

April 26, 1949.

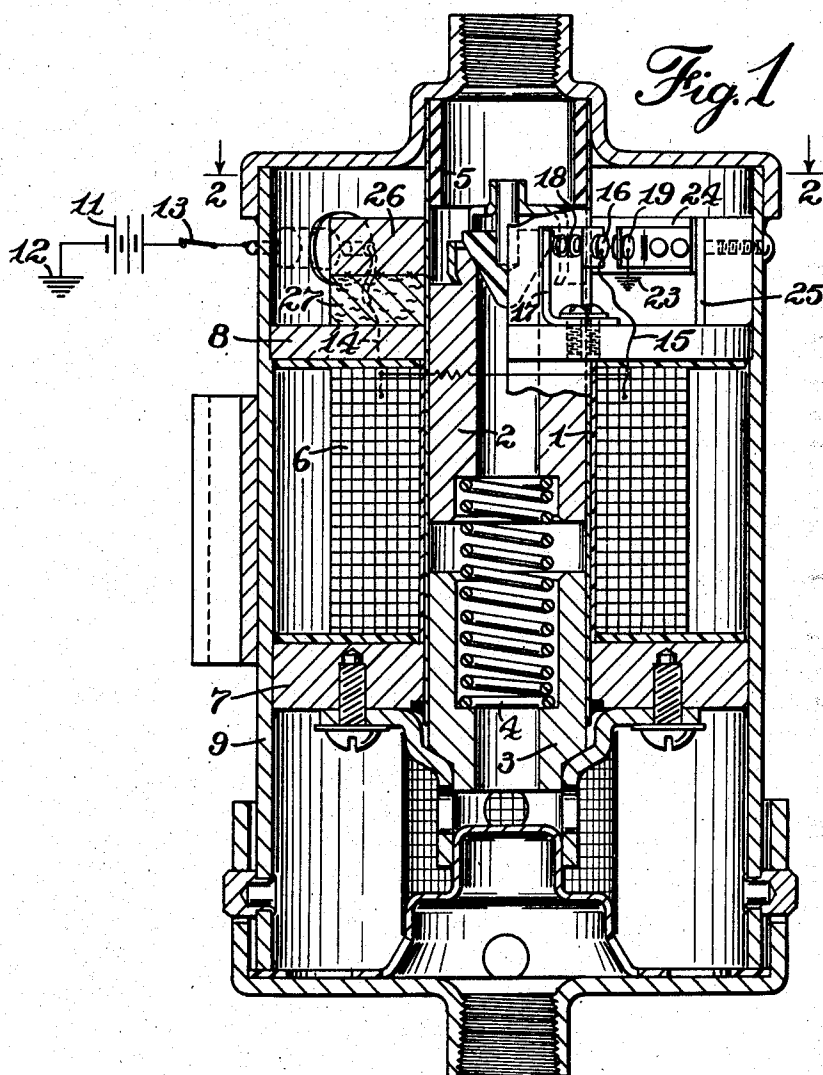
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2,468,343

RECIPROCATORY ELECTROMAGNETIC MOTOR

Filed Aug. 26, 1947

2 Sheets-Sheet 1



WITNESS:

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2 Sheets-Sheet 2

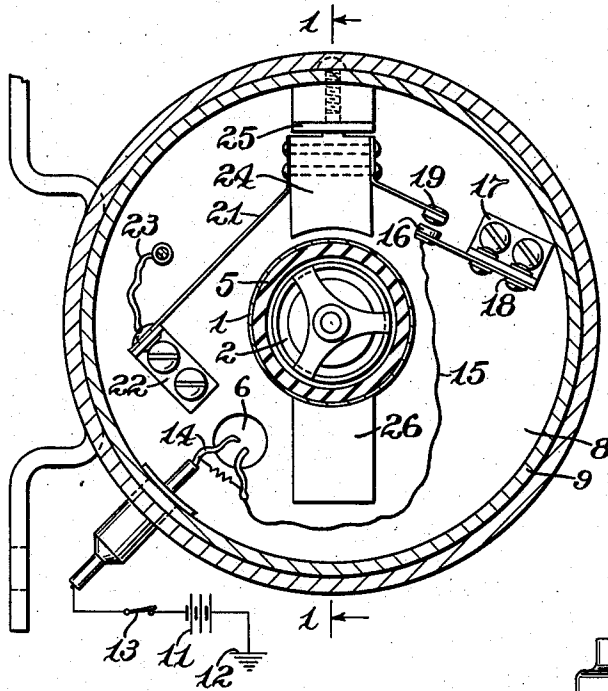


Fig. 2

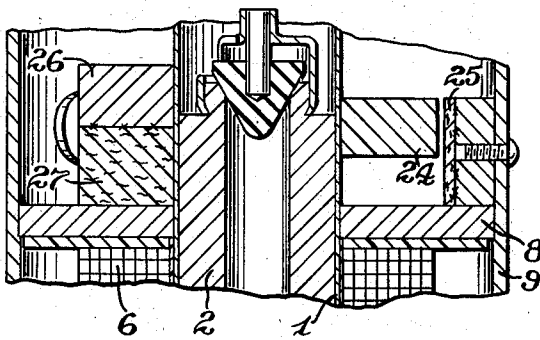


Fig. 3

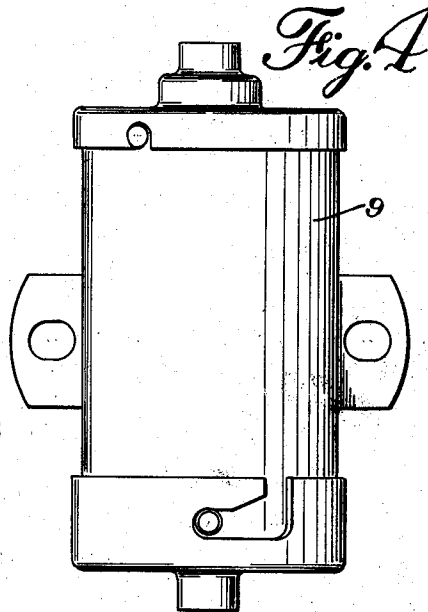


Fig. 4

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2,468,343

RECIPROCATORY ELECTROMAGNETIC MOTOR

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Application August 26, 1947, Serial No. 770,611

3 Claims. (Cl. 172-126)

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The present invention relates to a reciprocatory electromagnetic motor, and more particularly to the means for controlling the energization of the actuating electromagnet of such motor.

In reciprocating motors such as used to actuate fuel pumps and the like, the actuating electromagnet is customarily controlled by contacts which are operated magnetically by the approach and recession of the pump piston. The contact-controlling magnet is usually a permanent magnet which may be mounted on the contact-carrying member or may be mounted on the piston, in which latter case the contacts are controlled by a movable armature. In both cases, the flux of the magnet must traverse an air gap of considerable width in order to magnetize the armature or the pump piston as the case may be, to cause closure of the contacts. This makes it necessary to use a larger permanent magnet than would otherwise be needed, and tends to make somewhat indefinite the points in the travel of the piston where the contacts open and close.

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

It is another object to provide such a device incorporating contacts for controlling the motivating electromagnet, and novel actuating means for said contacts.

It is another object to provide such a device in which the actuating means for the contacts includes a pair of permanent magnets arranged to magnetize the piston when it comes between them.

It is another object to provide such a device in which one permanent magnet is movable and actuates the control contacts, while the other is fixed and located closely adjacent the path of the piston at the point where the contacts are to be closed.

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 preferred embodiment of the invention as used in a fluid pump, the upper part of the device being sectioned substantially on the line 1-1 of Fig. 2, and the electrical system therefor being indicated diagrammatically;

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

Fig. 3 is a detail of a modified form of the device shown in vertical section, the section being

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taken substantially on the line 1-1 of Fig. 2; and Fig. 4 is a side elevation of a pump unit on a reduced scale.

In Fig. 1 of the drawing, there is illustrated a cylinder 1 of non-magnetic material in which is slidably mounted a piston 2 of magnetic material such as soft iron. A pole piece 3 of magnetic material is fixedly mounted in the lower end of the cylinder in any suitable manner, and a spring 4 located between the pole piece and piston urges the piston toward a cylindrical stop member 5 of cushioning material such as rubber or fibre in the upper end of the cylinder.

An electromagnet 6 surrounding the cylinder is arranged when energized to attract the piston toward the pole piece 3 against the action of spring 4, the magnetic circuit being preferably completed through the lower and upper plate members 7 and 8 and the case 9, all of which are made of magnetic material.

An electrical system for energizing the electromagnet 6 is provided comprising a battery 11 grounded at 12 and connected by a manual switch 13 and lead 14 to one terminal of the electromagnet 6. The other terminal of the electromagnet is connected by a lead 15 to a fixed contact 16 (Fig. 2) which is mounted on a bracket 17, the contact 16 being suitably insulated from the bracket as indicated at 18. A movable contact 19 is mounted on a flexible blade member 21 which is fixed to the upper plate member 8 by means of a bracket 22 and is grounded as indicated at 23 so as to complete the energizing circuit for the electromagnet 6 when the contacts 16 and 19 are in engagement.

Means for controlling the contacts 16 and 19 is provided comprising a permanent magnet 24 mounted on the elastic blade 21 in position to move toward and away from the cylinder 1. The blade 21 is arranged to urge the magnet 24 away from said cylinder into engagement with a non-magnetic stop member 25 fixedly mounted in the casing 9. A second permanent magnet 26 is mounted on the upper plate 8, suitably spaced therefrom by a block 27 of non-magnetic material. The magnet 26 conforms to the exterior of the cylinder 1 and is maintained in engagement therewith so that when the piston 2 is at the upper end of its stroke, said magnet is separated from the piston only by the thickness of the cylinder. The magnet 26 is thus effective to strongly magnetize the upper end of the piston. The poles of the first mentioned permanent magnet 24 are oriented similarly to those of the second magnet 26 so that the adjacent poles of the magnet 24

and of the piston as magnetized by the magnet 26 are of opposite polarity. The magnet 24 is therefore strongly attracted by the piston, causing the magnet to flex the blade 21 and bring contact 19 into engagement with fixed contact 16 so as to close the solenoid circuit.

In operation, starting with the parts in the positions illustrated in Fig. 1, closure of the manual switch 13 connects the electromagnet to the battery 11. Since the piston is in the upper end of the cylinder 1, the contacts 19, 16 are closed, and the battery circuit is completed through the electromagnet which is accordingly energized and draws the piston downward toward the pole piece 3. When the upper end of the piston leaves the zone of influence of the permanent magnets 24, 26, the permanent magnet 24 is released and the blade 21 moves said magnet back against the stop and deenergizes the electromagnet 6. The spring 4 is thereupon operative to move the piston toward the upper end of the cylinder, such motion being utilized in the structure illustrated to propel fluid from the cylinder 1. When the upper end of the piston comes opposite the permanent magnet 26, the piston becomes magnetized thereby and attracts the permanent magnet 24 so as to close the control contacts 16, 19 whereby the cycle is repeated.

The magnet 26 may be located directly opposite the magnet 24 or, as illustrated in Fig. 3, it may be spaced axially of the cylinder in respect to magnet 24. Since, when the contacts are open, there is a substantial air gap between the permanent magnet 24 and the cylinder 1, the magnet 24 will not become effective to close the contacts until the piston has been magnetized by magnet 26. The position of magnet 26 thus determines the point in the travel of the piston at which the contacts will be closed. Since the air gap between the magnet 24 and the cylinder is substantially closed when the contacts are closed, the piston will hold the contacts closed as long as it is in proximity to the magnet 24. It will thus be seen that considerable latitude of adjustment of the length of the stroke of piston 2 may be secured by adjustment of the magnet 26 axially of the cylinder 1.

Although certain structure has been shown and described in detail, it will be understood that other embodiments are possible and various changes may be made in the design and arrangement of

the parts without departing from the spirit of the invention.

I claim:

1. In a reciprocatory electromagnetic motor, a cylinder of non-magnetic material, a piston of magnetic material slidably mounted therein, a spring for actuating the piston, an electromagnet surrounding the cylinder operable when energized to overcome the spring and retract the piston, means for controlling the energization of the electromagnet including a pair of contacts and means for actuating the contacts including a permanent magnet mounted adjacent the cylinder and movable toward the cylinder by attraction of the piston therein to close the contacts, means for magnetizing the piston to cause it to attract said magnet including a second permanent magnet mounted closely adjacent the path of the piston at the end of its forward stroke and arranged to induce in the piston a polarity opposite to that of the first permanent magnet and yielding means normally holding the first mentioned permanent magnet so separated from the cylinder as to be ineffective to close the contacts except when the piston is magnetized by proximity to the second permanent magnet.

2. An electromagnetic motor as set forth in claim 1 in which the second permanent magnet is arranged substantially on the opposite side of the cylinder from the first-mentioned permanent magnet and in contact with said cylinder.

3. An electromagnetic motor as set forth in claim 1 including further, yielding means urging the first-mentioned permanent magnet away from the cylinder to hold the contacts open, and means limiting the movement of the first-mentioned permanent magnet away from the cylinder to define the air gap between said magnet and the cylinder.

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