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RECIPROCATING ELECTRO-MAGNETIC PUMP

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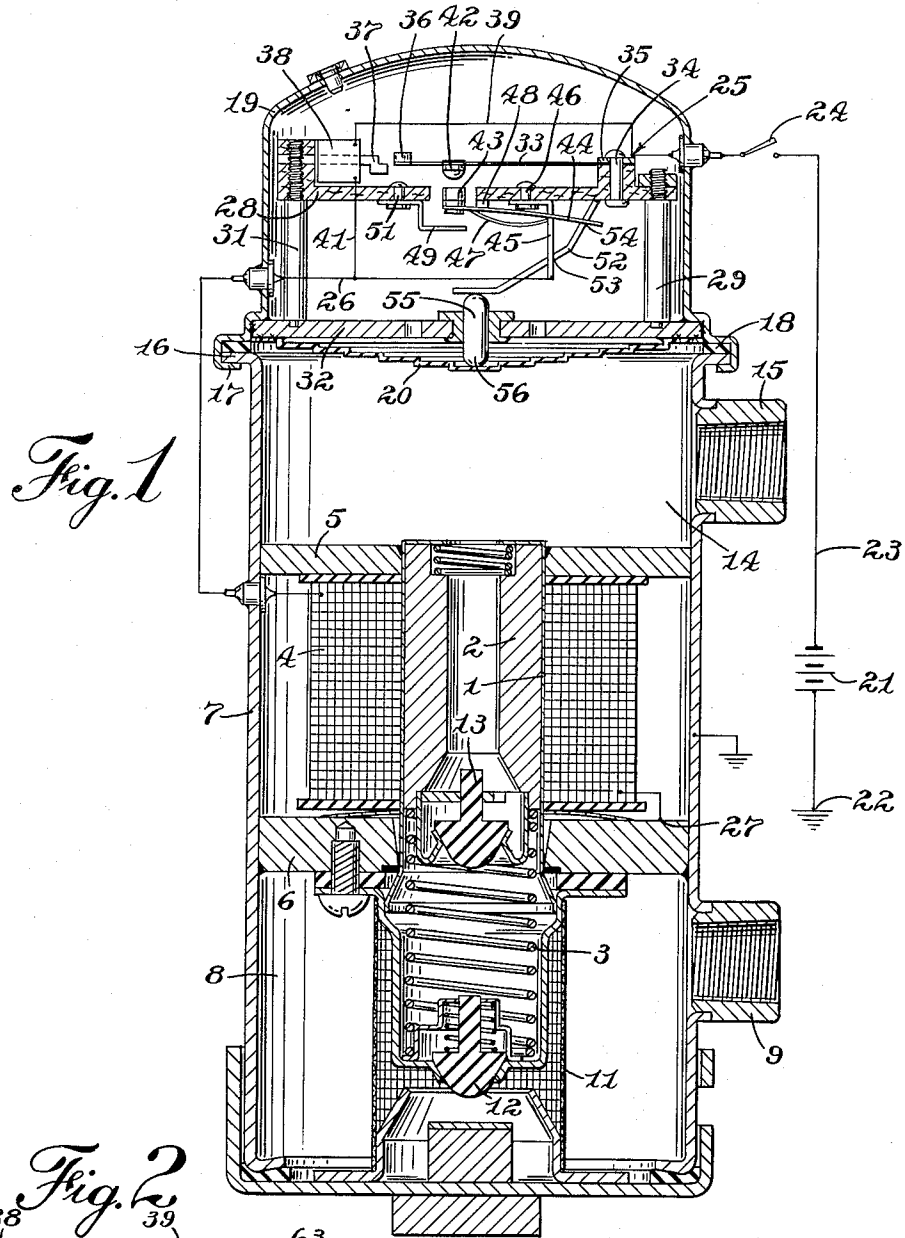


Fig. 1

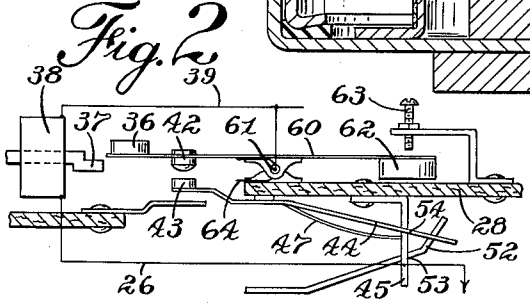


Fig. 2

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RECIPROCATING ELECTRO-MAGNETIC PUMP

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2 Claims. (Cl. 103—25)

The present invention relates to a reciprocating electromagnetic pump and more particularly to controlling and regulating means for such pumps.

The present application is in the nature of an improvement on the applicant's prior application, Serial Number 236,935, filed July 16, 1951, now Patent No. 2,631,250. In that application the contacts which control the operation of the pump are normally open and are closed magnetically by the pump plunger to secure the desired reciprocation. In the present case, an electromagnetic control for the pump contacts is used, and means are provided for modifying the action of the contacts to regulate the output pressure of the pump.

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

It is another object to provide such a device in which the control of the actuation of the piston is independent of the movement of the piston.

It is another object to provide such a device incorporating means for maintaining a substantially constant output pressure irrespective of the volume of delivery, up to the maximum capacity of the pump.

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

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

Fig. 2 is a detail of a modified form of contact controlling mechanism.

In Fig. 1 of the drawing there is illustrated an electromagnetic pump comprising a cylinder 1 of non-magnetic material in which a magnetic piston 2 is slidably mounted. A spring 3 normally maintains the piston 2 in its upper position as illustrated, and a solenoid 4 is arranged, when energized, to draw the piston downward against the force of the spring 3.

Circular pole pieces 5 and 6 for the solenoid 4 serve as mounting means for the solenoid and cylinder 1, and position these members coaxially in a cylindrical casing 7 which is also of magnetic material and therefore forms a flux path between said pole pieces.

Casing 7 provides an inlet chamber 8 which receives liquid to be pumped through the inlet nipple 9. The liquid passes through a filter 11, inlet check valve 12, and check valve 13 in the lower end of the piston 2, whereby reciprocation of the piston discharges the liquid into the outlet chamber 14 of the casing 7 which is provided with an outlet nipple 15.

The upper end of casing 7 is provided with an outturned flange 16 on which a cap 19 is secured in any suitable manner as by crimping over a lip 17 of the cap, a gasket 18 being interposed to ensure against leakage. A backing plate member 32 is soldered in the cap 19, and a circular flexible diaphragm 20 is soldered at its periphery to the backing plate, thereby effectively sealing the cap

19; and, when the cap is mounted on the casing 7, providing a flexible closure for the outlet chamber 14.

Means for periodically energizing the solenoid 4 to cause reciprocation of the piston 2 is provided comprising a battery 21 which is grounded at 22 and connected by a lead 23 through a switch 24 to a contact mechanism in the cap 19 indicated generally by numeral 25. A lead 26 connects the contact mechanism to one end of the solenoid 4, the opposite end thereof being grounded at 27 to complete the solenoid circuit.

The contact mechanism 25 comprises a base or frame member 28 of any suitable insulating material which is mounted by means of posts 29 and 31 on the plate member 32. A flexible metallic reed 33 is anchored at one end to the frame 28 as by means of a rivet 34 and washer 35, and is thereby electrically connected to the battery lead 23. Reed 33 has on its free end an armature 36 which is normally spaced a short distance above a pole piece 37 of an electromagnet 38. One terminal of the electromagnet is connected by a lead 39 to the battery lead 23, and the other end is connected by a lead 41 to the lead 26 which goes to the solenoid 4.

Reed 33 carries a contact 42 adjacent the armature 36 which contact is normally spaced a short distance from a cooperating contact 43 mounted on the end of a metallic blade 44 which is pivotally mounted on a metallic bracket 45 fixed to the frame member 28 by means of a rivet 46. A bowed spring member 47 bears at its ends against the bracket 45 and the contact carrying end of the blade 44 and serves to urge the blade against its upper stop 48 on the frame 28, or against the lower stop bracket member 49 attached to the frame by a rivet 51, as the blade is moved through "dead-center" position by an operating lever 52 pivoted on the bracket 45 at 53 and to the blade 44 at 54.

Means for moving the contact 43 into and out of the path of movement of the vibrator contact 42 is provided in the form of a plunger 55 slidably mounted in the plate 32, bearing at its lower end at 56 on the flexible diaphragm 20, and at its other end engaging the free end of the lever 52.

Contact 43 is connected through the blade 44 and bracket 45 to the solenoid lead 26 so that when the contacts 42 and 43 are in engagement, the solenoid 4 is connected directly to the battery 21, whereas when said contacts are open, the electromagnet 38 is inserted in the solenoid circuit. The resistance of electromagnet 38 is such that when it is placed in series with the solenoid 4, it prevents effective energization of the solenoid.

In operation, starting with the parts in the positions illustrated, closure of the manual switch 24 completes the circuit from the battery 21 through electromagnet 38 and solenoid 4, whereby the electromagnet is energized, but the solenoid is not sufficiently energized to actuate the piston 2. Energization of the electromagnet 38 attracts the armature 36 downward toward the pole piece 37, bringing contact 42 into engagement with contact 43. This short-circuits the electromagnet 38 and connects the solenoid 4 directly to the battery 21 whereby the solenoid is caused to draw the piston 2 downward, compressing the spring 3. The deenergization of the electromagnet 38 caused by closure of the contacts 42, 43 across which said electromagnet is bridged, releases the armature 36 allowing the contacts 42, 43 to open, whereby the solenoid 4 is so weakened as to permit the spring 3 to return the piston 2 to its normal position. Repetition of this cycle of operation causes the piston to be reciprocated, and thereby transfer the liquid to be pumped from the inlet chamber 8 to the outlet chamber 14. When the fluid pressure in the output chamber has been thus built up to the desired point, the flexible diaphragm 20 moves upwardly, which motion is transmitted through the plunger

55 to the lever 52, causing the blade 44 to be moved downwardly beyond its "dead-center" position, whereupon the spring 47 becomes operative to snap the contact 43 out of the range of movement of contact 42, and against the back stop 49. The pump is then maintained inoperative until liquid has been withdrawn through the output nipple 15 sufficiently to reduce the pressure in the outlet chamber to a point where the diaphragm 20 releases the lever 52 and thus permits the blade 44 to rise and cause the spring 47 to snap the contact 43 back to its normal position.

It has been found desirable to fill the cup 19 with an inert gas under a slight amount of pressure in order to prolong the life of the contacts. This arrangement forms a convenient way of regulating the output pressure of the pump by varying the pressure of the gas on the upper side of the diaphragm 20.

In some instances it may be desired to retard the movement of the contact 42 in order to increase the stroke of the piston 2. One arrangement for securing this result is illustrated in Fig. 2 of the drawing in which the contact 42 is mounted on a blade member 60 which is pivoted at an intermediate point 61 to the frame member 23 and carries a weight member 62 for counterbalancing the armature 36. An adjustable stop 63 is preferably provided for limiting the downward travel of the contact 42, and a spring 64 is employed for biasing blade 60 toward its normal position.

The operation of this embodiment of the invention is the same as the first described embodiment, with the exception that the tilting movement of the blade 60 is more deliberate than the vibration of the reed 33 so that the pump piston is operated more slowly.

Although certain structure has been shown and described in detail, it will be understood that other embodiments are possible and changes may be made in the precise form and arrangement of the parts without departing from the spirit of the invention.

I claim:

1. In a reciprocating electromagnetic pump a casing having an inlet chamber and an outlet chamber, a cylinder connecting said chambers, a hollow magnetic piston slidable in the cylinder, a spring urging the piston toward the outlet chamber, a solenoid operative to retract the piston; and means for energizing the solenoid including a normally stationary contact, a spring-mounted contact normally spaced therefrom, electromagnetic means for moving the spring-mounted contact into engagement with the normally stationary contact, and a source of electrical energy connected through said contacts to the pump solenoid, the contact-actuating electromagnet being bridged across said contacts; including further a cap for said casing forming a housing for the contact assembly, a flexible diaphragm which constitutes a partition between the outlet chamber of the casing and said cap, and means responsive to flexure of said diaphragm by pressure in the outlet chamber for moving the normally stationary contact out of the path of the spring-mounted contact.

2. An electromagnetic pump as set forth in claim 1 in which the cap is filled with gas under a predetermined pressure which opposes the flexure of the diaphragm in response to the output pressure of the pump.

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