Sept. 7, 1926. 1,598,792

H. WALLACE

ELECTROMAGNETIC PUMP

Filed August 3, 1925

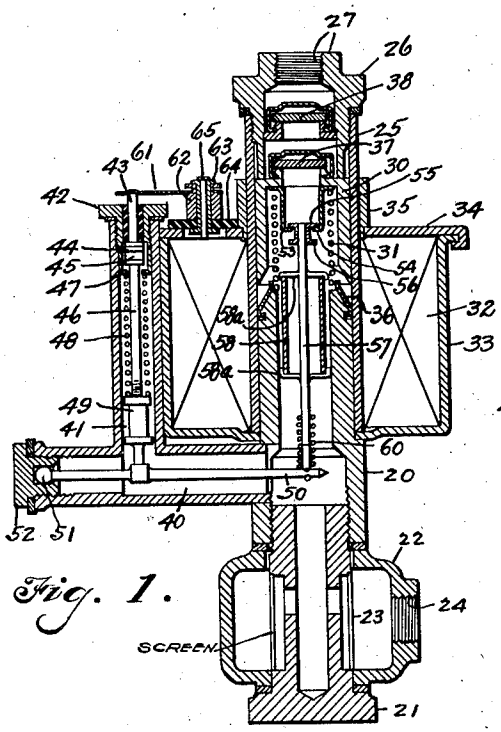


Fig. 1.

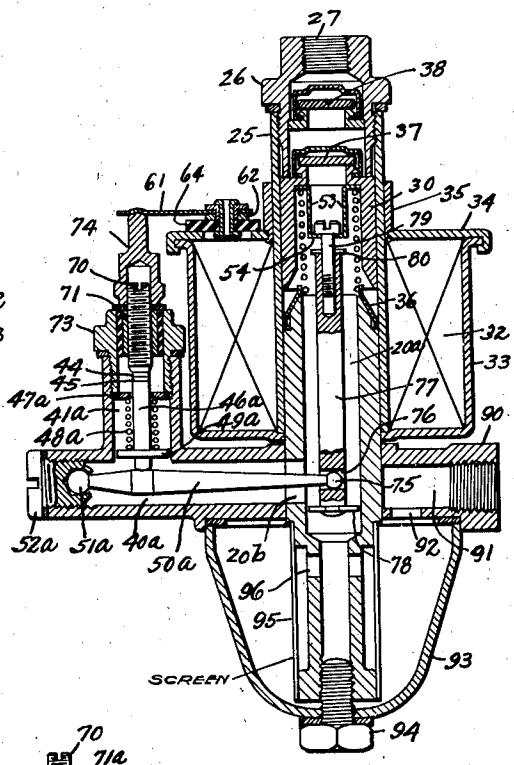


Fig. 2.

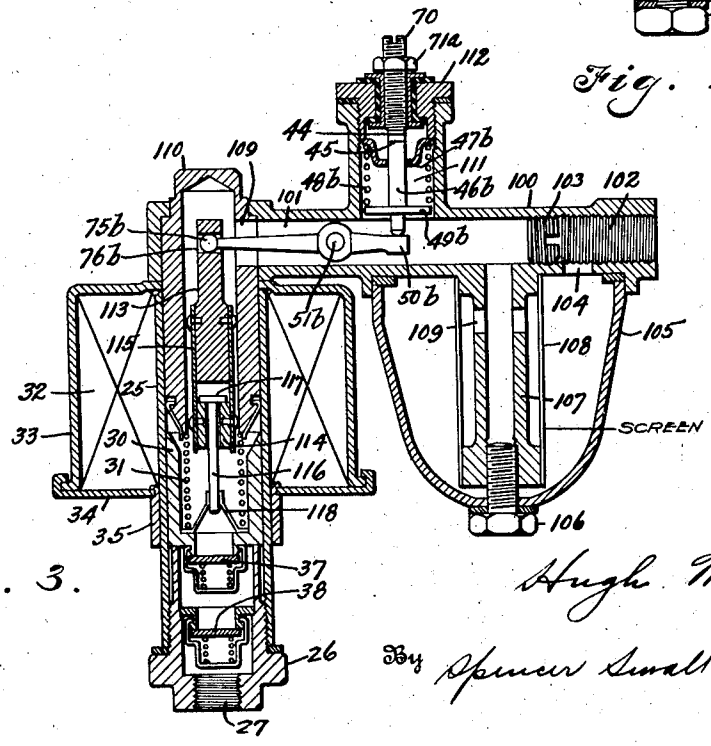


Fig. 3.

Inventor

Hugh Wallace

By Spencer Sinall & Hardman

his Attorneys

Patented Sept. 7, 1926. 1,598,792

UNITED STATES PATENT OFFICE.

HUGH WALLACE, OF DAYTON, OHIO, ASSIGNOR TO GENERAL MOTORS RESEARCH CORPORATION, OF DAYTON, OHIO, A CORPORATION OF DELAWARE.

ELECTROMAGNETIC PUMP.

Application filed August 3, 1925. Serial No. 47,678.

This invention relates to electrical liquid pumps and more particularly to gasoline feed pumps for automobiles. In this type of pump there is usually an electromagnet which operates a piston in one direction, and a spring for moving the piston in the opposite direction after the circuit of the electromagnet is interrupted. The magnet circuit is controlled by a pair of contacts, which are engaged and separated by the movements of the piston.

One of the objects of the present invention is to keep the contacts clean at all times, in order to assure the continuous operation of the pump. In the present invention this object is accomplished by providing a chamber, which is in communication with the main liquid duct which includes the pump cylinder. The chamber is arranged so as to be isolated from the liquid current, and also to trap a quantity of air above the liquid level in the chamber. The contacts are located in the chamber above the liquid level, and are controlled by mechanism connected with the piston and located wholly within the fuel passages of the pump so as to be entirely enclosed.

A further object is to provide an electromagnetic piston pump in which the contacts which control the electromagnet are opened or closed only after the piston has made substantially a full stroke. In the present invention this is accomplished by providing the pump with a movable magnetizable body or auxiliary armature in addition to the piston, which is magnetizable, and in providing a lost-motion connection between the piston and the auxiliary armature. The auxiliary armature is connected with one of the contacts and is so located in the magnetic circuit that, while the electromagnet is energized, the armature is held magnetically in position to maintain the contacts closed until the piston strikes the armature in moving toward a stationary core of the magnet. The contacts are held apart by a light spring until the piston has been moved from the stationary core nearly a full stroke by a spring which is stronger than the spring which tends to separate the contacts.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein preferred forms of the present invention are clearly shown.

Figures 1 to 3 inclusive of the drawings are sectional views of different forms of pumps embodying the present invention.

In the modification shown in Fig. 1, the main fuel duct of the pump is provided by a tube 20, to which is attached by a plug 21, a well 22 enclosing a strainer 23. The well member 22 is tapped at 24 for receiving a pipe connection leading fuel into the pump. The fuel duct includes also a cylinder 25 surrounding a portion of the tube 20. The cylinder 25 supports a coupling 26 which is tapped at 27 to receive a pipe connecting the pump with a vessel, for receiving liquid, such as the float bowl of a carburetor. The cylinder 25 receives a piston 30 which is moved upwardly, into the position shown, by spring 31, and downwardly by an electromagnet 32 surrounded by a housing cup 33 having a cover 34 which supports a tube 35 surrounding the cylinder 25. The magnetic circuit of the magnet includes the tube or stationary core 20, cup 33, cover 34, tube 35 and the piston 30. These parts are of magnetizable metal, while the cylinder 25 is of non-magnetizable metal. Movement of the piston 30 toward the tube 20 is limited by a non-magnetic stop 36. Piston 30 carries a pump-inlet valve 37, and the connection 26 carries the outlet valve 38. Reciprocation of the piston 30 will cause the valves to open and close alternately in the usual manner.

The pump is preferably disposed vertically, as shown in Fig. 1. The tube 20 is connected by a transverse, substantially horizontal passage 40 with a spur duct 41 which provides a chamber, which is vertically disposed and is isolated from the current of liquid flowing upwardly through the plug 21 and tube 20. The upper end of the chamber 41 is closed by a plug 42, so that a quantity of air will be trapped within the chamber 41 above the liquid level therein. The plug 42 insulatingly supports a rod 43 carrying at its lower end a contact 44 which cooperates with a contact 45 supported at the upper end of a rod 46. Rod 46 slides through a guide 47 which is maintained against the lower end of the plug 42 by spring 48. The lower end of the spring 48 bears against a guide 49 into which the rod 46 is threaded. Rod 49 bears against a

lever 50 which is provided with a ball 51 pivotally received by a plug 52 which closes the outer end of the passage 40. The spring 31 maintains, in the position shown, a yoke 53 having flanges 54 for engaging either the flange 55 or the flange 56 of a collar, which is supported by a rod 57. Rod 57 is attached to a magnetizable auxiliary armature 58 which slides within the tube 20 by non-magnetizable brackets 58ª which provide for the passage of liquid through the tube 20 and armature 58. The lower end of rod 57 is connected by a flexible connection 60 with one end of the lever 50.

The rod 43 which supports the contact 44, is connected by a spring conductor 61 with a metal hub 62 which is rotatable around a bushing 63 carried by a non-conducting block 64 supported by the magnet cover 34. The sleeve 63 is connected by a wire 65 with one end of magnet winding 32. The other end of the magnet winding 32 is connected by a switch with one terminal of a current source, such as a storage battery. It is customary in automobiles to ground one terminal of the storage battery upon the vehicle frame. Therefore, when the pump shown, is mounted upon the engine frame of an automobile, a circuit will be made from the contact 45 to the grounded side of the storage battery.

The contacts 44 and 45 are normally closed and the piston 30 is normally in its upper position, as shown in Fig. 1. To operate the pump, it is connected by the switch referred to, with the current source. The magnet winding 32 is energized and the pump piston 30 is attracted downwardly against the spring 31. During this downward movement, the flanges 54 of the yoke 53 will first release the flange 55 and then engage the flange 56 toward the end of downward travel of the piston 30. While the flanges 54 are between the flanges 55 and 56, the contacts 44 and 45 remain closed in spite of the tendency of spring 48 to separate them, because the auxiliary armature 58 tends to move upwardly while the magnet is energized. The attraction of the piston 30 downwardly is greater than the attraction of the armature 58 upwardly so that, the rod 57 will be moved downwardly after flanges 54 engage flange 56. This will cause the contact 45 to be moved downwardly out of engagement with the contact 44. The circuit of the magnet will, therefore, be broken and spring 31 will be released to move the piston upwardly. Toward the end of upward travel of the piston 30, the flanges 54 of the yoke 53 will engage the collar flange 55 and will pull the lever 50 upwardly. The spring 48 tends to maintain the contact 45 out of engagement with the contact 44, but the spring 31 is strong enough to overcome the spring 48, so that after the yoke flange 54 engages the collar flange 55, the contact 45 will begin to move toward contact 44. Consequently, the contacts will be closed again, only after the piston has moved upwardly substantially its entire travel.

It is, therefore, apparent that the contacts will be maintained in engagement during substantially the entire downward travel of the piston, and out of engagement during a substantial portion of its upward travel. In this manner, the rate of operation of the piston will be low and its stroke will be relatively long, as compared with piston movements at a rapid rate and through a very short amplitude. This mode of operation is desirable for long life and economy in operation.

The modification shown in Fig. 2 differs from Fig. 1, in that the contact 44 is carried by a screw 70 adjustable through a bushing 71 which is insulatingly supported by a plug 73 closing the upper end of the chamber 41ª. The screw 70 is maintained in adjusted position by a nut 74, the upper end of which receives the spring conductor 61. The contact 45 is mounted upon a rod 46ª having a guide 49ª, and a spring 48ª located between the guide 49ª and a guide 47ª, in order to have the same function as the spring 48, shown in Fig. 1. The rod 46ª bears against a lever 50ª having a ball-end 51ª carried by a socket plug 52ª. The other ball-end 75 of the lever 50ª is received by an opening 76 in a magnetizable rod 77 carrying at its lower end a guide 78, and at its upper end a screw 79 and a washer 80. The underside of the head of screw 79 is normally engaged by the flanges 54 of the yoke 53. Thus the head of screw 79 performs the function of the flange 55 in Fig. 1. The washer 80 performs the function of the flange 56 in Fig. 1. The mode of operation of the pump shown in Fig. 2, is the same as that in Fig. 1,—one of the features being that the contacts 44 and 45 are not separated until the flange 54 engages the washer 80, or not until the piston 30 has substantially completed its downward stroke. The rod 77 constitutes an auxiliary armature having the same function as the armature 58 in Fig. 1.

The form of the invention shown in Fig. 2 differs from Fig. 1 also in the manner of constructing the fuel passages. A member 90 is provided with a horizontally-disposed passage, including the passage 40 and a passage 61, which is separated from the passage 40 by the magnetizable tube 20ª, which extends through the bottom and top walls of the member 90, and is provided with a side opening 20ᵇ connected with the passage 40. The liquid-inlet passage 91 is connected by a hole 92 with the interior of a well 93 which is attached by a screw 94 to the tube 20ª.

The liquid passes through a screen 95 and through side openings 96 into the interior of the tube 20ª.

Fig. 3 shows still another form of the invention, in which the pump magnet cylinder, and piston and valves are inverted. A member 100 provides passages 101 and 102, which are separated by a screw plug 103. Passage 102, with which the inlet pipe is connected, communicates with a hole 104 within the interior of a well 105 attached by a screw 106 to a vertical tube 107 integral with the member 100. Liquid passes through a screen 108 and side openings 109 into the tube 107 and thence into the passage 101. Passage 101 is connected with a magnetizable tube 110 through a side opening 109 therein, the tube 110 being supported by the member 100. The tube 110 corresponds to the elements 20 and 20ª, shown in the other views, and supports in an inverted position the pump, piston, cylinder and electromagnet.

The duct member 100 includes a spur passage 111, which provides a chamber located out of the liquid current through the passage 101. The chamber 111 is closed by a plug 112, so that it is adapted to trap a quantity of air above the surface of the liquid which is received by the chamber 111. The plug 112 insulatingly supports the adjusting screw 70, which has been described in connection with Fig. 2. The screw 70 is held in adjusted position by nut 71ª. Contact 44, which is supported by the screw 70, cooperates with the contact 45 carried at the upper end of rod 46ᵇ having a guide 49ᵇ and extending through a guide 47ᵇ which is held in position by a spring 48ᵇ. The rod 46ᵇ engages a lever 50ᵇ pivoted at 51ᵇ and having a ball-end 75ᵇ received by a recess 76ᵇ, Recess 76ᵇ is provided by a magnetizable rod 113. Rod 113 is connected in spaced relation to a sleeve 114 by a magnetizable tube 115 constituting an auxiliary armature having the functions of armature 58. A rod 116 is provided with a head 117 of lesser vertical dimension than the distance between the members 113 and 114. The rod 116 passes through a hole in the block 114 and is attached at its lower end to a yoke 118, which is maintained by the spring 31 against the piston 30. It is apparent, therefore, that the head 117 and the rod 116 performs the functions of the flanges 55 and 56 of the collar, which is attached to the rod 57 in Fig. 1.

In the modification shown in Fig. 3, the contacts 44 and 45 are normally closed and the piston 30 is normally down against the plug 26, as shown in Fig. 3. When the magnet coil 32 is connected with a current source through the contacts 44 and 45, the piston 30 will be moved upwardly and the head 117 will release the block 113, so that the spring 48ᵇ may move the contact 45 away from the contact 44. Owing to the resistance offered magnetically to the upward movement of the auxiliary armature 115, the contact 45 will not be separated from the contact 44 as soon as the head 117 releases the block 114. The piston 30 will travel upwardly a substantial distance until the head 117 engages the block 113 and then move the block sufficiently to break the magnet circuit at contacts 44 and 45. When the magnet winding 32 will be deenergized, so that the spring 31 may move the piston 30 downwardly. The contact 45 will remain out of engagement with the contact 44 until a substantial downward movement of the piston 30 has taken place. When this has occurred, the head 117 will engage the block 114 and will cause the stem 46ᵇ to move upwardly to engage the contacts again. Therefore, it is apparent that in this form of the invention, as in the other forms, the opening and closing of the contacts occurs only as the piston nears the ends of its travel.

In all the forms of the invention, the contacts are maintained in an isolated chamber and above the surface of the liquid which may enter the chamber. Thus the possibility of particles of dirt getting upon the contacts is minimized.

While the forms of embodiment of the invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A liquid pump comprising, in combination, a duct for the flow of liquid, means for causing liquid to flow through said duct and including a reciprocating member, a chamber connected with said duct but isolated from the current of liquid in said duct and adapted to trap a quantity of air above the surface of the liquid therein, an electromagnet for operating said member, contacts in said chamber above the liquid surface therein, and mechanism connected with said member and extending from the duct into the chamber for opening and closing the contacts.

2. A liquid pump comprising, in combination, a liquid duct including a pump cylinder, a piston in said cylinder, a vertical chamber connected with said duct but arranged to be isolated from the current of liquid through said duct and to trap a quantity of air above the liquid surface therein, an electromagnet for operating the piston, a pair of contacts for controlling the magnet located above the liquid level in said chamber, and mechanism connecting the piston with one of the contacts.

3. A liquid pump comprising, in combination, a liquid duct including a vertically-disposed pump cylinder, a piston within the

cylinder, a vertically-disposed chamber disposed out of the liquid current in said duct and arranged to trap a quantity of air above the liquid level therein, a transverse passage connecting the cylinder and chamber, a pair of contacts located in said chamber above the liquid level, mechanism connecting the piston and one of the contacts and including a lever located in the transverse passage, and an electromagnet controlled by the contacts.

4. A liquid pump comprising, in combination, a liquid duct having a spur duct out of the liquid current and providing a chamber adapted to trap a quantity of air above the surface of liquid therein, a piston in the liquid duct, contacts in the chamber above the liquid level therein, mechanism located wholly with the duct and spur for connecting the piston and one of the contacts and including a motion-reducing lever between the piston and lever, and an electromagnet for operating the piston controlled by the contacts.

5. A liquid pump comprising, in combination, a cylinder, a movable piston, an electromagnet for moving the piston, contacts controlling the magnet circuit, means for controlling separation of the contacts by motion of the piston and including an auxiliary armature in the magnetic circuit of the electromagnet and having a lost-motion connection with the piston.

6. A liquid pump comprising, in combination, a cylinder, a magnetizable piston, an electromagnet having a tubular core in proximity to the piston, contacts controlling the magnet circuit, and connections between the piston and one of the contacts including a magnetizable body within the tubular core and a lost-motion connection between said body and the piston.

7. A liquid pump comprising, in combination, a cylinder, a movable piston, an electromagnet for moving the piston in one direction, a spring for moving the piston in the opposite direction when the magnet is not energized, contacts controlling the magnet circuit, and mechanism controlled by the piston movements for causing the separation and closing of the contacts, said mechanism comprising a spring tending to separate the contacts and a magnetizable body having a lost-motion connection with the piston and magnetically resisting separation of the contacts by the last-mentioned spring but yielding to the movement of the piston after the lost motion is taken up during movement of the piston by magnetic force, the last-mentioned spring being overcome by the first-mentioned spring whereby the contacts are closed by the spring-produced movement of the piston after the lost motion is taken up.

8. A liquid pump comprising, in combination, a displacement member, inlet and outlet valves, an inlet chamber, an electromagnet for operating the displacement member, contacts located within the inlet chamber and controlling the magnet, and means for controlling the separation and closing of the contacts including a magnetizable member in the magnetic circuit of the magnet and having a lost-motion connection with the displacement member.

In testimony whereof I hereto affix my signature.

HUGH WALLACE.