(No Model.)

C. E. LIPE.

ELECTRO MAGNET.

No. 452,003. Patented May 12, 1891.

Fig. 1.

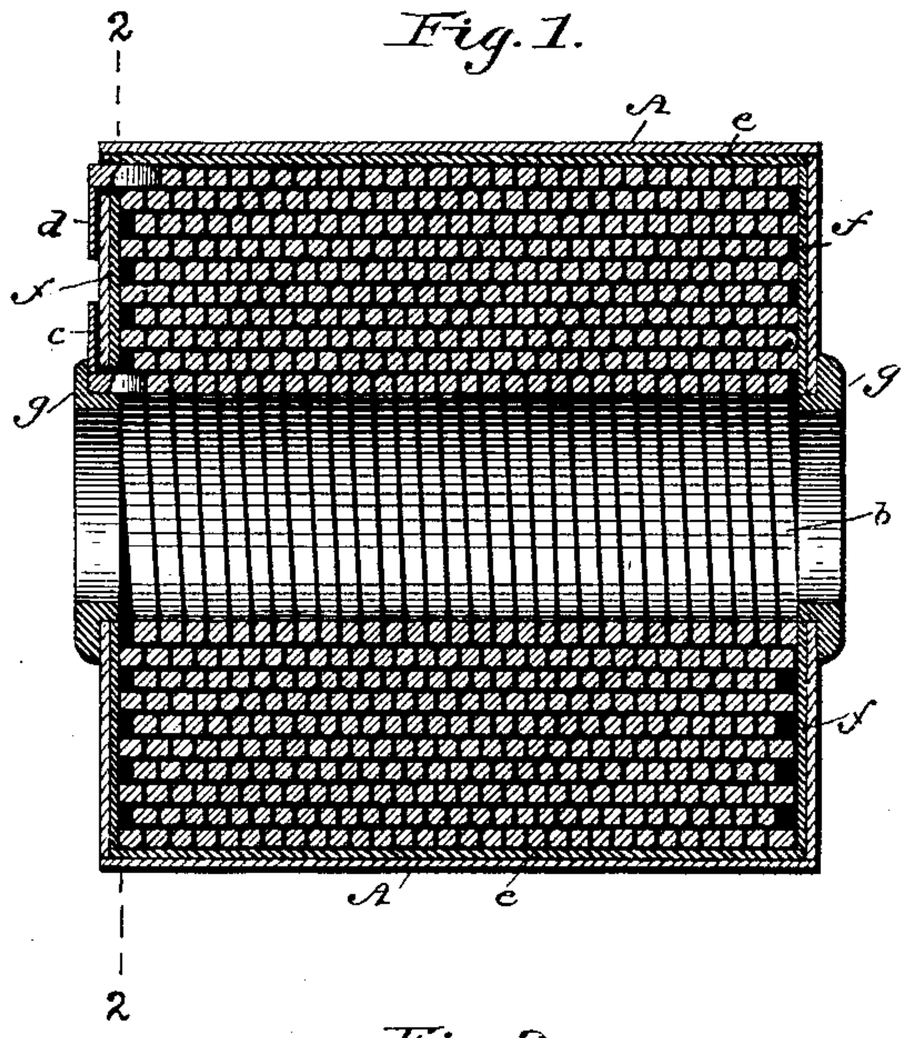

Fig. 2.

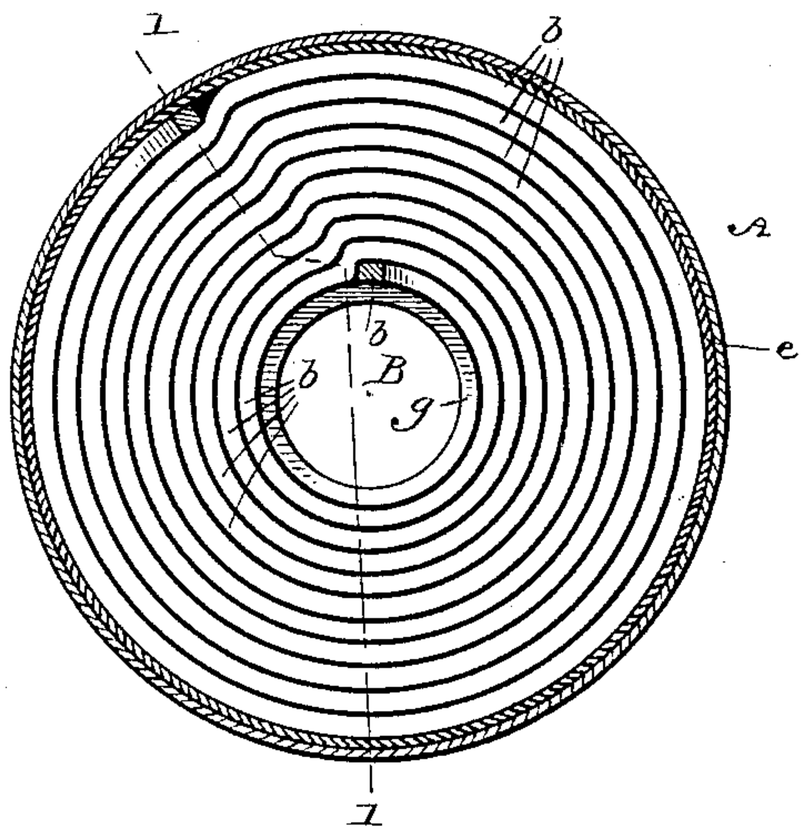

Fig. 3.

a b

Witnesses

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CHARLES E. LIPE, OF SYRACUSE, NEW YORK.

ELECTRO-MAGNET.

SPECIFICATION forming part of Letters Patent No. 452,003, dated May 12, 1891.

Application filed November 20, 1889. Serial No. 331,008. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. LIPE, a citizen of the United States, residing at Syracuse, in the county of Onondaga and State of New York, have invented certain new and useful Improvements in Electro-Magnetic Coils; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to certain new and useful improvements in electro-magnetic coils, and particularly electro-magnetic coils of the kind employed to actuate reciprocating tools for mining and other purposes, and wherein the convolutions are traversed by powerful currents from dynamo-electric machines. In electro-magnetic coils of the kind referred to the character of the current employed requires wire of correspondingly-great carrying capacity, and wire whose insulation will not be liable to be charred or destroyed by the heating effects of currents of extra intensity. It is also desirable to reduce the dimensions of the coils to the smallest limits practicable, so that the reciprocating tool as a whole may be less cumbersome and more readily manipulated by the operator. In order, however, that this reduction in size may be accomplished without loss in mechanical energy, it is essential not to diminish the number of layers of convolutions normally required to develop the desired magnetic strength for a given current, but if possible, while retaining the necessary cross-sectional area of the wire and preserving its complete insulation, to concentrate within a smaller space a greater number of concentric layers of convolutions and a greater number of convolutions in each layer, so that the strength of the coil as a whole may be increased rather than diminished.

The object of my invention is to produce an electro-magnetic coil having the particular characteristics described, thereby combining the minimum external dimensions with the maximum magnetic efficiency and with permanent reliable insulation, a construction peculiarly adapted to the principal uses for which I contemplate employing it.

In the accompanying drawings, wherein I have illustrated the preferred form of my invention, Figure 1 represents in longitudinal section an electro-magnetic coil embodying said invention, the section being taken on a plane indicated by the line 1 1 of Fig. 2. Fig. 2 represents a transverse section and partial elevation taken on a plane indicated by the line 2 2 of Fig. 1. Fig. 3 represents approximately the preferred cross-section of the wire before coiling and its cross-section thereafter.

Similar letters of reference indicate similar parts throughout the several views.

In carrying out my invention I make use of wire substantially rectangular in cross-section, although preferably deviating somewhat therefrom, as indicated at *a* in the left-hand view of Fig. 3, wherein the cross-section is shown as a quadrilateral figure having two slightly-acute angles at the top and two slightly-obtuse angles at the base. I find the use of wire of this particular cross-section of advantage, for the reason that in the act of coiling such wire to form the magnet-convolutions it assumes the rectangular cross-section indicated at *b* in the right view of Fig. 3—that is, the wire, originally of the slightly-irregular cross-section described, becomes in coiling of regular cross-section, and for the reason that the coiling operation stretches the outer part of the wire represented by the top side of the irregular quadrilateral figure and compresses the inner part, or that nearest the mandrel upon which the wire is wound. The effect of the stretching of the outer part of the coiled wire is to lessen the width of said outer part, while the compression of the inner part increases the width of the latter. The wire when coiled, therefore, is of substantially equal width throughout, so that the intervening space for the insulation between the convolutions shall be substantially equal in width at top and bottom. The insulation can therefore be made by the interposition of insulating material of regular thickness—such as strips or spiral disks of mica—which will occupy the entire intervening space between the convolutions, enabling the convolutions and separating insulation to be compactly arranged, thereby obtaining a greater number of convolutions within a given space. A notable

economy in consumption of mica is also effected as the result of this particular arrangement, as no more mica is required between the convolutions than that necessary for their effective insulation.

My preferred manner of coiling the wire to make the coil is to wind it upon a suitable mandrel—such as a cylindrical iron rod—in a regular spiral, and during the winding operation interposing between the edges of the convolutions strips of mica. On the completion of the first spiral or layer of convolutions I cover or inwrap the exterior surface of said spiral with a sheet or sheets of mica, and upon this mica bed I wind the second layer of convolutions, and preferably in such manner as to break joints with the first layer—*i. e.*, so that the convolutions of the second layer will be wound over the dividing-line between the convolutions of the first layer. The second spiral is then covered or inwrapped with mica in the same manner as the second spiral, and the third spiral is thereupon wound over the dividing-line, separating the convolutions of the first spiral in the manner described, care being taken during the winding of all the spirals to interpose between the convolutions thereof the insulating strips or spiral disks of mica above referred to. Subsequent spirals or layers of convolutions with their separating insulation of mica are made in like manner until the coil has attained its desired dimensions.

In practice I have found it convenient to employ sixty convolutions for each of the spiral layers and from eighteen to twenty of the spiral layers themselves, the length and diameter of the coil being approximately equal. These particular dimensions and number of convolutions and layers of convolutions are however not of the essence of my invention, but are merely given as an exemplification of one embodiment thereof.

In Figs. 1 and 2 of the drawings I have shown the coil constructed as above described and provided with a suitable insulating-casing and its adjuncts, whereby it is adapted for use in a reciprocating electrical engine or drill. The leading-in wire *b* is connected to a terminal plate *c*, and the outgoing end of said wire is connected to a terminal plate *d*, whereby the coil may be readily put in circuit with the line. The coil is preferably surrounded by a casing A of sheet brass separated from the exterior of the coil by a heavy layer *e* of mica and from the ends of the coils by disks *f*, also of mica. After the mandrel upon which the coil has been wound is withdrawn the coil has the hollow interior B for the reception of the reciprocating tool or drill of the electrical engine, which drill may conveniently work within the insulating-bearings *g* at opposite ends of the casing.

It is evident that I may in some instances employ instead of mica equivalent substances having similar capacity for resisting heat and similar insulating properties, although in most cases I prefer the employment of mica. It is also evident that instead of winding the coil in a series of superposed longitudinal spirals it may be wound in the form of a succession of flat spirals separated from each other by intervening circular disks of mica, and the convolutions of each spiral being separated by the interposition of mica between them, the main characteristics of my invention being, broadly, an electro-magnetic coil whose individual convolutions and layers of convolutions are made up of naked rectangular wires separated from each other by mica or its equivalent hard, insulating, fire-resisting substance.

My improved coil is practically solid throughout, being made up of rectangular wire with the interposition of a hard non-elastic insulating material, which will not yield or be compressed by the violent shocks and vibrations to which the coil is subjected when used in the electric drills or mining-machines for which it is intended. The said shocks and vibrations will not, therefore, have the effect of loosening the coil convolutions or of cutting through the insulating material, objections which are inherent in the usual form of coils employed for such machines.

Having thus described my invention, what I claim is—

1. A practically solid coil of substantially rectangular naked wire having its individual convolutions and its layers of convolutions separated by layers of hard, insulating, fire-resisting material.

2. A practically solid coil of substantially rectangular wire consisting of alternate layers of mica sheets and substantially rectangular wire wound one upon the other, and mica strips separating the individual convolutions.

3. The method of producing an electro-magnetic coil whose convolutions shall be substantially rectangular in cross-section, which consists in making the wire from which the coil is wound of irregular quadrilateral cross-section, as described, and coiling said wire upon the shorter side of said quadrilateral, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES E. LIPE.

Witnesses:

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