

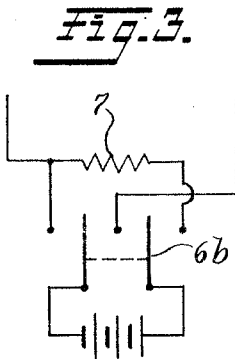
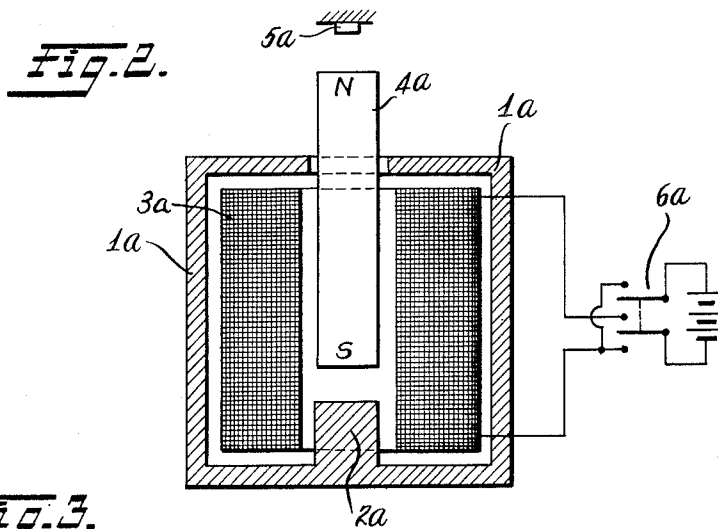
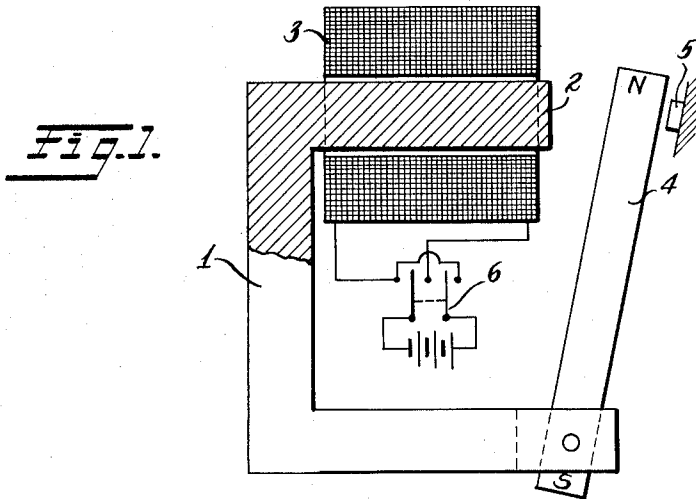
Nov. 16, 1965

H. E. BENSON

3,218,523

ELECTROMAGNETIC DEVICE HAVING A PERMANENT MAGNET ARMATURE

Filed July 29, 1963



INVENTOR
Hector E. Benson

BY

Bacon & Thomas

ATTORNEYS

1

3,218,523

ELECTROMAGNETIC DEVICE HAVING A PERMANENT MAGNET ARMATURE

Hector Eugene Benson, Cheveley, Newmarket, England

Filed July 29, 1963, Ser. No. 298,250

2 Claims. (Cl. 317-172)

This invention relates to direct-current tractive electro-magnet devices, of which solenoids, relays and the like are common forms.

It is normal practice to make iron parts of electromagnets entirely of ferrous material which is magnetized by the excitation of a coil or coils and which ceases to be magnetized when the current is switched off. The armature or plunger of such an electromagnet device, therefore, requires the continuous passage of current through the coil in order to hold it in the closed position, unless otherwise achieved by a mechanical latch.

It is an object of the present invention to enable the armature or plunger of a D.C. electromagnet device, once closed by brief coil excitation, to remain closed with current switched off and without the aid of a mechanical device, and to be released by a further coil pulse of reversed polarity.

According to the invention, the moving armature or plunger of the electromagnet device consists wholly or partly of a permanent magnet, which in the open position lies sufficiently far away from a fixed pole piece in the electromagnet coil, not to move spontaneously towards the fixed pole piece under influence of its own permanent magnetism, or which in the open position magnetically attaches itself to a fixed piece of ferrous material in order to restrain it from spontaneous closing.

Energizing of the electromagnet coil with direct current of the correct polarity causes the permanent magnet armature to close by interaction of the permanent magnet and electromagnet fields, and in closing to exert external mechanical force in the manner known for tractive electromagnets of which solenoids and relays are common forms.

Once closed, the permanent magnet armature will contact the fixed pole piece and because of its magnetism, will be attracted thereto and remain closed, sustaining whatever mechanical load is within its power, without further passage of current in the coil.

The armature or plunger is restored to the open position by energizing the coil with current of reverse polarity to the closing current, so that interaction of permanent magnet and electromagnet fields results in mutual repulsion of the fixed and moving parts.

One manner of using this principle is to apply reverse current of the same strength as the closing current, to produce definite repulsion of the armature or plunger. An alternative manner is to apply a reverse current weaker than the closing current, sufficient to cancel attraction of the fixed and moving parts but without repelling force.

The present invention will now be described in greater detail by way of example with reference to the accompanying diagrams, wherein:

FIG. 1 is a diagrammatic view of a form of the invention wherein a coil encircles a fixed pole piece to which a moving armature is pivotally attached;

FIG. 2 is a diagrammatic view of a form of solenoid electromagnet wherein the moving plunger enters the coil; and

FIG. 3 illustrates a modified form of switching arrangement.

In each of the illustrated embodiments a yoke 1 or 1a defines a fixed pole 2 or 2a and is energized by a coil 3 or 3a. The armature 4 or plunger 4a is composed

2

either wholly or partly of a permanent magnet, the effect in either case being to present magnetic poles of unlike polarity at opposite ends of the moving part. Characters 5 and 5a identify stops of ferrous material to which the armature or plunger may releasably attach itself by magnetic attraction when in the open position. The stops 5 or 5a are mounted on any suitable fixed support (not shown).

It will be evident that in each form, the coil may be energized with direct current applied in such direction as to, selectively, attract or to repel the permanent magnet armature or plunger.

The ganged switching arrangement shown at 6 and 6a illustrates one way in which current may be sent through coils 3 or 3a in either desired direction and the modified switching arrangement 6b of FIG. 3 illustrates a resistor 7 in one side of the circuit so that more current will flow in one direction than in the other.

The above described examples have been found to have the following advantages:

Only a momentary coil pulse is required to close or to open the electromagnet, which by permanent magnet attraction will sustain its load without current, without coil heating, and without the tendency to deterioration of insulating materials caused by coil heating.

The repelling effect of the reverse-polarity opening current can drive the armature or plunger out to the open position, and take the place of the spring return frequently necessary with conventional electromagnets.

The same repelling effect can be used to achieve a double-acting solenoid which without the benefit of this invention, necessitates the use of two separate coils each with its own iron circuit.

The same repelling effect can give much faster opening than is possible in a conventional D.C. electromagnet in which it is necessary to wait for the decay of flux in the magnetic circuit before the armature or plunger can drop out.

I claim:

1. An electromagnetic device comprising: a coil; means for selectively directing electric current to flow in either direction through said coil; a ferromagnetic pole piece in said coil and having a pole face therein; a member mounted adjacent said pole piece for movement of at least one portion of said member toward and from said pole face; said member being a permanent magnet and said one portion being one magnetic pole thereof, said pole piece having another pole face adjacent another portion of said member which comprises the other magnetic pole thereof; a ferromagnetic stop member, separate from said pole piece, fixed in spaced relation to said pole face and said coil; said member being engageable with said pole piece or with said stop member, selectively, to be magnetically held thereby in either of two positions.

2. A device as defined in claim 1 wherein said pole piece comprises a generally U-shaped member with said coil surrounding one leg thereof; said member being pivotally mounted on the other leg of said pole piece, in the region of its said other magnetic pole.

References Cited by the Examiner

UNITED STATES PATENTS

2,740,956	4/1956	Hatton	317-172 X
3,119,940	1/1964	Pettit et al.	317-171 X
3,126,501	3/1964	Flora	317-171 X

BERNARD A. GILHEANY, *Primary Examiner.*

JOHN F. BURNS, *Examiner.*