightly towards and away from said end wall. One end of the coil C of the solenoid is electrically connected with the contact carrying member 12^a by a clamping plate 17 arranged parallel to same, as shown in Figure 2, so as to clamp the terminal portion 18 of the coil against the contact carrying member 12^a. The member 12^a and the parts associated with same are insulated from the end wall of the housing F by insulators 19, shown in Figure 2.

55 The member D' of the core of the solenoid is arranged inside of the coil C of the solenoid in such a manner that when the contacts 12 and 13 of the intermittent switch are brought together, thus energizing said coil, said core piece D' will move to the left, looking at Figure 2, towards the end wall of the housing F. When the coil circuit is opened the member D' of the core will move away from the end wall of the housing F under the influence of the resilient member 12^a.

Accordingly, the member D' of the core may be said to float inside of the coil, and for convenience I have referred to said member in the claims as the floating member of the core. This movement of the core piece D' is used to increase the clamping pressure of the contact 13 on the contact 12. The movement is very slight, only sufficient to close the gap that exists between the outer end of the core piece D' and the inner face of the end wall of the housing F when no current is flowing through the coil of the solenoid, but it is great enough to effect movement of the members 12^a and 13^a and thus cause the contacts thereon to be jammed tightly together when the coil circuit is closed. As shown in Figures 1 and 3, the core piece D' is rigidly connected with the contact carrying member 12^a by screws or other suitable fastening devices 20 that pass through spacers 21 interposed between the core piece D' and the contact carrying member 12^a and arranged in holes in the end wall of the housing F. Due to the fact that the member D' of the core of the solenoid is rigidly connected to the plate 12^a that carries the contact 12 of the intermittent switch, movement of said core member D' to the left, looking at Figure 2, reduces the distance between the contacts 12 and 13, and movement of said member D' to the right increases the distance between said contacts. It is, of course, not essential that the member D' of the core and the contact carrying member 12^a of the intermittent switch be constructed and arranged in the particular manner herein illustrated and above described; the important thing is that the member D' of the core be mounted in such a way that it is capable of a slight reciprocating movement longitudinally of the axis of the core and that said member be rigidly connected to the member that carries one contact of the intermittent switch so that when the coil of the solenoid is energized by closing the contacts of said switch, the member D' of the core will move, due to the magnetic force, in a direction to increase the pressure of the contacts 12 and 13 on each other.

As shown in Figure 2, the contact lever 13^a is provided at its lower end with an angularly-disposed extension 22 of fibre or other suitable insulating material that projects towards the tail piece at the lower end of the contact carrying member 12^a. When said member 12^a flexes to the left, as previously described, due to the movement imparted to said member by the core piece D', when the coil C of the solenoid is energized, said tail piece bears against the extension 22 on the lever 12^a and rocks said lever in a direction to increase the clamping pressure of the contacts 12 and 13 on each other. In other words, after the contacts 12 and 13 have been closed or brought together, the slight movement of the core piece D' to the left immedi-

ately after the coil circuit has been closed, causes the contacts 12 and 13 to be jammed tightly together and to be maintained in this condition until the coil circuit is thereafter
 5 opened.

The lever 13^a, which virtually forms the movable element of the intermittent switch, is moved into position to close the coil circuit by a stop 23 on a rod 24 that is connected to the actuating member D of the core, and said
 10 lever is moved in the opposite direction to open the coil circuit by an abutment member 25 arranged in spaced relation to the stop 23 and herein illustrated as being formed by a
 15 tubular member surrounding the rod 24 and connected to the core piece D and the members 9 and 10 which grip the center portion of the diaphragm. A means is used to prevent
 20 too free movement of the lever 13^a and thus tend to hold said lever in the position into which it has been moved by the stop 23 or
 25 abutment 25, and in the form of my invention herein illustrated said means consists of a coiled spring 26 arranged on the support
 30 14 for said lever, between one side of said lever, and a stop 27 on said support, as shown in Figure 1, the pressure which said spring
 35 exerts on the lever 13^a causing it to be clamped against a friction device 28 that
 40 bears against the opposite side of said lever.

When the manually-operated switch (not shown) in the coil circuit is open, the actuating member D of the core of the solenoid is positioned some distance to the right of the
 35 core piece D', and the contact 13 on the lever 13^a is in engagement with the contact 12, said lever having been moved into this position by the stop 23 on the rod 24 when the core piece
 40 D moved to the right under the influence of the spring E. If said manually-operated switch is then moved into its closed position so as to set the pump in operation, the coil C
 45 of the solenoid will become energized and the core piece D' will immediately move to the left, looking at Figure 2, thus causing the contact carrying member 12^a to flex to the
 50 left and exert pressure on the extension 22 of the lever 13^a in a direction to rock said lever and increase the pressure of the contacts 12
 55 and 13 on each other. The actuating member D' of the core also starts to move to the left, as soon as the coil is energized, and at about the time the member D of the core
 60 comes into contact with the member D' of the core, the abutment member 25 strikes the lever 13^a and moves the upper end of same to the left, looking at Figure 2, thereby opening the
 65 coil circuit. Immediately thereafter, the actuating member D of the core moves to the right under the influence of the spring E, and just before said actuating member reaches
 the end of its stroke to the right, the stop 23 on the rod 24 strikes the lever 13^a and moves it in a direction to bring the contact thereon
 into engagement with the contact 12, where-

upon the movements of the co-operating parts previously described will be repeated. It will thus be seen that in my improved
 pump the clamping pressure of the contacts of the intermittent switch is increased as
 70 soon as the coil of the solenoid becomes energized, and said increased pressure is maintained during the inward stroke of the actuating member D of the core. This is highly
 75 desirable, as it insures the current flowing freely through the contacts, it eliminates the possibility of the contacts separating before the actuating member D of the core has completed
 80 its stroke to the left and it permits the contacts of the intermittent switch to be made of tungsten or other material which is of such a nature that there is a tendency for a
 85 resistance to be set up between the contacts unless they are subjected to considerable pressure when they are engaged with each other.

In order to prevent the spring E from becoming worn by rubbing against the core piece D' inside of which it is arranged, the
 bore in said core piece that receives said spring is lined with a shell 29 of fibre or
 90 some other suitable material that will prevent the spring E from wearing when it rubs over same. The valves in the valve passageway B that govern the admission and discharge of
 95 the fuel into and out of the pumping chamber 2 of the pump, are preferably constructed in the manner shown in Figure 2, as valves of this design are inexpensive to manufacture
 100 and are reliable in operation. Each of said valves consists of a thin disk arranged between a flat faced valve seat member 30 and a stop member 31, said members 30 and 31 preferably consisting of cup-shaped sheet metal
 105 stampings that are forced into the valve passageway B and retained therein by the frictional pressure of the flanged portion of same against the side wall of said passageway.
 110 As shown in Figure 2, the stop member 31 of the discharge valve is first pressed into the valve passageway B against a shoulder at the upper end of same, the valve 6 is then introduced,
 115 and thereafter the valve seat member 30 of said valve is pressed into the valve passageway in abutting relation with the stop member above the valve. The lower end of
 120 the valve passageway B is counterbored so as to form a shoulder for the stop member of the inlet valve 5 and the seat member 30 of said valve is pressed into the valve passageway in
 abutting relation with the stop member above the valve.

When my improved pump is used in a fuel supply system for internal combustion engines means is provided for maintaining a
 125 pressure on the carburetor or other device to which the fuel is being supplied. In some instances said means may consist of the well known float chamber (not shown) into which the fuel is discharged from the valve passageway B of the pump, and in other in-
 130

stances said means may consist of an air-tight chamber G, as shown in Figure 2, connected with the upper end of the valve passageway B, or with the conduit that leads from the outlet 8 at the upper end of said passageway. When the pump is in operation fuel stands in the lower portion of the chamber G and rises and falls therein according to the consumption of the fuel by the carburetor. If the consumption of the fuel drops below normal, the air in the chamber G above the level of the fuel therein will be compressed to a higher degree, due to the rising of the fuel in said chamber, and this increased pressure will be exerted on the diaphragm A of the pump in such a way as to hold said diaphragm flexed to the left, looking at Figure 2, thus causing the abutment member 25 to bear against the contact carrying lever 13^a of the intermittent switch and hold it in its open position. Consequently, the variation in the level of the fuel in the air chamber G, beyond certain limits, renders the diaphragm-operating mechanism operative and inoperative automatically and results in the diaphragm being held at rest, with the energizing circuit of the coil of the solenoid open, when the consumption of the fuel being supplied by the pump is below normal.

In Figure 4 I have illustrated a slight modification of my invention, wherein the contact carrying lever 13^a of the intermittent switch is provided at its upper end with an extension 32 that carries two leaf springs 33 arranged at opposite sides of said lever in position to co-operate with the stop 23 that moves said lever in a direction to close the coil circuit and to co-operate with the abutment member 25 that moves said lever in the opposite direction to open the coil circuit. The springs 33 are stronger than the spring 26, previously described, that is used to press the lever 13^a against the friction device 28. The advantage of the springs 33 is that they insure the contacts of the intermittent switch remaining open until the actuating member D of the core has completed its stroke to the right and they insure said contacts remaining closed until said actuating member has completed its stroke to the left. Moreover, they cause said contacts to be closed with a quick movement at the completion of the outward stroke of the actuating member D of the core, and they cause said contacts to be separated with a quick break at the completion of the inward stroke of said actuating member. In such a structure it is not essential that the solenoid be provided with a floating core piece D', in view of the fact that the springs 33 which are combined with the contact lever 13^a overcome the frictional pressure that normally holds said lever and cause said lever to jump from one position to the other after said springs have been placed under a certain tension.

Accordingly, while I have herein illustrated this feature of my invention embodied in an apparatus whose solenoid is provided with a floating core piece, I wish it to be understood that the member D' of the core may be made stationary without departing from the spirit of my invention.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In an electrically-operated pump, a solenoid for operating the pumping element provided with a core composed of an actuating member and a floating member, a switch for intermittently opening and closing the circuit that energizes the solenoid, and means for utilizing the movement of said floating member produced by closing the energizing circuit for increasing the pressure of the contacts of said switch on each other.

2. In an electrically-operated pump, a solenoid for operating the pumping element provided with a core composed of an actuating member and a floating member, a spring that exerts pressure on said actuating member in a direction tending to hold it spaced away from said floating member, an intermittent switch for opening and closing the circuit that energizes the solenoid, and a means rendered operative by the movement of the floating member of the core when the coil circuit of the solenoid is closed for increasing the pressure of the contacts of said switch on each other and for maintaining said increased pressure when the actuating member of the core is being moved by the magnetic force towards the floating member of the core.

3. In an electrically-operated pump, a solenoid for operating the pumping element provided with a core composed of an actuating member and a floating member, and an intermittent switch for opening and closing the coil circuit comprising a contact carrying member combined with the floating member of the core in such a way that the movement of said member produced by closing the coil circuit increases the pressure of the contacts of said switch on each other.

4. In an electrically-operated pump, a solenoid provided with a core composed of an actuating member and a floating member, an intermittent switch provided with two movable contact carrying members, a connection between one of said contact carrying members and the floating member of the core, and means operated by the movement of the actuating member of the core for moving the other contact carrying member of the switch so as to open and close the coil circuit.

5. In an electrically-operated pump, a solenoid provided with a core composed of an actuating member and a floating member, a switch in the coil circuit provided with

two contact carrying members, means for moving one of said contact carrying members to open and close the coil circuit, and means for utilizing the movement of the floating member of the core when the coil circuit is first closed to shift the other contact carrying member of the switch so as to increase the pressure of the contacts of the switch on each other.

6. In an electrically-operated pump, a solenoid provided with a core that comprises an actuating member and a floating member, an intermittent switch in the coil circuit provided with a pivotally mounted contact carrying member that is adapted to be moved so as to open and close the coil circuit, and means for utilizing the movement of the floating member of the core produced by closing the coil circuit for rocking said contact carrying member so as to increase the pressure of the contacts of said switch on each other.

7. In an electrically-operated pump, a solenoid provided with a core composed of an actuating member and a floating member, an intermittent switch in the coil circuit provided with a flexible contact carrying member and a rockable contact carrying member, means for moving said rockable contact member to open and close the coil circuit, and a connection between said flexible contact carrying member and the floating member of the core, for the purpose described.

8. In an electrically-operated pump, a solenoid provided with a core composed of an actuating member and a floating member, an intermittent switch in the coil circuit provided with a rockable contact carrying member, and an opposed contact carrying member connected to the floating member of the core and adapted to be moved by same so as to increase the pressure of the contacts of said switch after said contacts have been engaged.

9. In an electrically-operated pump, a solenoid provided with a core composed of an actuating member and a floating member, an intermittent switch in the coil circuit provided with a rockable contact carrying member and a flexible contact carrying member, a connection between said flexible contact carrying member and the floating member of the core, and means whereby movement imparted to the flexible contact carrying member by the floating member of the core causes the rockable contact carrying member of the switch to move in a direction to increase the pressure of the contacts of the switch on each other.

10. In an electrically-operated pump, a solenoid provided with a core composed of an actuating member and a floating member, an intermittent switch in the coil circuit provided with a rockable contact carrying mem-

ber, means for rocking said contact carrying member in a direction to close the coil circuit, and a means rendered operative by a change in the position of the floating member of the core when the coil circuit is closed for exerting pressure on the rockable member of the switch so as to increase the pressure of the contacts of the switch on each other.

11. In an electrically-operated pump, a solenoid provided with a core composed of an actuating member and a floating member, an intermittent switch in the coil circuit provided with two opposed contacts, a lever that carries one of said contacts, a spring that carries the other contact, a connection between said spring and the floating member of the core, and a part on said lever against which the free end of said spring exerts pressure in a direction to increase the pressure of said contacts on each other after they have been engaged.

12. In an electrically-operated pump, a solenoid provided with a core composed of an actuating member and a floating member, a spring that exerts pressure on said actuating member in a direction tending to hold it away from said floating member, an intermittent switch in the coil circuit provided with two opposed contacts, a lever that carries one of said contacts, a spring that carries the other contact, means operated by the movement of the actuating member of the core for moving said lever so as to open and close the coil circuit, a rigid connection between said contact carrying spring and the floating member of the core, and a part on said lever on which the free end of said contact carrying spring exerts pressure when the coil of the solenoid is energized.

13. In an electrically-operated pump, a solenoid provided with a core composed of an actuating member and a floating member, said actuating member being adapted to be moved in one direction by the magnetic force produced in the solenoid, a spring for moving said actuating member in the opposite direction, a switch in the coil circuit provided with two relatively movable contact carrying members, means operated by the movement of the actuating member of the core for moving one of the contact carrying members of the switch in opposite directions to open and close the coil circuit, and means for utilizing the movement of the floating member of the core to move the other contact carrying member of the switch so as to increase the pressure of the contacts of said switch on each other after the coil circuit has been closed.

14. In an electrically-operated pump, a solenoid comprising a coil and a core, said core being composed of an actuating member and a floating member, a housing that encases the solenoid, an intermittent switch on the exterior of said housing provided with two op-

- posed contacts, a lever that carries one of said contacts, a spring that carries the other contact, a connection between said spring and the floating member of the core extending through one wall of the housing, co-operating means on said spring and lever for increasing the pressure of the contacts on each other when the coil circuit is closed, and means for rocking said lever intermittently.
- 10 15. In an electrically-operated pump, a solenoid provided with a reciprocating core member for actuating the pumping element, said member being adapted to be moved in one direction by the magnetic force produced
- 15 in the solenoid, a resilient means for moving said member in the opposite direction, a switch in the coil circuit comprising a rockable contact carrying member, means for actuating said rockable member to open and
- 20 close the coil circuit, and a separate reciprocating core member which tends to hold said rockable contact carrying member in the position into which it has been moved.
- 25 16. In an electrically-operated pump, a solenoid for operating the pumping element provided with a core composed of an actuating member and a floating member, a spring

inside of said floating member that exerts pressure on said actuating member in a direction to hold said members separated, a non-metallic lining for the bore in the floating member that receives said spring, and a switch for intermittently opening and closing the circuit that energizes the solenoid.

17. In an electrically operated pump, a solenoid including a coil and an actuating member, the latter being provided with a floating member, an intermittent switch in the coil circuit provided with two opposed contacts, a support, a lever mounted on the support and carrying one of said contacts, friction means cooperating with the lever to yieldingly hold the same in position, springs combined with said lever, a device connected with said actuating member and engageable with said springs to compress them sufficiently to effect the movement of said lever to open and close the coil circuit, and means for utilizing the movement of the floating member when the coil of the solenoid is energized for jamming the contacts of the intermittent switch tightly together.

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