H. E. WARREN.

ELECTROMAGNETIC ACTUATOR.

APPLICATION FILED MAR. 7, 1913.

1,252,312.

Patented Jan. 1, 1918.

2 SHEETS—SHEET 1.

Fig. 1

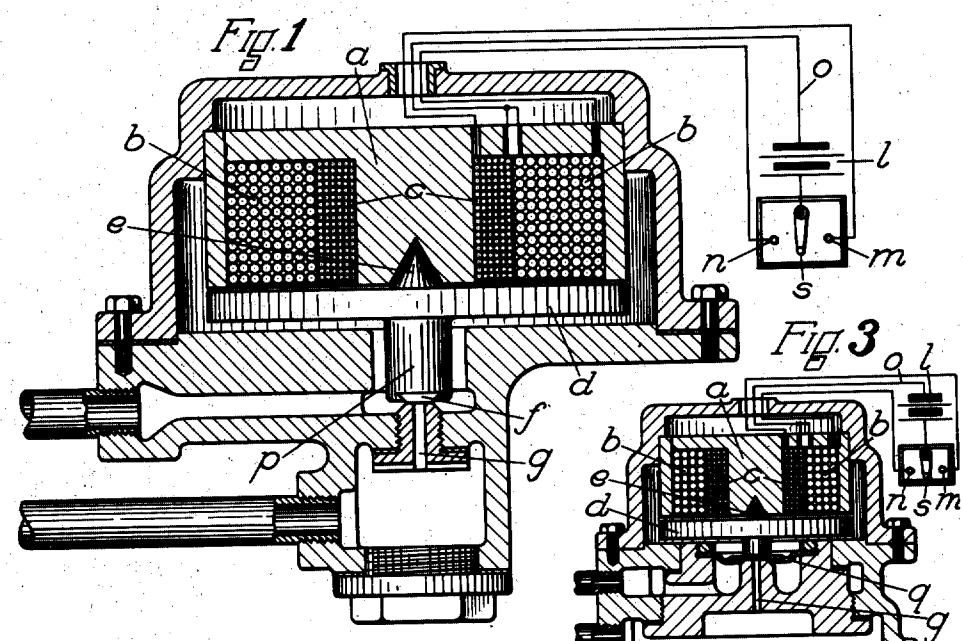
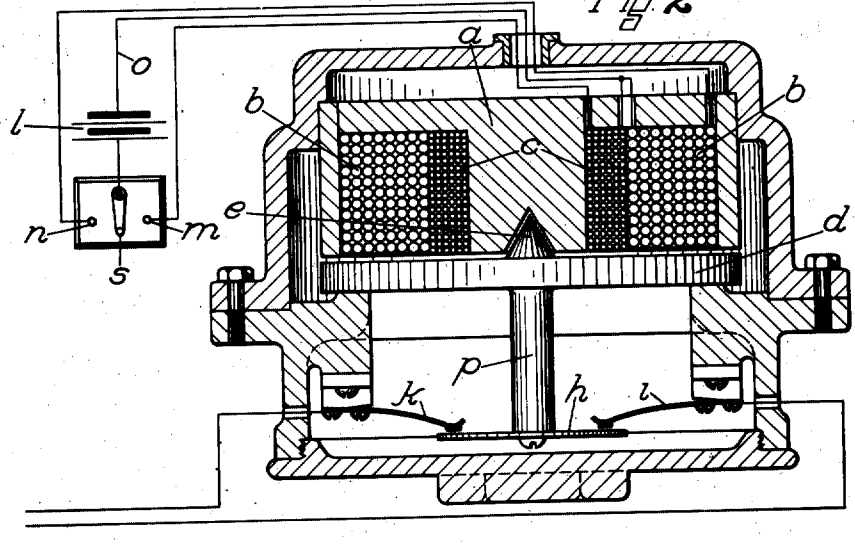


Fig. 3

Fig. 2



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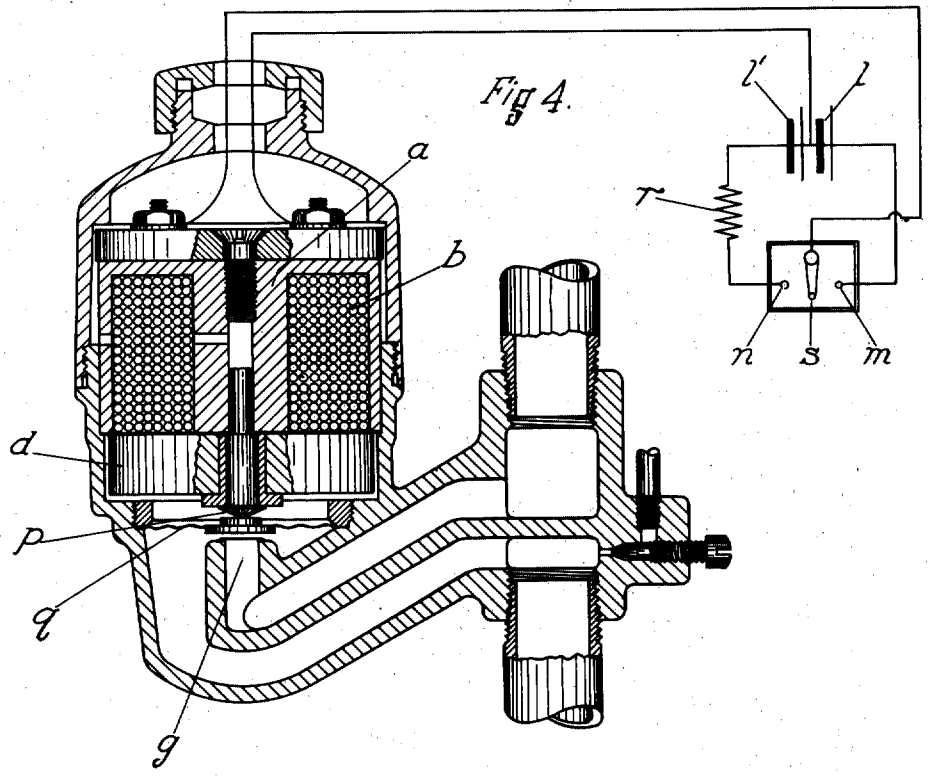
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2 SHEETS—SHEET 2.

Fig 4.



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ELECTROMAGNETIC ACTUATOR.

1,252,312. Specification of Letters Patent. Patented Jan. 1, 1918.

Application filed March 7, 1913. Serial No. 752,654.

To all whom it may concern:

Be it known that I, HENRY E. WARREN, a citizen of the United States of America, and resident of Ashland, in the county of Middlesex and Commonwealth of Massachusetts, have invented Improvements in Electromagnetic Actuators, of which the following is a specification.

This invention relates to electro-magnetic actuators and consists of an improved form of electro-magnetic actuating mechanism for valves, circuit breakers, etc., whereby movement is obtained and the operating part of the actuating mechanism is held in either of two positions with the minimum consumption of electric current.

These desirable results are accomplished by the utilization of the weight of the operating part of the actuating mechanism, or some external force acting thereon, for holding it in one of its extreme positions, and of the residual magnetism which remains in the actuating mechanism after it has once been magnetized for the purpose of holding its operating part in its other extreme position.

Movement of the operating part, which should be of magnetic material, from the first position to the second, is secured by passing a momentary electric current through the coil of an electro-magnet, which attracts the magnetic material and holds it by the residual magnetism after the current ceases; while movement from the second position to the first position is secured by eliminating the residual magnetism through the use of a demagnetizing coil, which has a momentary current impulse sent through it. Thus it is only necessary to utilize the electric current for an instant, to throw the actuator from either of its positions to the other position, while it may be depended upon to remain indefinitely in the position in which it is left after the current impulse has passed.

In the accompanying drawings,—

Figure 1 is a central vertical section of the apparatus, with the operating part arranged to open and close a valve;

Fig. 2 is a central vertical section, with the operating part arranged to make and break electrical contacts; and

Fig. 3 is a view similar to Fig. 1, showing a diaphragm interposed between the magnet chamber and the valve seat.

Fig. 4 is a central vertical section of the apparatus in which a single coil is used for magnetizing and demagnetizing the magnet *a*, and the current through the coil is reversed by means of a switch *s*, two batteries being employed for the purpose.

Fig. 1 shows an application of the apparatus to a valve for the control of fluid, as for example, illuminating gas, wherein *a* is an annular electro-magnet for which there are provided two magnetizing coils *b* and *c*. Coil *b* being wound of heavier wire having a lower resistance, is for the purpose of magnetizing *a*, while coil *c* of fine wire having high resistance, provides sufficient magnetomotive force in the reverse direction from *b*, to demagnetize *a*.

The armature or operating part of the magnet consists of a flat steel or iron plate *d*, which is placed directly below *a* and held concentric with it by means of a centering cone *e* or some equivalent device. The valve *f* is attached to *d* so that when *d* is down the valve rests upon the valve seat *g* and the valve is thereby closed; when *d* is up against the face of *a*, the valve is open. In Fig. 4 the portion of the valve which makes contact with the seat *g*, is shown attached to the diaphragm *q* instead of directly to the plate *d*. A suitable material for the core *a* is ordinary soft steel which will retain sufficient residual magnetism when *d* is resting against the face of *a* to hold the contact of these two parts firmly and indefinitely. The air gap between *d* and *a* may be very slight so that the electric energy required to pass through coil *b* in order to lift *d* is extremely small; for example, if *a* is about 2″ in diameter and the air gap for *d*, which weighs about 4 ounces is .02″, an instantaneous upward motion of *d* will be effected by an energy consumption of one quarter of one watt for one half of a second, and for the purpose of releasing *d* the application of one eighth as much energy to coil *c* for one half second is adequate. At all other times when *d* is down or up there is absolutely no electric current consumption.

In Fig. 2 is illustrated an application of the mechanism as a circuit breaker, the contact plate *h* with contact fingers *i* and *k* being substituted for the valve parts; otherwise the mechanism is identical.

For the purpose of supplying electricity for operating the apparatus, I have shown the battery *l* with contacts *m* and *n* whereby

current may be sent through either one or the other of the coils *b* and *c*, by means of a switch *s*, the return from these two coils being through a common wire *o*. It is, of course, obvious that a single coil, as *b*, Fig. 4, could be used in the place of the two coils *c* and b_1, the reversal of the magnetizing effect being then obtained by a reversal of the current through the coil by the use of two opposed batteries 1, 1′ and a suitable switch, as *s*, but I am inclined to prefer a double coil arrangement on account of simpler switches which may be employed.

A resistance *r* may be inserted in one of the battery circuits to weaken the demagnetizing current.

In Fig. 1 the fluid under control by the valve has free access to the chamber containing the magnet *a*, but this access may be readily prevented by the interposition of packing around the stem *p*, or a similar result may be reached by the use of a flexible diaphragm which moves freely up and down with *p* but prevents fluid from passing by. Fig. 3 shows such a diaphragm at *q*, and with the construction shown, the diaphragm *q* serves the double purpose of preventing the entrance of fluid into the chamber around *a* and also being interposed between the valve and its seat *g*, acts as the valve *g*. When the armature *d* is lifted by the magnet *a*, the valve is opened by the outward pressure of the fluid upon diaphragm *q*, but when the armature *d* drops, its weight or some added weight or spring is sufficient to overcome the pressure beneath the valve and force the diaphragm down against the valve and close it. With this simple construction, it is feasible to make the valve and diaphragm as a unit, which may be readily replaced.

I claim:—

An electro-magnet forming with an armature when in its attracted position, a substantially closed magnetic circuit; a magnetizing coil having sufficient ampere turns to cause its core to attract said armature when current flows through the coil, and a demagnetizing coil which has only sufficient ampere turns to cause it to substantially remove the remnant magnetism from the core of the magnet when said latter coil is supplied with current at the same voltage as that of the magnetizing coil, and means for connecting either of said coils momentarily to the same source of potential.

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