June 7, 1949.

J. W. DICKEY ET AL

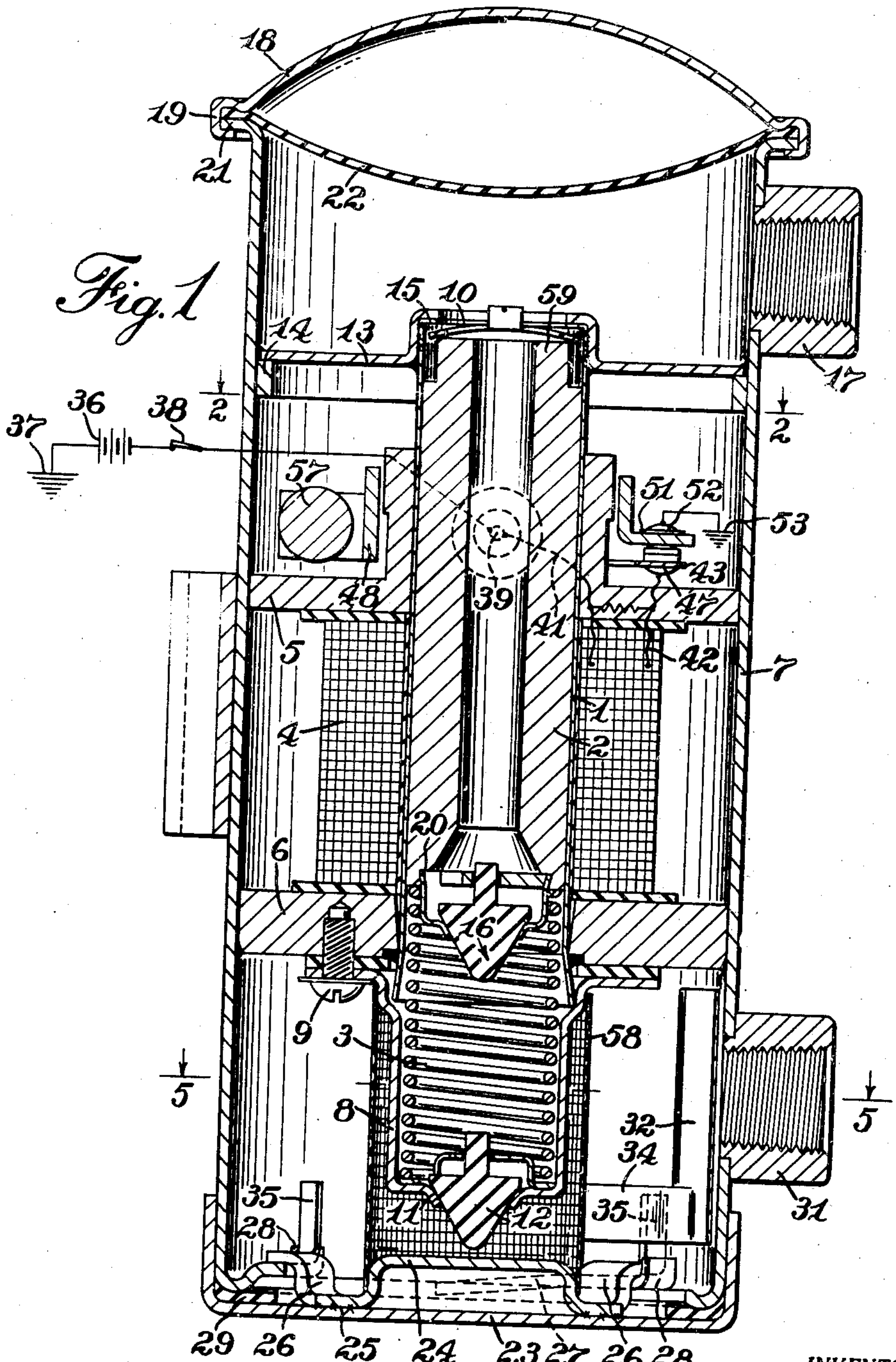
2,472,067

ELECTROMAGNETIC PUMP

Filed March 24, 1947

3 Sheets-Sheet 1

Fig. 1



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Filed March 24, 1947 3 Sheets-Sheet 2

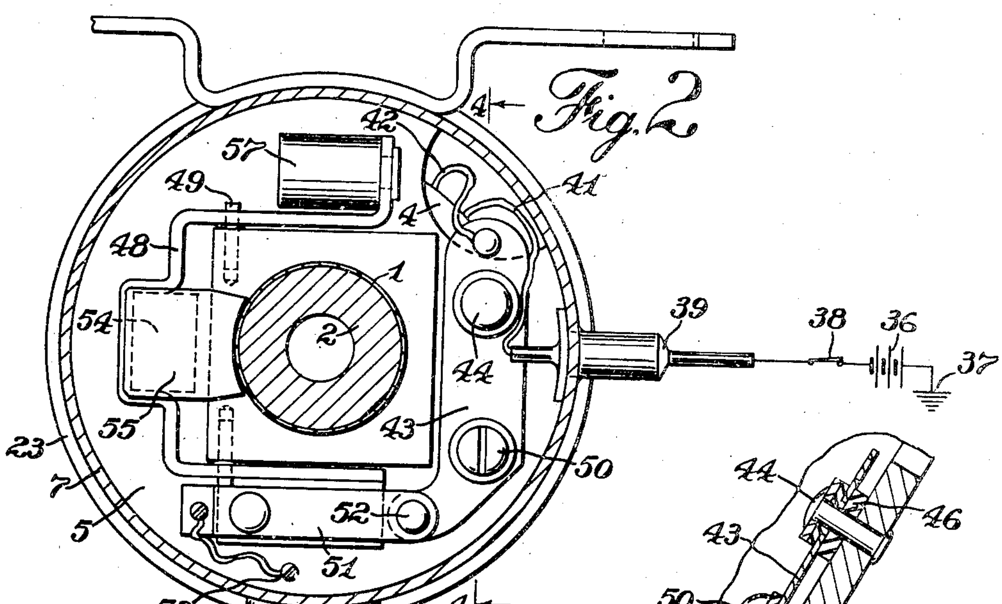

Fig. 2

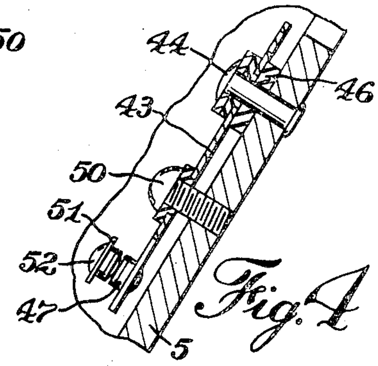

Fig. 4

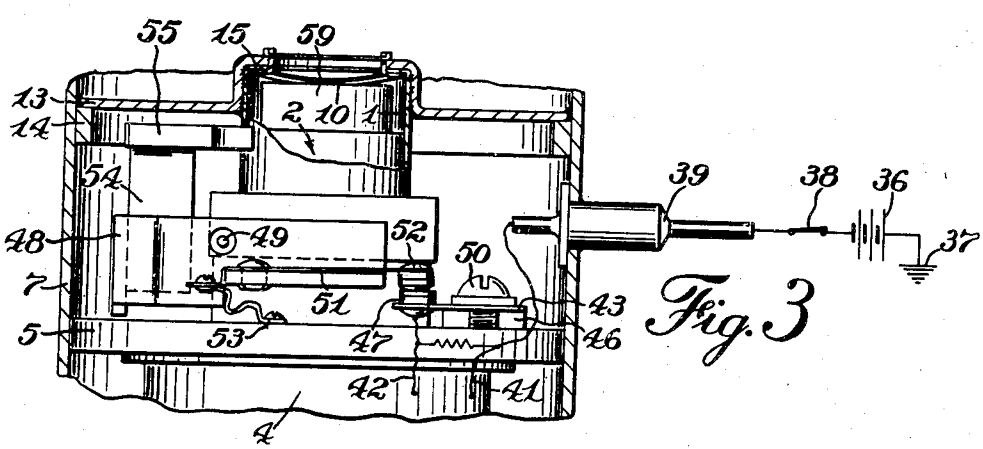

Fig. 3

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Filed March 24, 1947 3 Sheets-Sheet 3

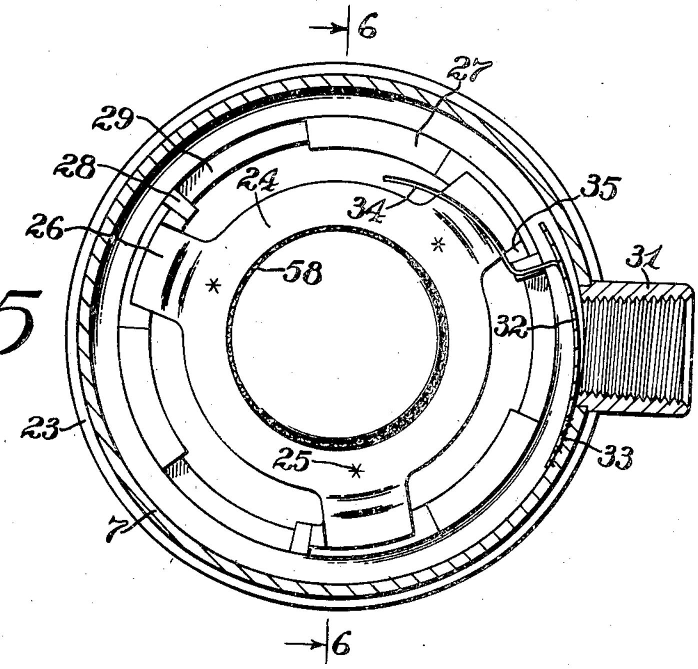

Fig. 5

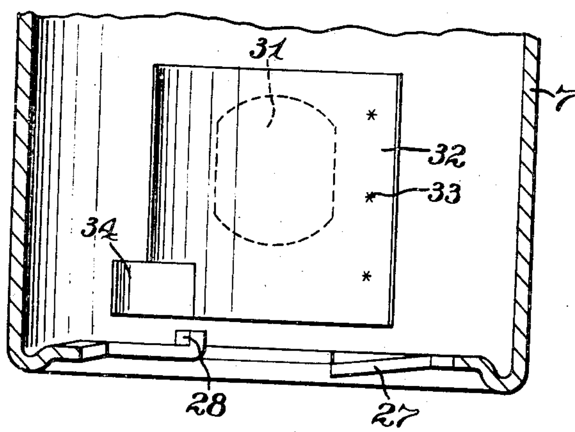

Fig. 6

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Patented June 7, 1949

2,472,067

UNITED STATES PATENT OFFICE

2,472,067

ELECTROMAGNETIC PUMP

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Application March 24, 1947, Serial No. 736,862

6 Claims. (Cl. 103—53)

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The present invention relates to an electromagnetic pump and more particularly to a reciprocating pump for liquids such as fuel for internal combustion engines.

It is an object of the present invention to provide a novel electromagnetic pump which is reliable and efficient in operation while being simple and economical in construction.

It is another object to provide such a device which is fully enclosed in a cylindrical casing, the lower end of which is closed by a removable cap; with means for automatically shutting off the supply conduit when the cap is removed.

It is another object to provide such a device in which the means for shutting off the supply is in the form of a tangentially arranged baffle which serves to give the liquid a rotary motion when the pump is in operation.

It is another object to provide such a device in which the upper end of the cylinder is closed by a domed cover and an elastic gasket which serves to provide a cushion or air dome, thus increasing the output of the pump and rendering its operation smooth and quiet.

It is another object to provide such a device in which the control mechanism for the pump is positive in action and is balanced about its pivotal axis so as to be unaffected by vibration.

It is another object to provide such a device in which the control contacts for the pump are readily adjustable to secure optimum performance.

It is another object to provide such a device incorporating a stop for the pump piston in its discharge stroke which is integral with the pump cylinder so that hammering of the piston when the pump is air bound cannot loosen the parts.

Further objects and advantages will be apparent from the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a vertical substantially mid-sectional view of a pump constituting a preferred embodiment of the invention, the electrical system being indicated diagrammatically;

Fig. 2 is a section taken substantially on a line 2—2 of Fig. 1;

Fig. 3 is a detail showing the contact actuating means in side elevation;

Fig. 4 is a detail of the contact elements in section substantially on the line 4—4 of Fig. 2;

Fig. 5 is a section taken substantially on the line 5—5 of Fig. 1; and

Fig. 6 is a sectional detail taken substantially on the line 6—6 of Fig. 5.

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In Fig. 1 of the drawing, there is illustrated a cylinder 1 of non-magnetic material in which a hollow piston 2 of magnetic material is slidably mounted. A spring 3 is provided for urging the piston 2 toward the upper end of the cylinder 1, and a solenoid 4 is arranged to draw the piston down against the action of the spring 3. Pole pieces 5 and 6 of magnetic material fit the cylinder at each end of the solenoid 4 and a cylindrical casing 7 of magnetic material surrounds the pole pieces and cylinder and forms a flux path between the pole pieces.

A sleeve 8 is fixed as indicated at 9 to the pole piece 6 and forms a seat for the lower end of the spring 3. The lower end of the sleeve 8 has a tapered opening 11 and a check valve 12 prevents the passage of liquid down through said opening.

The upper end of the cylinder 1 is rigidly attached as by soldering or brazing to a partition member 13 which is soldered or brazed in the casing 7 against a ring 14 having a press fit in the cylinder. The cylinder is constricted where it is attached to the partition 13, forming a shoulder 15 which provides a stop for the upper end of the piston 2, a spring washer 10 being preferably anchored in the upper end of the cylinder to cushion the impact of the piston in case the pump is operated while no liquid is supplied to it. A check valve 16 is mounted in the lower end of the piston by means of a thimble 20 expanded into the end of the piston and providing a valve seat preventing downward flow of liquid therethrough.

The upper part of the casing 7 forms a chamber having an outlet fitting 17 and closed by a domed cap 18 which is crimped on a terminal flange 21 of the casing as indicated at 19. A diaphragm or septum 22 of elastic material such as rubber is interposed between the flange 21 of the casing and the cap 18 so as to form a gasket sealing the joint between these means. Diaphragm 22 also serves to provide with the cap 18 an air dome which serves as a cushion, rendering the operation of the pump quiet and uniform, and increasing the output.

The lower end of the casing 7 is closed by means of a removable cap 23 which fits over the lower end of the casing, and has a cam member 24 fixed thereto as indicated at 25. The cam member 24 is arranged to cooperate with inwardly extending inclined flanges or ramps 27 (Fig. 6) formed on the lower end of the casing 7 whereby rotation of the cap 23 causes the arms 26 to move up the ramps until stopped by terminal lugs 28 thereon, at which time the cap 23 is thereby tightly clamped to the casing. A gasket 29 of suitable material such as cork composition is used to seal the joint between the casing and cap.

The lower part of the casing 7 is provided with an inlet fitting 31, and means are provided for automatically closing the inlet when the cap 23 is removed from the casing so as to prevent the liquid supply from draining out through said inlet at that time. As here shown, this is accomplished by means of a spring baffle member 32 (Fig. 5) fixed to the interior of the casing as indicated at 33. The baffle 32 is made of suitable spring material which is so tensioned as to cause it to press tightly against the opening of the inlet 31. The free end of the baffle 32 is provided with a curved arm 34, and the cams 26 of the cam member 24 are provided with upwardly extending fingers 35 which are arranged to engage the arm 34 and draw the baffle 32 away from the inlet when the cap 23 is rotated to its fully clamped position. When the cap is rotated reversely to remove it from the casing, the finger 35 which was holding open the baffle 32 moves out of engagement with the arm 34 and permits the baffle to close the inlet.

Means for actuating the solenoid 4 in order to operate the pump are provided in the form of a battery 36 grounded at 37 and connected through a switch 38 to a sealed binding post 39 (Fig. 2) mounted in the wall of the casing 7. One end of the solenoid is connected by a lead 41 to the binding post 39, while the other end is connected by a lead 42 to a flexible conductive blade or strip 43 (Fig. 4) mounted as indicated at 44 on the upper pole piece 5, insulated therefrom as shown at 46, and carrying a fixed contact 47. The end of the bracket 43 which carries contact 47 is preferably adjustable vertically by suitable means such as an insulated screw 50 traversing the bracket and threaded into the pole piece 5.

A cradle 48 of non-magnetic material is pivoted horizontally as shown at 49 on the upper pole piece 5, and has fixed thereon a spring 51 carrying a movable contact 52 on its free end in position to cooperate with the fixed contact 47. Spring 51 is grounded as indicated at 53 so as to complete the circuit for energizing the solenoid when the contacts are closed.

Means for rocking the cradle 48 to open and close the contacts is provided in the form of a permanent magnet 54 (Fig. 3) mounted in the cradle with its poles arranged vertically and with opposite polarity from the solenoid 4. In other words, if the upper end of the solenoid is a north pole, the upper end of the magnet 54 is a south pole. A pole piece 55 of magnetic material is fixed on the upper end of the magnet 54 in any suitable manner as by soldering or brazing, and is shaped to conform loosely to the adjacent surface of the cylinder 1, as best shown in Fig. 2. The pole piece 55 is located adjacent the upper end of the cylinder 1 so as to be attracted by the piston 2 as the piston completes its upward stroke. A counterweight 57 is provided for substantially balancing the cradle and the parts mounted thereon about the axis of its pivot 49.

The upper end of the piston 2 may be reduced in diameter for a short distance if deemed desirable, as indicated at 59. This increases the length of the stroke of the piston by causing the contacts 52, 47 to remain closed until the top of the piston has been pulled down below the pole piece 55, whereas the contacts do not reclose until the unreduced part of the piston returns to proximity with said pole piece.

In operation, starting with the parts in the positions shown in Fig. 1, closure of the switch 38, which may be the ignition switch of the motor to be supplied with fuel by the pump, causes energization of the solenoid 4, which draws the piston 2 downward, whereby liquid trapped in the cylinder 1 escapes by the check valve 16. Since the solenoid has opposite polarity from the magnet 54, energization of the solenoid assists the magnet to attract the piston thus keeping contacts 52, 47 closed until the piston is withdrawn a substantial distance from the pole piece 55. As soon as the piston descends sufficiently, the pole piece 55 of permanent magnet 54 is released, permitting the attraction of the lower end of the permanent magnet 54 for the pole piece 5 of the solenoid to swing the cradle 48 in a counterclockwise direction as seen in Fig. 3 thus opening contacts 52, 47 and deenergizing the solenoid 4. Spring 3 thereupon becomes effective to actuate the piston 2 in its discharge stroke whereby liquid is forced into the upper end of the casing 7 and out through the outlet 17. When the piston thus comes into proximity with the pole piece 55 of the permanent magnet 54, the mutual attraction of the piston and pole piece 55 causes the cradle to rotate in a clockwise direction, thus closing contacts 52, 47 and causing the operation to be repeated as rapidly as liquid is allowed to escape through the outlet.

It will be understood that this device will normally be positioned below the level of the container from which it obtains its supply of liquid so that the pump will be primed automatically. It has been found in practice, however, that a pump constructed as here shown will prime itself even though located substantially above its source of supply.

When it becomes necessary to take off cap 23 in order to remove any accumulation of water or other foreign matter, it is merely necessary to rotate the cap sufficiently to disengage the cams 26 from the ramps 27. This rotation also disengages the finger 35 from the arm 34 of baffle 32 and permits the baffle to close the inlet 31. The cap 23 can then by drawn off without substantial loss of liquid. When the cap is again applied and rotated into clamping position, the baffle 32 is again deflected into open position by the engagement of a finger 35 with the arm 34. The baffle then serves to cause tangential motion of the incoming fluid which facilitates separation of any sediment therein, preventing premature clogging of the inlet screen 58.

Although but one embodiment of the invention has been shown and described in detail, it will be understood that other embodiments are possible and that various changes may be made in the design and arrangement of the parts without departing from the spirit of the invention.

What is claimed is:

1. In an electromagnetic pump, a cylinder of nonmagnetic material, a hollow piston of magnetic material therein, a spring for actuating the piston on its discharge stroke, means including a solenoid surrounding the cylinder for retracting the piston, a casing surrounding the cylinder and solenoid and providing an inlet chamber at one end of the cylinder having an inlet opening and an outlet chamber at the other end having an outlet opening, means preventing backward flow of liquid through the cylinder and piston, a removable cap closing the inlet end of the casing, means in the casing closing the inlet

opening, and means on the cap for opening the closure when the cap is attached to the casing.

2. An electromagnetic pump as set forth in claim 1 in which said inlet closing means is in the form of a flexible baffle which when open directs the incoming liquid tangentially to the inlet chamber.

3. An electromagnetic pump as set forth in claim 1 in which said inlet closing means is in the form of a flexible baffle attached to the inner side of the inlet chamber at one side of the inlet so as to cover the inlet, and said cap and baffle have interengaging elements formed to cam the baffle away from the side of the chamber and open said inlet.

4. An electromagnetic pump as set forth in claim 2 in which the pump casing and cap have interengaging cam means in the form of a bayonet joint for clamping the cap to the casing by rotation of the cap, said cam means being arranged to open the baffle by the rotation of the cap to its clamped position.

5. In an electromagnetic pump, a cylinder of nonmagnetic material, a hollow piston of magnetic material therein, a spring for actuating the piston on its discharge stroke, means including a solenoid surrounding the cylinder for retracting the piston, a casing surrounding the cylinder and solenoid and providing an inlet chamber at one end of the cylinder having an inlet opening and an outlet chamber at the other end having an outlet opening, means preventing backward flow of liquid through the cylinder and piston,

said retracting means including a cradle pivoted to the cylinder adjacent its outlet end on an axis transverse to that of the cylinder, a permanent magnet seated in the cradle with its poles arranged substantially parallel to the axis of the cylinder, a pole piece on said magnet conforming to the adjacent surface of the cylinder, means for balancing the cradle about its pivotal axis and contacts actuated by the cradle for controlling the energization of the solenoid.

6. An electromagnetic pump as set forth in claim 5 in which the poles of the permanent magnet and solenoid are similarly oriented, so that energization of the solenoid reneforces the flux of the permanent magnet.

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