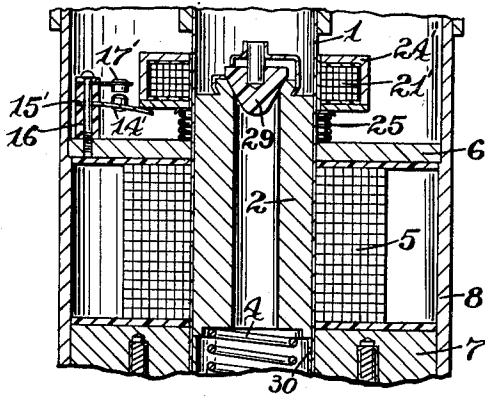
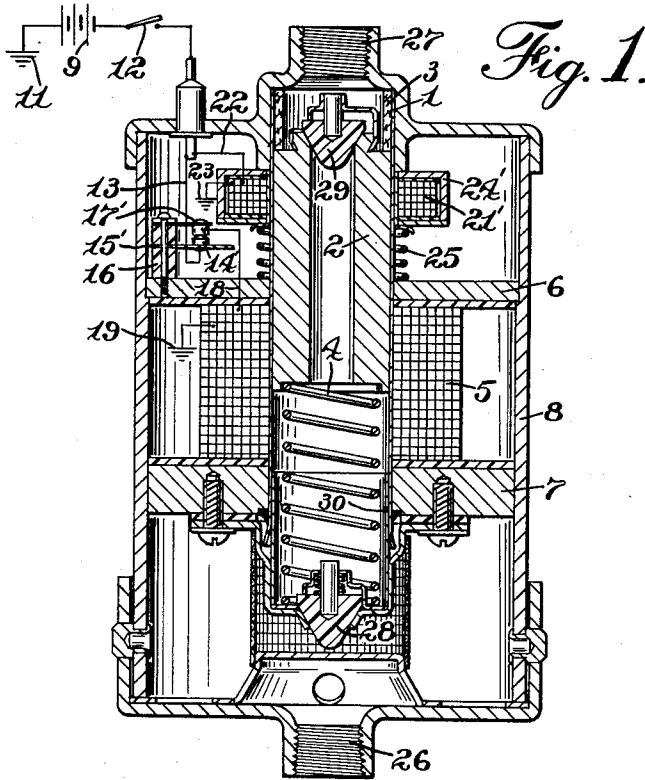


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RECIPROCATORY ELECTRIC MOTOR

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WITNESS:

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## RECIPROCATORY ELECTRIC MOTOR

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1 Claim. (Cl. 310—34)

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The present invention relates to a reciprocatory electric motor and more particularly to an electromagnetic device for reciprocating a plunger such as the piston of a fuel pump.

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

It is another object to provide such a device which incorporates simple and effective means for controlling the electromagnet.

It is another object to provide such a device in which all the moving parts of the motor are arranged to have rectilinear motion only, and are balanced so as to be unaffected by accelerational forces lateral to their path of movement.

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 midsectional view of a preferred embodiment of the invention showing the parts in idle position;

Fig. 2 is a fragmentary section showing the parts in the positions assumed when the piston approaches the lower end of its stroke.

In Fig. 1 of the drawing there is illustrated a cylinder 1 of non-magnetic material in which is slidably mounted a hollow plunger 2 of magnetic material such as soft iron. The upper position of plunger 2 is defined by a cylindrical stop 3 of suitable material such as fiber. A spring 4 urges the piston upward toward said stop, and means for overcoming the spring and drawing the piston downward is provided in the form of a solenoid 5. Circular pole pieces 6 and 7 are located at the ends of the cylinder 5 and serve to locate the solenoid and the cylinder 1 within a cylindrical housing 8 of magnetic material which serves to complete the external magnetic circuit of the solenoid.

Means for energizing the solenoid 5 is provided comprising a battery 9 which is grounded at 11 and connected through a switch 12 and a lead 13 to a contact 14' mounted on a resilient blade 15' attached to but insulated from the casing 8 as indicated at 16. A second contact 17' adapted to cooperate with the contact 14' is connected by a lead 18 to one terminal of the solenoid, the opposite terminal of which is grounded at 19 to complete the electrical circuit. Means for controlling the contacts 14', 17' is provided comprising an electro-magnet 21' which is slidably mounted on the exterior of the cylinder 1. One terminal of the electro-magnet 21' is connected by a lead 22 to the battery lead 13 and the other terminal is

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grounded as shown at 23 so that the electro-magnet is energized continuously as long as the switch 12 is closed.

Electro-magnet 21' is provided with a casing 24' of magnetic material which serves to complete the external magnetic circuit thereof, and is urged upwardly by a spring 25.

In order to utilize this motor as a pump, the casing 8 is provided with an inlet 26 and an outlet 27, and check valves 28 and 29 are mounted in the lower end of the cylinder 1 and the upper end of the plunger 2 respectively.

The contacts 14', 17' are located below the electro-magnet 21' and are opened by the downward movement of the electro-magnet, and the plunger 2, when in idle position, extends through and beyond the electro-magnet 21' as shown in Fig. 4.

In the operation of this embodiment, closure of the switch 12 causes energization both of the electro-magnet 21' and of the solenoid 5 since the contacts 14', 17' are closed. Plunger 2 is consequently drawn downward, compressing the spring 4. When the plunger begins to be withdrawn from the electro-magnet 21', said electro-magnet is drawn down thereby against the action of the spring 25 until the casing 24' of electro-magnet 21' engages the contact-carrying blade 15' so as to open contacts 14', 17' as shown in Fig. 5. The consequent deenergization of solenoid 5 permits the plunger 2 to be moved upwardly on its discharge stroke by the spring 4 until the top of the plunger emerges from the electro-magnet 21' which accordingly is raised by the spring 25 so as to permit contacts 14', 17' to close, whereupon the operation is repeated.

The downward movement of plunger 2 is preferably limited by a suitable stop member 30 so as to prevent the plunger from moving beyond the zone of flux of electro-magnet 21'.

Although certain embodiments of the invention are 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.

We claim:

In a reciprocating electromagnetic motor a solenoid, a non-magnetic hollow cylinder fixed in the solenoid and projecting therefrom, a piston of magnetic material slidably mounted in the cylinder and projecting therefrom, an abutment limiting movement of the piston away from the solenoid and thus defining its idle position, a spring urging the piston toward the abutment,

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a cylindrical casing of magnetic material surrounding the solenoid, annular pole pieces of magnetic material at the ends of the solenoid supporting the solenoid in the casing and providing with the casing a path of low reluctance for the portion of its flux circuit external to the solenoid, an electro-magnet having a casing of magnetic material completing its external flux circuit, slidably mounted on the projecting portion of the cylinder, surrounding the projecting end of the piston and movable therewith by mutual attraction; means limiting movement of the electro-magnet away from the solenoid, a spring urging the electro-magnet away from the solenoid, means for energizing the solenoid including a pair of normally closed contacts, and

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means responsive to a predetermined movement of the electro-magnet toward the solenoid for opening said contacts.

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