No. 771,323. PATENTED OCT. 4, 1904.

D. PERRET.

IRON CLAD ELECTROMAGNET.

APPLICATION FILED APR. 21, 1904.

NO MODEL.

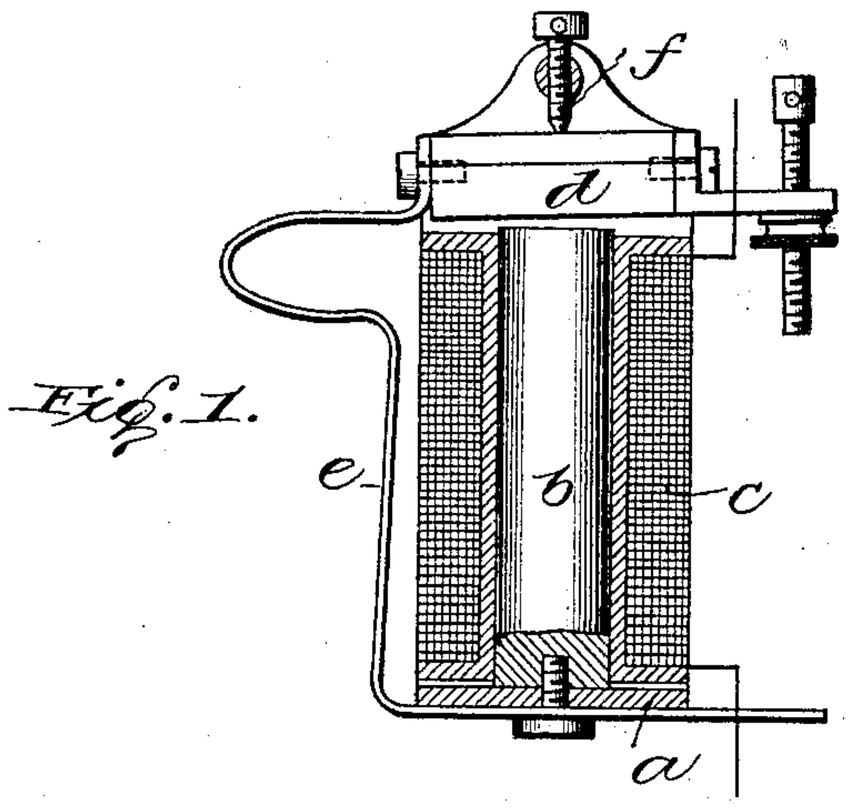

Fig. 1.

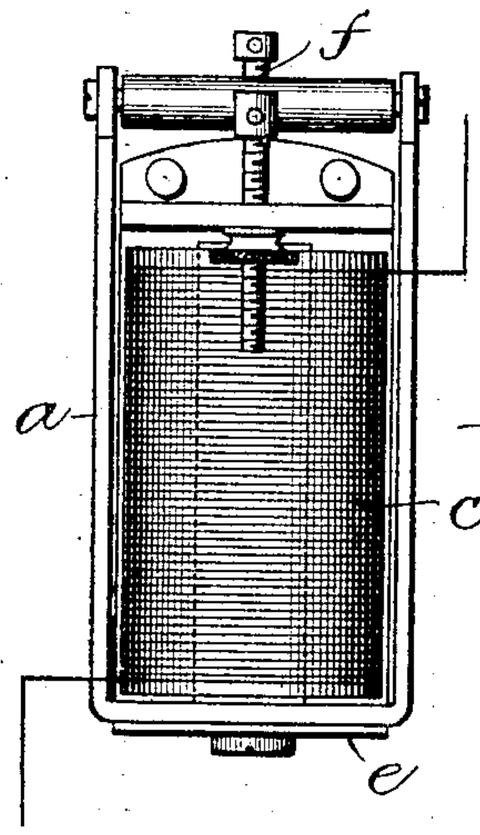

Fig. 2.

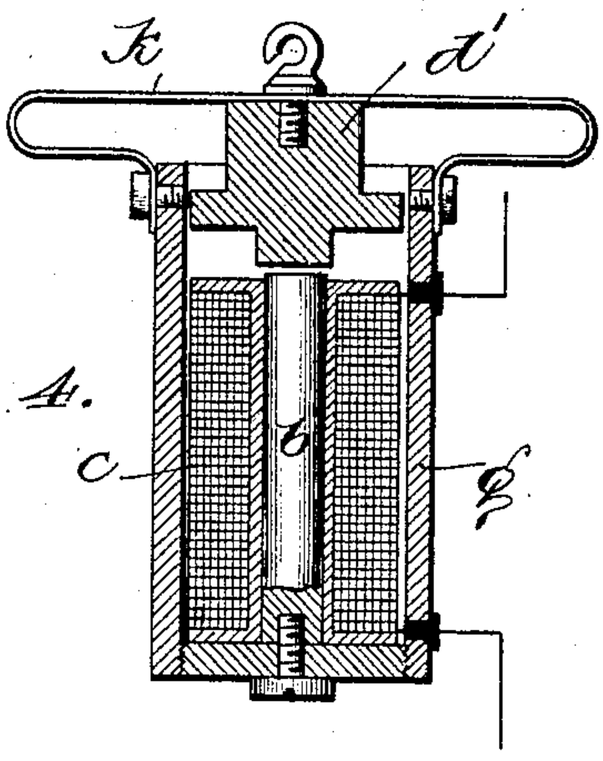

Fig. 4.

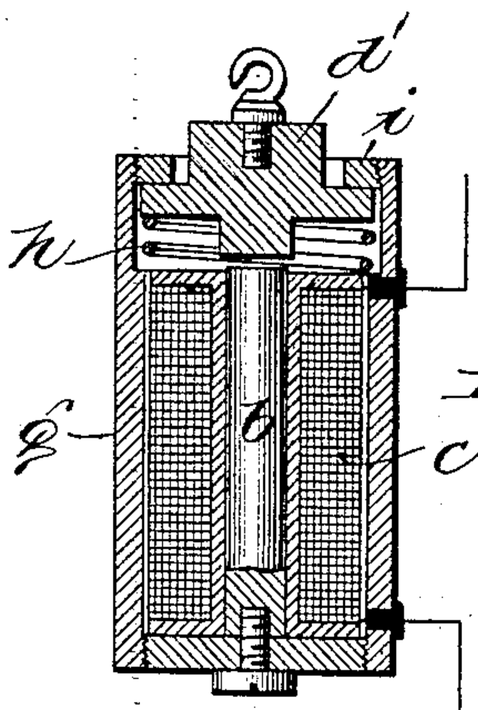

Fig. 3.

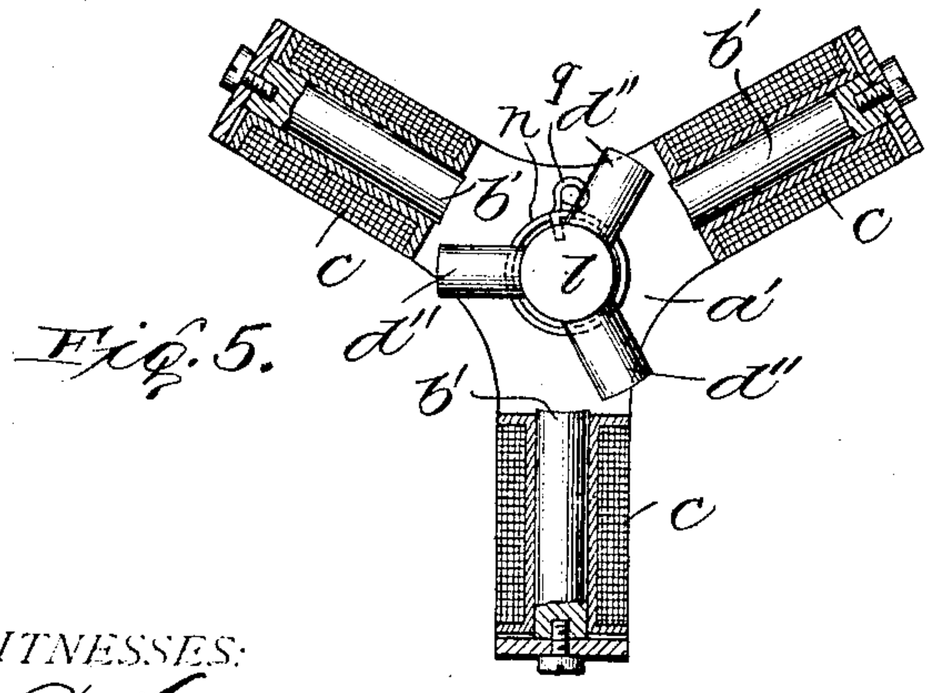

Fig. 5.

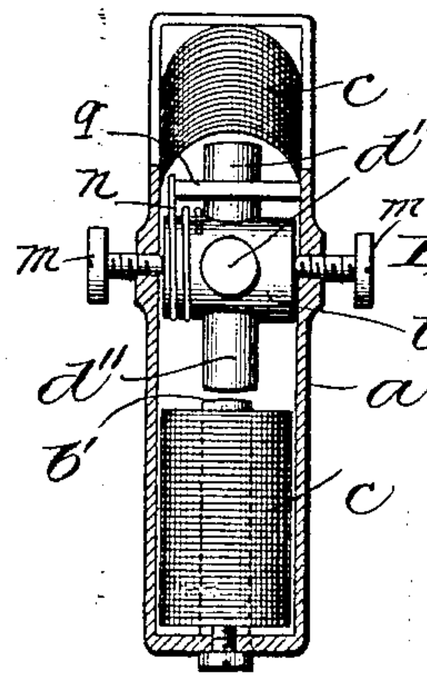

Fig. 6.

WITNESSES:

J. L. Morrison

Wm. A. Deane.

INVENTOR

DAVID PERRET

BY

James Hamilton

Attorney

No. 771,323. Patented October 4, 1904.

UNITED STATES PATENT OFFICE.

DAVID PERRET, OF NEUCHÂTEL, SWITZERLAND.

IRON-CLAD ELECTROMAGNET.

SPECIFICATION forming part of Letters Patent No. 771,323, dated October 4, 1904.

Application filed April 21, 1904. Serial No. 204,210. (No model.)

To all whom it may concern:

Be it known that I, DAVID PERRET, a citizen of the Republic of Switzerland, and a resident of Neuchâtel, in the Canton of Neuchâtel and Republic of Switzerland, have invented certain new and useful Improvements in Iron-Clad Electromagnets, of which the following is a specification, reference being had to the accompanying drawings, forming part of the same.

To the art are already known electromagnets called "iron-clad," or those in which the magnetic circuit between the opposite polar extremities consists in a sheath or casing of magnetic material to which is secured without air-gap one of the poles, which this casing incloses at least in part. In some of the electromagnets of this known class the armature is placed in prolongation of the magnetic casing, to and from the end of which it moves, according as the energizing electric circuit is closed or opened. Since at the moment when this circuit is closed the air-gap between the casing and the armature is the greatest, a part of the lines of force which traverse the thickness of the casing leak from its end and do not penetrate the armature, resulting in the development of only feeble poles in the armature. The initial attraction exerted upon the armature is therefore feeble, not only because of the distance of the other pole of the magnet from it, but also because of the weakness of the poles induced in the armature, the strength of which is less than that of the magnetic field of the casing as the travel of the armature is the greater. To the art are also known electromagnets of the iron-clad type in which the armature is placed inside of the casing and vibrates within the coil parallel to its axis. This arrangement has a double disadvantage. First, it makes it impossible to arrange the armature so that it will oscillate about a fixed point, as the armature is guided in a right line in the inside of the coil or spool, and, second, a portion of the inside of the spool must be destitute of core material in order to provide a free path for the armature. Now it is known that the attraction exerted between two parts of a magnetic circuit is directly proportional to the square of the magnetic permeability of the material traversed by the lines of force of said circuit, since in the part of the spool devoid of a soft-iron core the magnetic permeability is equal to that of air—that is, equal to unity—while were this portion of the spool provided with a core of soft iron its permeability would be three thousand. Therefore the coreless portion exerts a magnetic attraction equal to only one nine-millionth of what it would exert were it provided with a core of soft iron. For an equal number of ampere-turns an electromagnet with an armature inside the spool will always be considerably weaker than an electromagnet with a soft-iron core running the whole length of the exciting-winding.

In the iron-clad electromagnet which is the object of the invention herein described the armature and the casing are arranged in a known manner one within the other, so that the air-gap between these two members can be made as small as desired independently of the travel provided for the armature; but the armature is situated entirely outside of the spool, which is provided throughout its entire length with a core of soft iron forming the other polar extremity in such manner that the spool develops the maximum force of magnetic attraction corresponding to the number of its ampere-turns, and that nevertheless when the energizing-circuit is closed there are developed in the armature magnetic poles the strength of which, independently of the instantaneous position of that armature, are always very approximately equal to that of the magnetic field of the casing. The initial attraction exerted upon the armature will therefore be more energetic, and this armature completes its travel in less time than if it were arranged in prolongation of the magnetic casing or if it were plunged into the inside of the spool.

In the accompanying drawings several forms are shown, by way of example, embodying my invention.

Figure 1 is a sectional elevation of my new iron-clad electromagnet. Fig. 2 is an elevation of the same, and Figs. 3, 4, 5, and 6 illustrate modifications hereinafter referred to.

In the construction illustrated in Figs. 1

and 2 the magnetic casing or sheath is formed by a strap *a*, secured without air-gap to the pole-piece *b*, surrounded by the energizing-coil *c*. The armature *d* is arranged inside of the casing opposite the pole-piece *b*, completely outside the spool or coil *c* and between the two parallel branches or arms of the strap *a*, with an air-gap as small as practicable. The armature *d* is maintained at a proper distance from the pole piece or core *b* by a flat spring *e*, secured to the strap *a* and tending to force the armature against the adjustable stop *f*. This spring may be of magnetic or non-magnetic material. In the former case it strengthens the magnetic circuit between the pole-piece *b* and the armature *d*, which consists in the strap *a*, of magnetic material. The latter, as well as the armature *d*, is preferably designed so that the lines of force shall find at all points a section of magnetic material approximately equal to that of the core *b*. The two parallel arms of the strap *a* exert upon the armature *d* magnetic attractions equal in amount but contrary in direction and which therefore neutralize each other and can have no effect upon the freedom of movement of the armature between the two arms of the strap *a*.

In the construction shown in Fig. 3 the magnetic casing consists of the tube *g*, joined without air-gap to the pole-piece *b*, which carries the exciting-coil *c*. The disk armature *d'* is mounted opposite the end of the core *b*, completely outside of the spool *c* and inside the tube *g*, with a circular air-gap as small as it is practicable to make it. The armature *d'* is pressed by a spiral spring *h*, preferably of non-magnetic material, against a ring *i*, preferably of non-magnetic material, and screwed into the end of the tube *g*. In the embodiment disclosed in Fig. 4 the magnetic casing or sheath is similarly made up of a tube *g*, united without air-gap to the pole-piece *b*, opposite which is mounted in the interior of the tube *g*, but completely outside of the coil *c*, the armature *d'*, carried by a flat spring *k*, secured to the cylinder *g*. This spring may be of either magnetic or non-magnetic material.

It is obvious that the armature may equally well be arranged to inclose the magnetic sheath as to be inclosed by it.

In the form represented in Figs. 5 and 6 the magnetic casing comprises a three-armed strap *a'*, each arm of which is secured without air-gap to one of the three cores *b'*, upon each of which is mounted an exciting-winding *c*. The three armatures *d''* are each placed completely outside of its respective bobbin *c*, facing one of the cores or pole-pieces *b'*, and form one rigid piece with the shaft *l*, mounted on screw-pivots *m* between the standards of the strap *a'* at the junction-point of the three arms of the latter. A spiral spring *n* wound around the shaft *l* and one end of which is secured to said shaft, while the other end is fastened to the strap *a'*, tends to draw the armatures *d''* from the cores *b'*. When the energizing-current does not flow in the coils *c*, a fixed stop *q*, fast to the strap *a'*, limits the oscillation of the armatures *d''*. The latter, as well as the strap *a'*, the shaft *l*, and the cores *b'*, are so designed that the lines of force of the magnetic circuit find at all points a section of magnetic material approximately the same. A greater or less number of cores *b'* may be distributed around the same shaft *l*, provided with a corresponding number of armatures *d''*. The shaft *l* may obviously be rotatably mounted in the strap *a'* otherwise than upon screw-pivots *m*.

What I claim is—

1. An iron-clad electromagnet made up of a solid core of magnetic material extending the whole length of the energizing-coil; a yoke of magnetic material secured to one end of said core and extending above the other end of said core; said energizing-coil between said core and said yoke; and a spring-controlled armature within said yoke and at all times completely outside of said coil.

2. An iron-clad electromagnet made up of a solid core of magnetic material extending the whole length of the energizing-coil; a yoke of magnetic material secured to one end of said core and extending above the other end of said core; said energizing-coil between said core and said yoke; a spring-controlled armature within said yoke and at all times completely outside of said coil; and means for limiting the movement of said armature away from said core.

3. An iron-clad electromagnet made up of a plurality of yokes which spring from a common base, and each of which is secured to one end of a solid core of magnetic material, said yokes being of magnetic material and having mounted within them energizing-coils through and extending the whole length of which are said solid cores of magnetic material; said cores; said coils; and a shaft of magnetic material rotatably mounted within said base and provided with a plurality of arms which serve as armatures for said cores and lie completely outside of said coils.

In testimony whereof I hereunto set my hand, in the presence of two witnesses, this 5th day of April, 1904.

DAVID PERRET.

Witnesses:
ADOLF FEDERER,
HANS FURCHER.