(No Model.) 2 Sheets—Sheet 1.

O. C. WOOLSON.

ARMATURE FOR ELECTRO MAGNETS.

No. 341,981. Patented May 18, 1886.

Fig. 1.

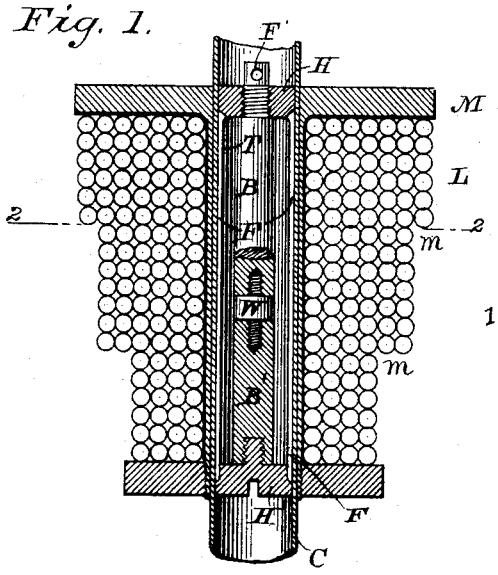


Fig. 2.

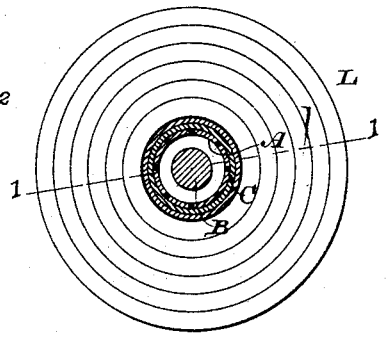


Fig. 3.

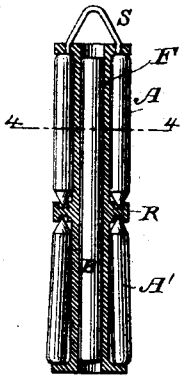


Fig. 7.

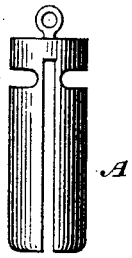


Fig. 5.

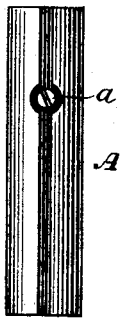


Fig. 4.

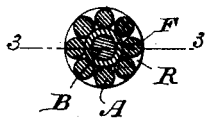
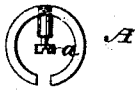


Fig. 8.

Fig. 6.



WITNESSES

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 9.

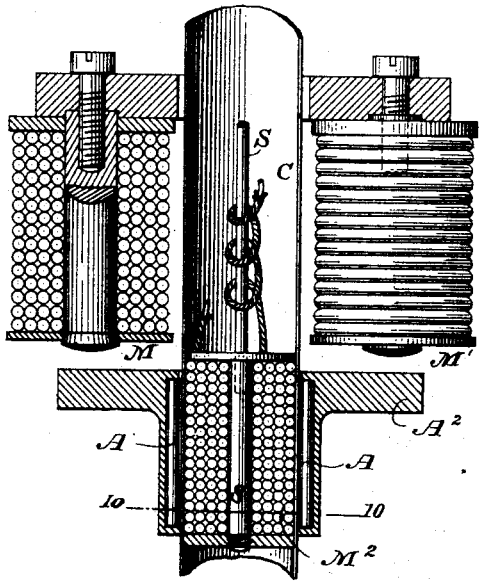
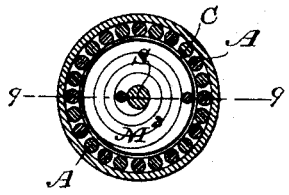


Fig. 10.



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UNITED STATES PATENT OFFICE.

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ARMATURE FOR ELECTRO-MAGNETS.

SPECIFICATION forming part of Letters Patent No. 341,981, dated May 18, 1886.

Application filed February 20, 1882. Serial No. 53,123. (No model.)

To all whom it may concern:

Be it known that I, OROSCO C. WOOLSON, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Armatures for Electro-Magnets, of which improvements the following is a specification.

My invention relates to an armature movable laterally relatively to its supports, so as when properly energized to be held in frictional contact with the surface against which it rests, in order to hold said surface and armature in a fixed relation to each other, and to be automatically released therefrom when demagnetized, so as to allow the surface and armature to move longitudinally relatively to each other. Such an armature is capable of numerous applications in the arts, which applications will readily suggest themselves to persons skilled therein. As one especially valuable application, I may mention its adaptability to the automatic control of the carbons of an electric light.

The subject-matter claimed is hereinafter specifically designated.

The details of construction of my improved armature may be modified in various ways without departing from the principle of my invention.

Some of the parts of the apparatus herein described may be used without the others and in organizations differing in their details of construction from that herein set forth.

The accompanying drawings represent so much of my improved apparatus as is necessary to illustrate the subject-matter herein claimed, and show various modifications of the invention.

Figure 1 represents a longitudinal central section through the apparatus on line 1 1 of Fig. 2; Fig. 2, a transverse section therethrough on the line 2 2 of Fig. 1. Fig. 3 represents a longitudinal central section through a modified form of the compound armature on line 3 3 of Fig. 4, and Fig. 4 a transverse section therethrough on the line 4 4 of Fig. 3; Fig. 5, a side elevation of another form of armature, and Fig. 6 an end view thereof; Fig. 7, a side elevation of another form of armature, and Fig. 8 an end view thereof. Fig. 9 is an elevation, partly in central longitudinal section of another form of apparatus, on line 9 9, Fig. 10, and Fig. 10 is a transverse section therethrough on the line 10 10.

Fig. 1 shows an ordinary magnetic spool, M, with a coil or helix, L, of properly-insulated wire wound thereon, so as to diminish in diameter from one end to the other. In this instance the coil is shown as diminishing by steps *m*, but obviously the wire might be wound in a conical form. The effect of this method of winding is, of course, to produce a greater energizing effect at one end of the coil than at the other, as is well understood, or, in other words, to transfer the center of the magnetic field proportionately nearer to the larger end of the coil. The spool is of course to be secured in a suitable frame. A supporting-frame, (shown as made in the form of a tube, C, of non-magnetic metal, and capable of moving freely endwise through the spool,) is connected with the object to be suspended, sustained, or acted upon (not shown in the drawings) in well-known ways. A skeleton frame would answer the same purpose as the tube.

Figs. 1 and 2 show two permanent magnets, B B′, arranged end to end, and connected by a double-threaded screw and insulating nut or washer, W, and provided with heads H H′. This organization constitutes a cage or carriage, F, which is suspended within the tube C from the point F′ in any suitable well-known way. The armature consists of parallel strips of metal—such, for instance, as a tube, T, with two or more parallel longitudinal slots. The sides or walls of this tube, or, in other words, the armature-sections A, are made yielding or elastic, so that they will collapse or expand, as the case may be, under the action of the energizing-helix—that is to say, instead of the sides of the tube moving freely bodily or parallel with each other, they centrally bulge or bow or bend outward, so as to clamp the tube or frame in which the armature slides. The armature-sections A or walls of the tube T, it will be observed, do not touch the permanent magnets. The tension of the armature-sections can be regulated at will by adjusting the permanent magnets B B′ nearer to or farther from each other by means of the double-thread-

ed screw above described. When the interposed insulating-block W and connecting-screw are removed, and the magnets B B′ arranged with their unlike poles outward, they will of course tend to approach, and thus cause the armature-sections A to bulge out. The contrary effect will be produced when the like poles of the permanent magnets are presented to each other, as is well understood. With the apparatus thus constructed, with the current flowing through the surrounding helix in one direction, the armature-sections A will be bulged out, and at the same time the magnetism of the permanent magnets B B′ will be neutralized or their polarity reversed, and thus cause them to act with a repulsive force on the armature-sections. Where the current from the helix is reversed the contrary effect will be produced, as is well understood.

Figs. 3 and 4 represent another form of the apparatus, in which the cage F is shown as made tubular in form, with the permanent magnet B inclosed therein, the armature-sections A A′ being shown in two series end to end and parallel to each other. These armature-sections rest in sockets near the center of the cage, so that while readily detachable therefrom their extreme ends only are capable of lateral movement in a way that will be readily understood from the drawings. The armature-sections in the upper portion of Fig. 3 are shown in the position they assume when contracted and in the lower portion as expanded. They are in this instance shown with their inner ends pointed and resting in the centrally-flanged ring R on the cage.

Figs. 5 and 6 show an expanding armature consisting of a soft-iron tube, A, with a longitudinal slot extending throughout its entire length on one side, its opposite side being provided with a set-screw, *a*, to secure it to the cage. This form of armature expands and contracts throughout its length under the influence of its energizing-coil, instead of merely bulging in the center, as in the form shown in Figs. 1 and 2. This tube might, if preferred, consist of a permanent magnet, in which case the current flowing through the enveloping helix in one direction would increase and in the other would decrease the magnetism of the armature in the manner and with the effects hereinbefore explained and well understood.

Figs. 7 and 8 represent a simple form of armature, consisting of a centrally longitudinally-slotted soft-iron core, A, reduced in cross-section near one end, so as to render the armature flexible or expansible. This armature corresponds in form somewhat to the shape of a clothes-pin, and its operation resembles that of a tuning-fork.

The operation of the apparatus will readily be understood from the foregoing description. When a current of electricity is passed through the coil, the armature-sections A are caused to press against the surface of the inner supporting frame or tube, C, and thus hold it by their frictional contact with a force proportioned to the energy of the actuating-current. When this current ceases, their contact is released and the tube is again free.

In addition to the action above described, owing to the fact that in the illustration shown in the drawings the center of the magnet-field or the magnetic attraction of the helix is nearer its upper than its lower end, the first effect of the energizing-current is a tendency to draw the armatures and cages upward, their frictional contact causing the tube to be lifted with them until they reach the neutral point of the magnetic field or one where the actuating forces are balanced, when they will be held there as long as the energizing-current flows.

In order that the lifting action may be exerted, it is of course necessary that the cage should move freely upon or with the support that suspends it, as otherwise the clamping action along would take place. The normal position of the cage with reference to the helix may also be adjusted by means of its support, if desired, in any of the various well-known ways.

In Fig. 9 two helices, M M′, are shown as mounted upon the respective cores of an ordinary horseshoe electro-magnet, with the movable supporting frame or tube C, above referred to, arranged parallel with and between the helices. A third coil or helix, M^2, is held within this tube by a rod or chain, S. This spool may be energized either by the same or a different current from that passing through the other spools, thus enabling me to employ currents of different polarities or intensities. An armature, A^2, arranged in relation to the cores of the magnet M M′ in the ordinary way, is provided with an opening through which the tube C, above mentioned, passes, the third coil, M^2, being contained within the tube and armature. The separable or expanding armatures A are shown as arranged within the armature A^2, outside of the tube and of the third coil, M^2.

In the operation of this apparatus it will be seen that the armature and tube are lifted directly by the attraction of the electro-magnet in the ordinary way, as well as by the frictional contact between the tube C and the expanding armatures A.

This apparatus obviously admits of a greater range of movement than the one above described.

I do not broadly claim herein disconnected armature-sections lying and moving parallel with each other and with the axis of their energizing-coil, nor the combination of such armature-sections with the other parts of the apparatus, as these form the subject-matter of another division of this application. Neither do I claim herein armatures moving transversely to the energizing-coils and acting through gearing, pivoted levers, or similar devices to clamp the objects to be acted upon by them, as such devices are old and differ essentially in function, principle, and method of operation from my apparatus.

I claim as my invention—

1. The combination, substantially as set forth, of a solenoid and a sliding armature having one or more magnetic portions that bend when acted on by the solenoid, for the purpose specified.

2. The combination, substantially as set forth, of a cage and two series of laterally-movable armatures mounted therein end to end and parallel with each other.

3. The combination, substantially as set forth, of separable permanent magnets placed end to end, interposed insulating material, and an expanding armature inclosing the magnets.

4. The combination, substantially as set forth, of separable permanent magnets placed end to end, interposed insulating material and adjusting-screws, and an expanding armature inclosing the magnets.

5. The combination, substantially as set forth, of a cage or support, and a series of armatures or armature-sections pivoted therein and movable laterally at one end.

6. The combination, substantially as set forth, of an electro-magnet, an armature therefor constituting a cage or carriage, a supporting-frame, a supplemental energizing-coil, and an expanding armature actuated thereby.

In testimony whereof I have hereunto subscribed my name this 13th day of February, 1882.

OROSCO C. WOOLSON.

Witnesses:
WILLARD L. CANDEE,
SCHUYLER S. WHEELER.