(No Model.)

T. COCHRAN.

ELECTRO MAGNET.

No. 265,485. Patented Oct. 3, 1882.

Fig. 2.

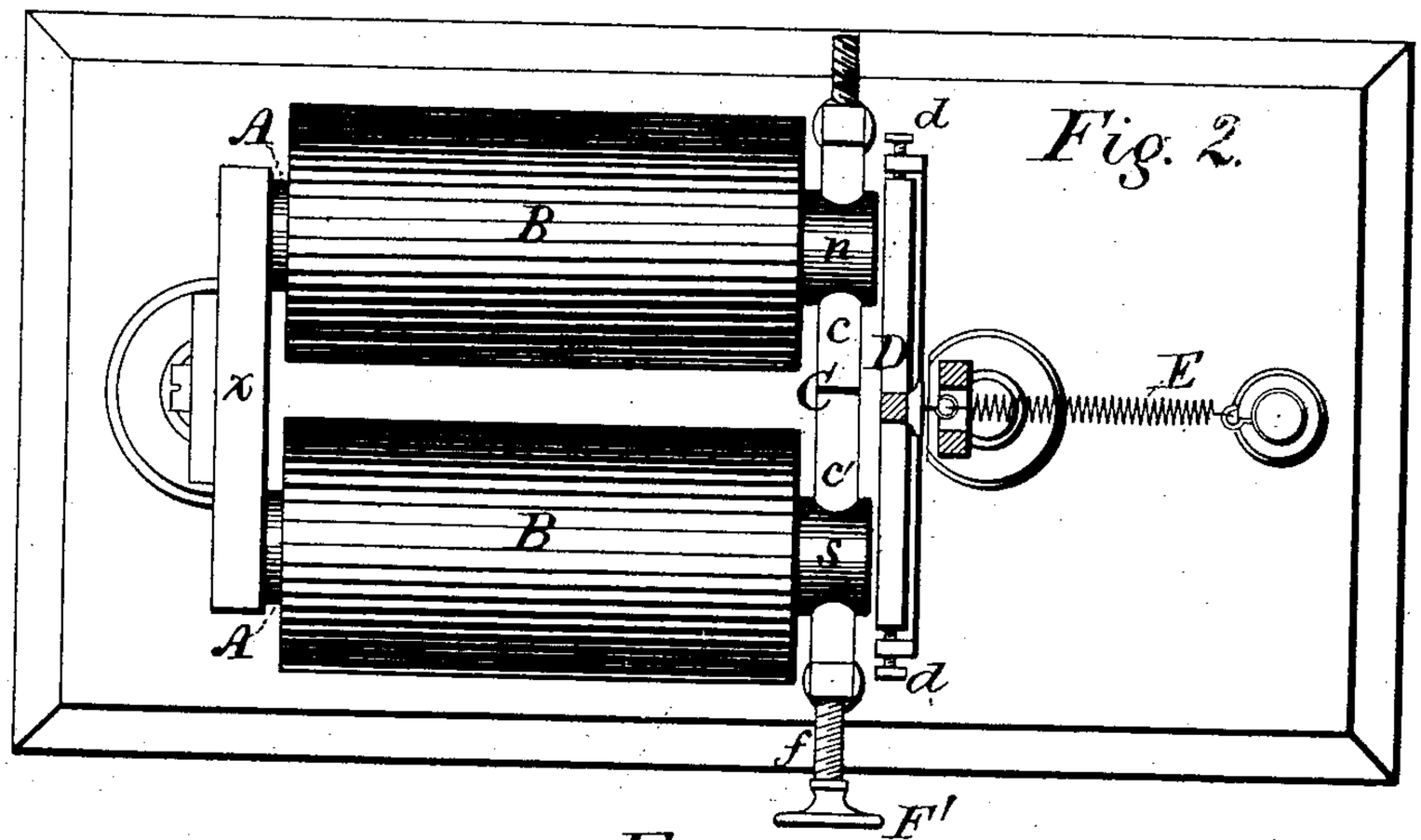


Fig. 3.

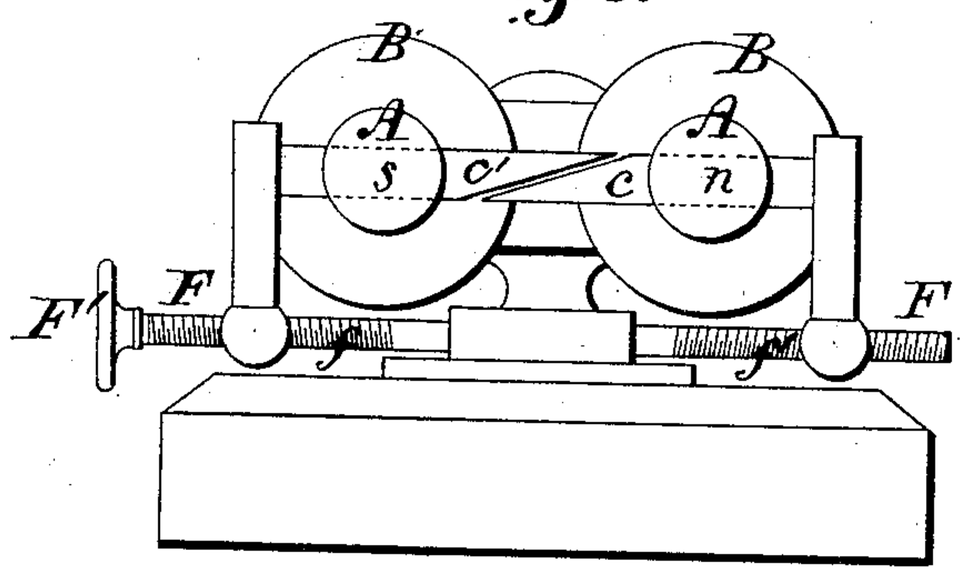


Fig. 1.

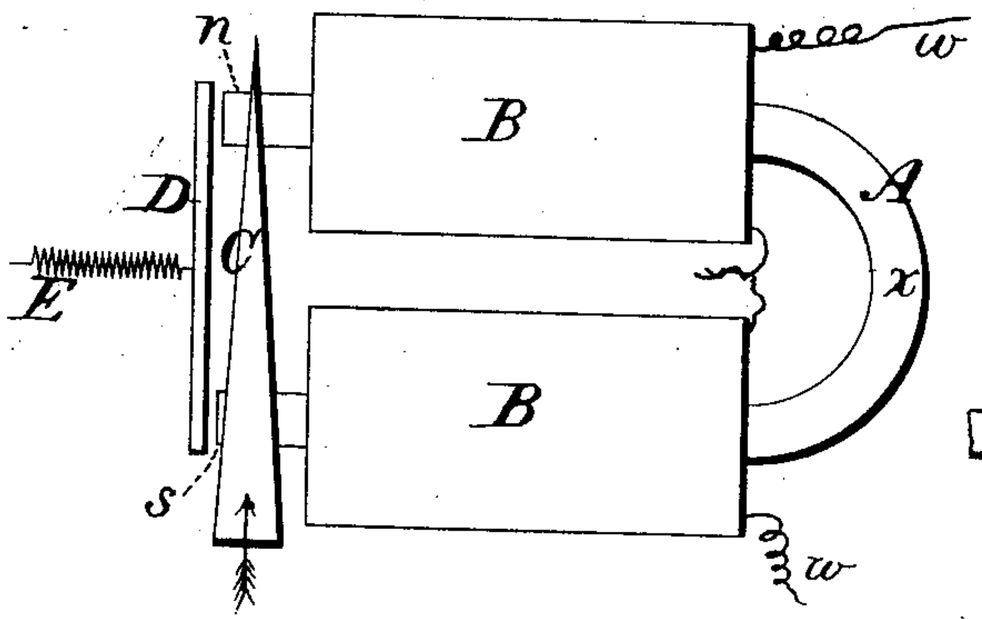
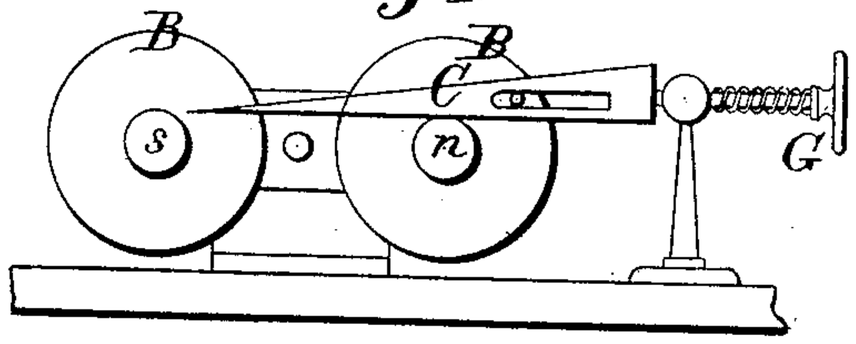


Fig. 4.



Witnesses;
Miller Cook
Mrs K. Lockwood French.

Inventor;
Thomas Cochran,
By his Attorney,
Frank L. Pope.

UNITED STATES PATENT OFFICE.

THOMAS COCHRAN, OF BROOKLYN, NEW YORK.

ELECTRO-MAGNET.

SPECIFICATION forming part of Letters Patent No. 265,485, dated October 3, 1882.

Application filed September 28, 1880. (No model.)

To all whom it may concern:

Be it known that I, THOMAS COCHRAN, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Electro-Magnets; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings.

The object of my invention is to provide an improved means of adjusting or controlling the attractive force exerted by an electro-magnet upon its armature, so that the said force may be kept practically constant, irrespective of any increase in the normal strength of the inducing electric current traversing the helices of the magnet. Such a means of adjustment is of especial value in connection with electro-magnets which are employed in the construction of telegraphic receiving-instruments, as the strength of the current at the receiving-station on long telegraph-lines fluctuates widely at times, especially during unfavorable weather, and the consequent irregularity of the force exerted upon the armature seriously interferes with the operation of the apparatus.

Heretofore the effects due to the varying force with which the armature is attracted, under the conditions stated, have usually been counteracted by means of an adjustable retracting-spring attached to the armature and acting in opposition to the force of the electro-magnet, the tension of which spring could be varied within certain limits to correspond with the variations of the opposing force in the electro-magnet.

My invention consists, in general, of a method of and apparatus for regulating or controlling the intensity of the field of force of the electro-magnet, or, in other words, the free magnetism which emanates from the poles of the electro-magnet and which exerts its attraction upon the movable armature. Under ordinary conditions this field of force varies in intensity in the same proportion that the strength of the inducing-current in the coils of the magnet varies.

My invention consists in forming an adjustable magnetic connection or shunt between two points of contrary polarity in the electro-magnet, whereby a certain portion (more or less considerable) of the magnetism developed by the action of the current may be diverted from the field of force, and thus prevented from acting upon the armature. The invention further consists in certain special apparatus and devices for the convenient application of the principle of the invention to practical use.

In the accompanying drawings, Figure 1 is a diagram illustrative of the principle of my invention. Fig. 2 is a plan view of a telegraphic receiving-instrument to which my invention has been applied. Fig. 3 is a front elevation of the same, and Fig. 4 represents a modification of the apparatus.

The law of magnetic action upon which my invention is based will be best understood by reference to the diagram in Fig. 1, in which A represents a bar of soft iron bent into the form of the letter U and having its limbs enveloped by coils or helices B B, composed of a wire, *w w*, wound upon the bar in many convolutions. When an electric current traverses the coils B B the bar A becomes magnetic and exerts an attractive force upon movable bodies of iron, steel, and other magnetic metals in its vicinity. This force is of a dual character, and is manifested principally at the ends *n s* of the bar A, which are termed the "north" and "south" magnetic poles of the bar, and it diminishes gradually from the poles to a point, *x*, near the middle of the length of the bar, where it is null. If a bar of soft iron, D, long enough to reach from one pole to the other of the bar A, is placed in front of them at a little distance, so as to be within the range of their attractive influence, (which is technically termed a "field of force,") it will be powerfully attracted by the contrary poles *n* and *s*, and, unless held back by a superior force, will fly into contact with them. When this has taken place the bar D is said to have closed the magnetic circuit of the bar A, and if the mass or cross-section of the bar D is equal to or greater than that of the bar A little or no attractive force will be manifested exterior to the bar in any portion of its length. Thus it will be understood that if the contrary poles of a magnet are connected by a bar of magnetic metal of a cross-section or mass not less than that of the bar itself its attrac-

tion for other bodies is practically destroyed. If, however, the mass of the connecting-bar is less than that of the magnet, only a portion of the magnetic action will be diverted, while the remainder will manifest itself at the poles, as before. If therefore the connection is formed by laying a tapering or wedge-shaped piece of soft iron, C, across the poles of the magnet A, as seen in Fig. 1, with its thin end touching one of them, the armature D will still continue to be attracted, but with somewhat diminished force, and if the wedge C is moved in the direction indicated by the arrow the portion of its mass between the poles *n* and *s* will constantly increase, and more and more of the magnetism in the field of force at the pole will be diverted, and the attraction of the poles for the armature D will be correspondingly weakened.

As the attractive force of an electro-magnet, other things being equal, is always in proportion to the strength of current traversing the coils, it is obvious that any increase in the magnetic force exerted upon the armature D resulting from an increase in the strength of the current traversing the coils B B may be compensated by diverting or shunting the surplus through the regulating-bar C, so that the action of the magnet upon its armature may be rendered practically uniform.

In Figs. 2 and 3 I have shown an application of my invention to an ordinary telegraphic receiving-instrument, as a relay or sounder; but I remark that it is equally applicable to electro-magnets employed for any purpose whatever, which are subject to irregularities of action resulting from variations in the electric current by which they are operated.

A is the core of the electro-magnet, consisting of two straight cylindrical bars of soft iron united by a yoke, the straight bars or limbs being enveloped in coils B B in the usual manner.

D is the armature, mounted upon screw-points *d d*, so as to move to and fro under the alternate influence of the attractive force of the poles *n* and *s*, and of the antagonistic retracting-spring E, in the ordinary manner of such apparatus.

The regulating-bar or magnetic shunt C is preferably made in two parts or pole-pieces, *c* and *c'*, which pass through transverse slots in the cores very near the poles, as shown in Figs. 2 and 3. I prefer that the two parts *c* and *c'* should be constructed with inclined faces overlapping each other, as best seen in Fig. 3, as greater delicacy of adjustment may be obtained thereby.

The adjustment of the apparatus may be conveniently effected by means of a spindle, F, carrying right and left screw-threads *f* and *f'*, and turned by a milled head, F'. The right and left screws work through corresponding nuts or projections fixed to the pole-pieces *c* and *c'*, respectively. It will be readily understood that by turning the milled head F' the pole-pieces *c* and *c'* may be made to approach toward or recede from each other, and that the effect will be to increase or diminish the actual mass of metal which constitutes the magnetic shunt for diverting the magnetism from the poles *n* and *s*.

The antagonistic spring E has a constant and invariable tension, and does not require to be adjusted or altered. In fact, the method of operation in my apparatus is precisely the reverse of that ordinarily employed, as I regulate the varying force of the attraction upon the armature, leaving the resistance of the armature constant, instead of varying the resistance of the armature to correspond with the varying degrees of magnetic force in the electro-magnet.

There are many different ways in which such an apparatus may be constructed without departing in the least from the principle of my invention; but I have not deemed it necessary to show more than one of these modifications, as others will readily suggest themselves to persons skilled in the art. For example, in Fig. 4 I have shown a tapering wedge of soft iron placed across the poles of the electro-magnet, and movable to and fro by means of a slow-motion screw and milled head, G. The mode of operation is of course the same as that already fully explained in connection with Figs. 1, 2, and 3.

I do not herein claim the specific mechanical devices hereinbefore described, except as they are involved in the following claim, as I contemplate embodying the same, in so far as they are novel, in an application to be hereinafter filed by me.

I claim as my invention—

The combination, substantially as hereinbefore set forth, of an electro-magnet placed in an electric circuit, an armature, and an interposed short-circuiting bar.

In testimony whereof I have hereunto subscribed my name this 25th day of September, A. D. 1880.

THOMAS COCHRAN.

Witnesses:
NELSON ZABRISKIE,
FRANK L. POPE.