(No Model.) 2 Sheets—Sheet 1.

C. D. HASKINS.

ELECTROMAGNET.

No. 553,675. Patented Jan. 28, 1896.

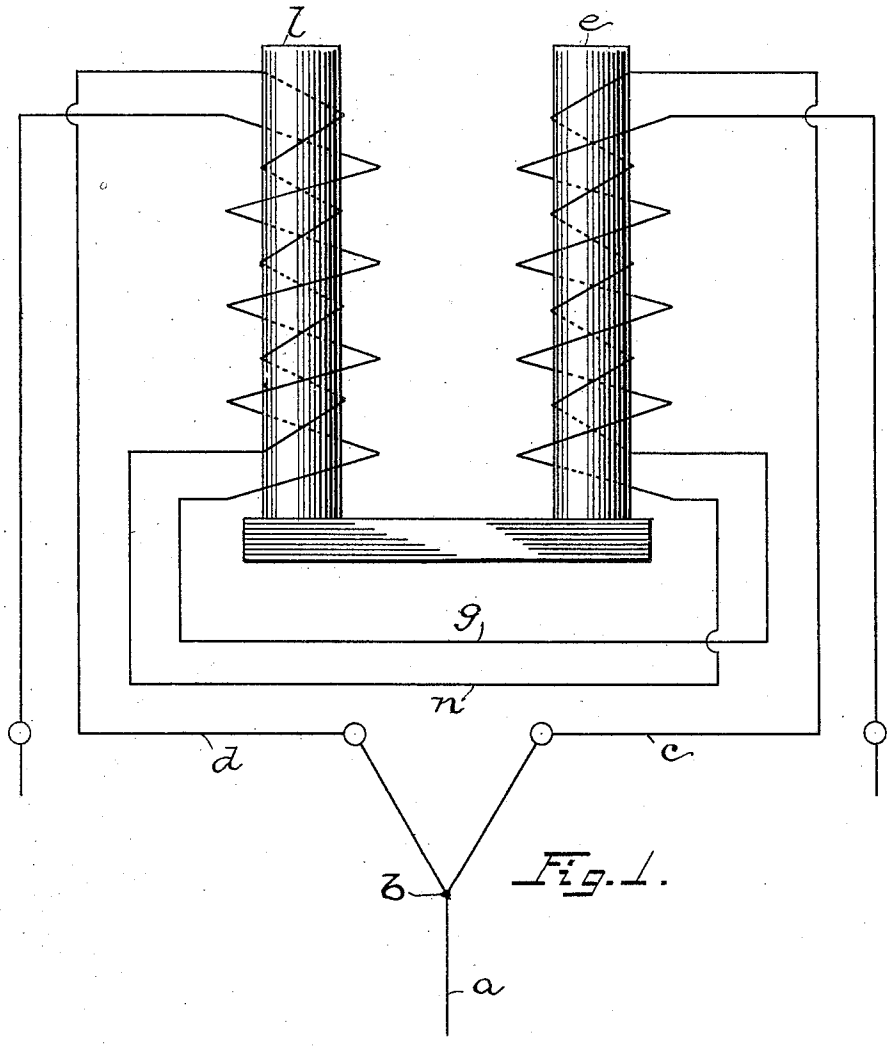

Fig. 1.

Witnesses.
Ella Edler
Geo. R. Parker.

Inventor.
Charles D. Haskins.
By: George P. Barton
Attorney.

(No Model.) 2 Sheets—Sheet 2.

C. D. HASKINS.

ELECTROMAGNET.

No. 553,675. Patented Jan. 28, 1896.

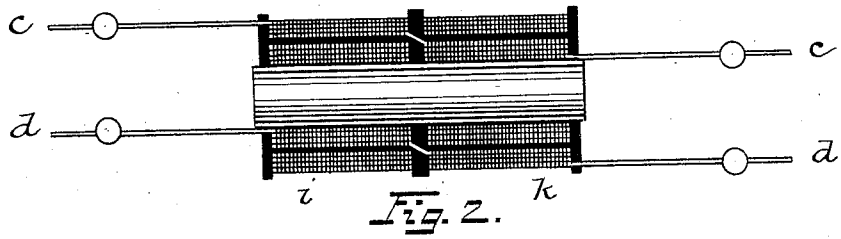

Fig. 2.

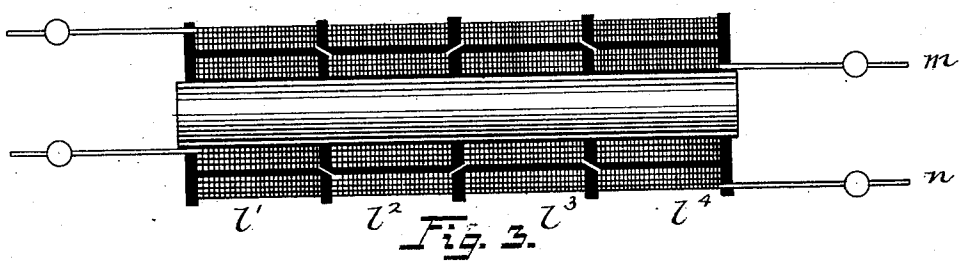

Fig. 3.

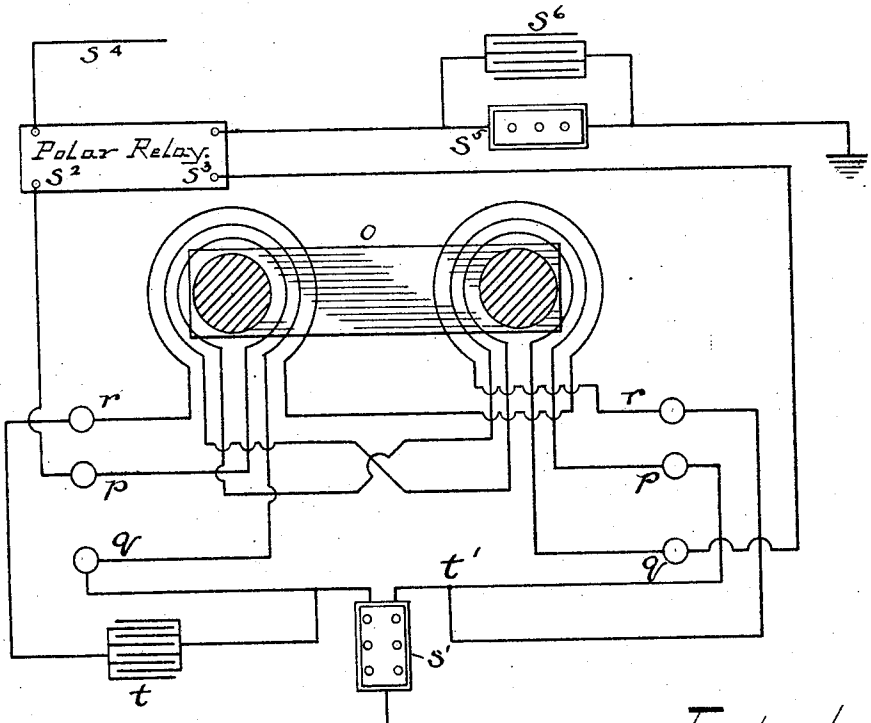

Fig. 4.

Witnesses.
Ella Edler
Geo. R. Parker.

Inventor.
Charles D. Haskins.
By: Fergus P. Barton
Attorney.

UNITED STATES PATENT OFFICE.

CHARLES D. HASKINS, OF BROOKLYN, NEW YORK, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS.

ELECTROMAGNET.

SPECIFICATION forming part of Letters Patent No. 553,675, dated January 28, 1896.

Application filed May 18, 1889. Serial No. 311,252. (No model.)

To all whom it may concern:

Be it known that I, CHARLES D. HASKINS, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented a certain new and useful Improvement in Induction and Repeating Coils, (Case No. 6,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to the winding of the helices of electromagnets, and is especially designed for use in duplex and quadruplex system of telegraphy.

My invention is also advantageously employed in the construction of any electromagnet on the core or cores of which it is desired to wind two conductors in such a way that each conductor shall have with a given current an equal magnetic influence on the soft iron and that the soft iron shall be magnetized to react inductively with an equal effect on each conductor, as in the case of repeating or induction coils. These electromagnets may be of the horseshoe type or each may be provided with a single straight core. Heretofore the helices of such relays and electromagnets have been wound in longitudinal sections and the direction of current in one-half of the sections has been opposed to that of the current in the other sections of the windings. In such case though there may be several sectional coils upon the same core and though each conductor may have an equal resistance and the same number of convolutions, simple tests show that they are not neutral, as no two coils thus arranged can act with equal effect upon the same portion of the core. In case of relays the retractile spring must therefore be adjusted so as to overcome the attraction caused by the polarity thus occasioned, and the working margin for incoming signals is thus materially reduced.

Another method of winding electromagnets having more than one conductor consists in winding the wires of the different coils upon the core simultaneously side by side. Such electromagnets having their coils parallel and laid on side by side have been successfully employed for various purposes, yet it has been found difficult to maintain at all times good insulation between the wires thus wound on without too greatly increasing the bulk of the coils by the thickness of the insulating covering upon the wires. It has also been found difficult to make the coils of a required resistance.

My invention consists in winding the core with two insulated conductors in concentric sections or helices, each conductor including an inner and an outer section or helix, and so arranged that the conductors shall reciprocally include an outer and an inner helix of the superimposed coils.

My invention also consists in two electric circuits and an electromagnet wound in two or any multiple of two longitudinal sections, each longitudinal section consisting of two concentric sections or helices and each circuit including an equal number of inner and outer helices.

My invention also comprises a quadruplex neutral relay in which the winding consists of three concentric helices, the outermost helices of the two cores being connected together as one conductor and the remaining helices being connected to form two conductors, one of which includes an innermost helix of one core and a middle helix of the other core and the other conductor vice versa.

My invention will be readily understood by reference to the accompanying drawings, in which—

Figure 1 is a diagram illustrative of the winding of a differential duplex relay according to my invention. Fig. 2 is a sectional view of an electromagnet or induction-coil with two circuits connected therewith and each circuit including an outer and an inner helix of the two longitudinal divisional windings. Fig. 3 is a sectional view of an electromagnet or induction-coil having four longitudinal sectional windings, each longitudinal section consisting of two concentric helices and two circuits, each including an equal number of inner and outer helices. Fig. 4 is a diagram showing my method of winding applied to a quadruplex neutral relay.

Like parts are indicated by similar letters of reference throughout the different figures.

Referring now to Fig. 1, line *a* may be con-

sidered as coming from the transmitter or key and branched at b. These branches c and d extend symmetrically in opposite directions around the cores e l to form the separate coils. Thus wire c is connected with the convolution wound directly upon the insulating-covering of core e and thence by wire g with the outer coils upon core l and thence to the rheostat and ground. Branch d is connected as shown, first, with the inner coil upon core l and thence by wire n with the outer coil upon core e and thence to line. The resistance of the two branches with their included coils will be practically the same, and as the number of turns of each of the concentric coils on each core is the same, current sent through wire a will divide equally and traverse the coils of each core in opposite directions, and consequently no magnetic effect will be produced in the cores. It will be seen that the resistance of the two branches c and d will be the same without reference to the relative resistances of the outer and the inner coils.

In Fig. 2 instead of an electromagnet with two cores connected together by a heel-bar, I have shown an electromagnet having a single straight core. In such case the coils are wound on in longitudinal sections i k, each longitudinal section consisting of two concentric helices. It will be seen that the wire c includes the inner helix of section k and the outer helix of section i, while the other wire or circuit d includes the outer helix of longitudinal section k and the inner helix of longitudinal section i. Thus each wire includes an outer helix of one section and an inner helix of the other section. It is evident that the longitudinal sections may be increased in number in multiples of two to any extent desired. In such case each circuit would include an equal number of outer and inner coils of the whole number of sections. Thus in Fig. 3 I have shown four longitudinal sections l' l^2 l^3 l^4. The wire m includes the inner helix of sections l^4, the outer helix of section l^3, the inner helix of l^2 and the outer helix of l'. Wire n, on the other hand, includes the outer, inner, outer and inner helices of said sections l^4 l^3 l^2 l', respectively.

I consider the horseshoe form preferable when the electromagnet is to be used as a part of a relay or to operate an armature. The form shown in Fig. 2 I consider the preferable form for induction-coils and repeating coils or converters.

In Fig. 4 I have shown a relay o provided with neutral windings p p and q q. These windings are usually spoken of as the "working coils" of a quadruplex neutral relay. These windings I have wound on in accordance with my invention, as hereinbefore described. The third winding r r is usually spoken of as the "extra" or "condenser" coil and is wound on in the usual manner, preferably outside the neutral coils.

I do not consider it necessary to describe in detail the application of my relay to a quadruplex system of telegraphy, as the drawings will be readily understood by those skilled in the art. Thus the wire s coming from the transmitter branches through the two arms of the rheostat s' and thence through the different windings p q, the wire p extending to the polar relay at binding-post s^2 and the winding q extending to the polar relay at binding-post s^3. The connection from binding-post s^2 is through one winding of the polar relay to the line s^4 and the connection from binding-post s^3 is differentially through the other coil of the polar relay to the equating-rheostat s^5 and thence to ground. The condenser s^6 is shown connected in the usual manner. The extra or condenser coil r is connected to one side of the condenser t, the other side of said condenser being connected to one terminal of the small rheostat s', as shown. The coil r upon the side opposite condenser t is connected at t' with the other arm of rheostat s'. These connections, as before stated, and the operation of the various parts are so well understood as not to require further explanation.

As above indicated, my system of winding may be applied to differential relays adapted for use in duplex telegraphy and to quadruplex neutral relays as well as to induction-coils and repeating-coils as used in telephony. My invention is also applicable to converters such as are designed more especially for electric-lighting systems.

It is obvious that the iron core may be omitted in cases where it is desired to electrically influence by the current of one circuit the electrical condition of another circuit. A core is therefore not in all cases essential to the useful employment of my system of disposing the coils.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. An electro magnet with two insulated conductors in concentric sections or helices, each conductor including an inner and outer section or helix, substantially as hereinbefore described.

2. In an electro-magnet, the combination with two electric circuits, of helices wound in two or any multiple of two longitudinal sections, each longitudinal section consisting of two concentric helices and each circuit including an equal number of inner and outer helices, substantially as described.

3. An electro magnet provided with three concentric helices in two divisions, corresponding outer and inner helices of the different divisions being included respectively in different circuits, the remaining helices being connected together as one conductor, substantially as and for the purpose specified.

4. In an electro-magnet, the combination with two circuits, of four different helices, two being included in the circuit of each, the said helices or coils of the two circuits being placed in inductive relation to one another

and forming outer and inner concentric helices, whereby each wire includes reciprocally an outer and inner helix of the said superimposed concentric helices, substantially as and for the purpose specified.

5. In an electro-magnet, the combination with a soft iron core, of two separate conductors wound thereon, said conductors comprising helices wound in two longitudinal sections, each of the two sections consisting of an outer and an inner helix, the outer and the inner helix of the different sections being reciprocally connected together, whereby each conductor thus formed shall have with a given current an equal magnetic influence on the soft iron, while the soft iron reacts with equal effect on each conductor; substantially as described.

6. In an electro-magnet, the combination with a soft iron core, of two conductors wound thereon, equal lengths of both of said conductors being wound in a helix next to the core and the remaining portion of each being wound externally to and surrounding that portion of the other which immediately surrounds the said core, whereby both are equally exposed to magnetic induction from the said core, and whereby each is enabled to act inductively with equal effect on the other; substantially as described.

7. In an electro-magnet, the combination with a soft iron core, of two conductors of approximately equal size, length and resistance surrounding the same, equal portions of both of said conductors being wound in separate helices next to the core, each being wound to an equal thickness from one end to the center of the said core, and the remaining portions of each being wound externally to and surrounding that portion of the other which immediately surrounds the core, whereby both are alike exposed to the inductive action of the core, and whereby each is enabled to reciprocally affect the other inductively; substantially as described.

8. In a quadruplex neutral relay, the combination with each core of the electro-magnet of three concentric helices, the outermost helices of the two cores connected together as one conductor for use as condenser coils or extra coils, the remaining helices being connected to form two conductors one of which includes an innermost helix of one core and a middle helix of the other core, the other conductor vice versa, as and for the purpose substantially as set forth.

In witness whereof I hereunto subscribe my name this 9th day of May, A. D. 1889.

CHARLES D. HASKINS.

Witnesses:

ELLA EDLER,

GEO. R. PARKER.