(No Model.) 2 Sheets—Sheet 1.

J. C. LUDWIG.

GENERATION OF INDUCED CURRENTS FOR TELEGRAPHIC AND OTHER PURPOSES.

No. 315,428. Patented Apr. 7, 1885.

Fig. 1.

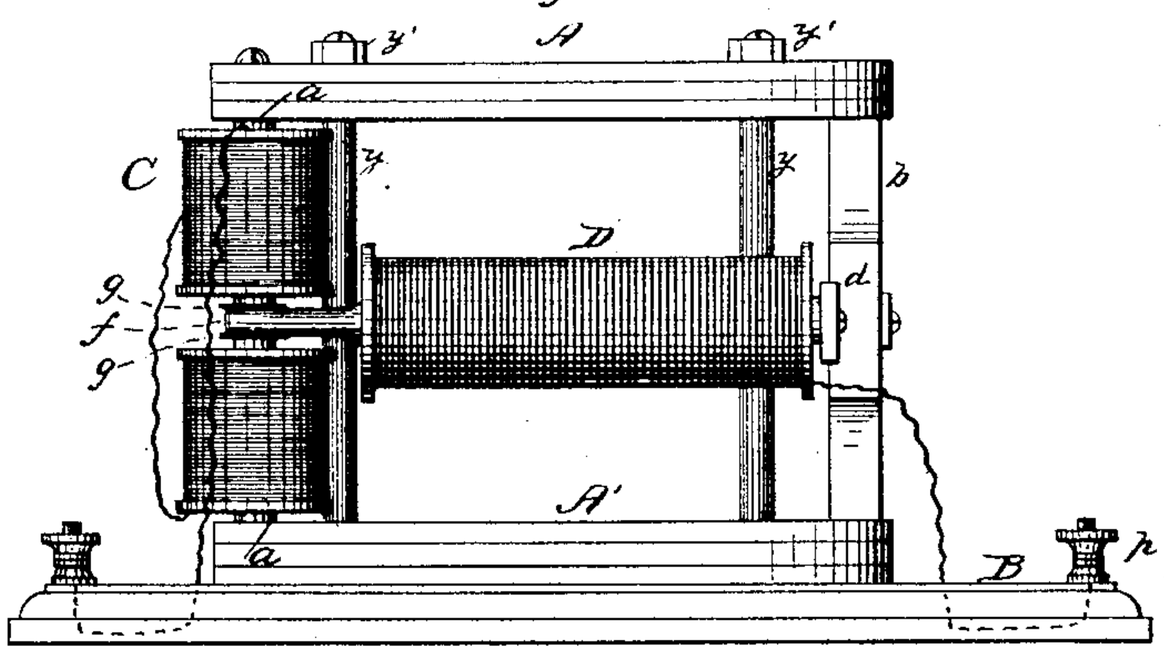


Fig. 2.

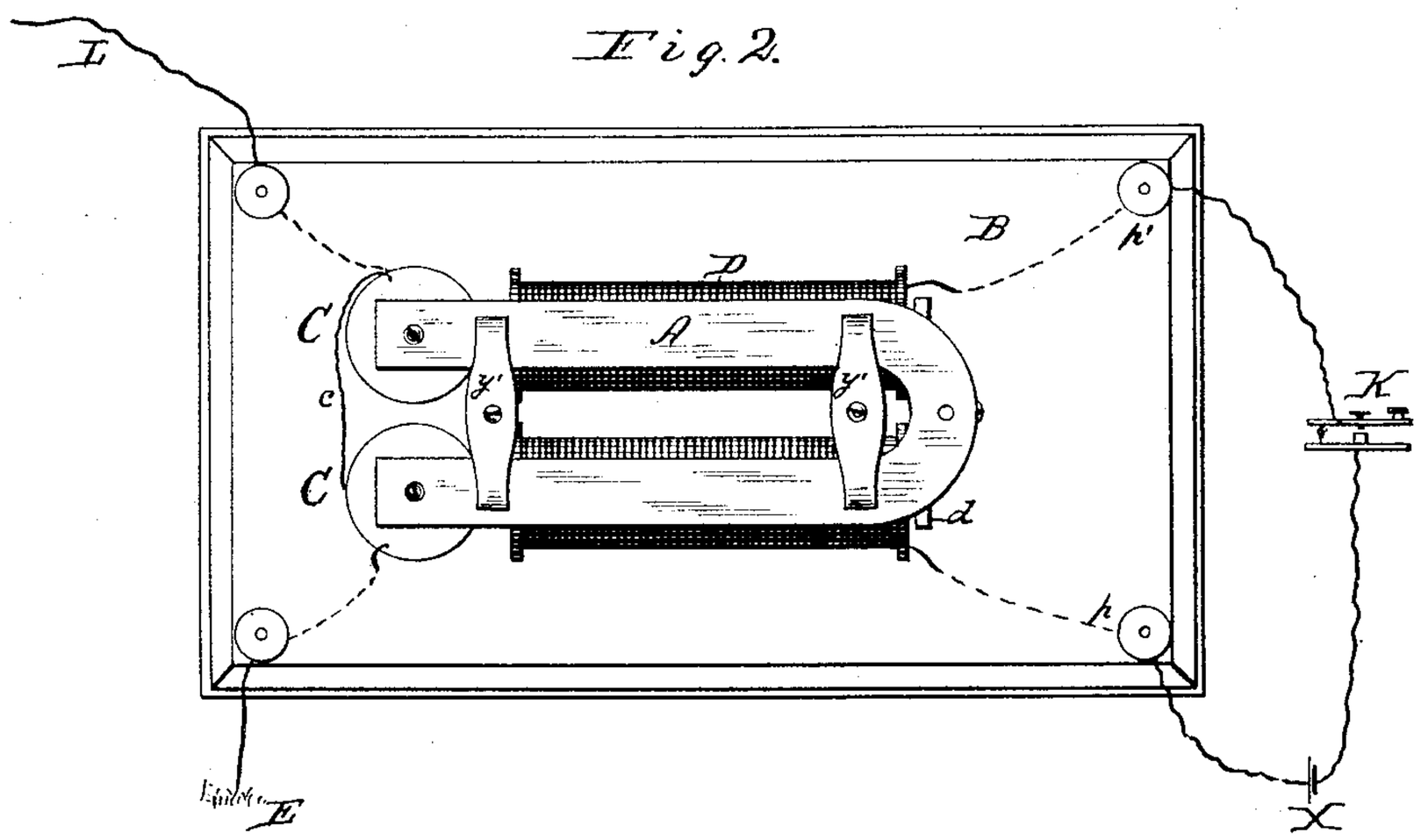
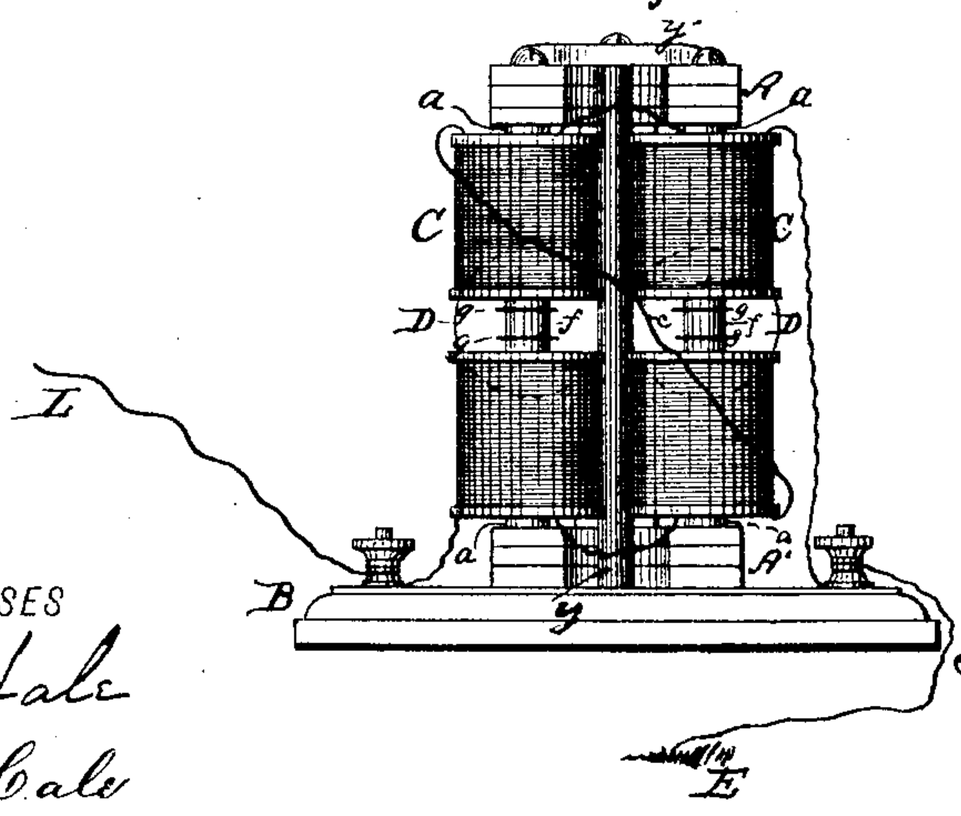


Fig. 3.



WITNESSES

W. B. Hale

P. W. Hale

INVENTOR

John C. Ludwig,

By his Attorney,

John Hewston Jr

N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model) 2 Sheets—Sheet 2.

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Fig. 4.

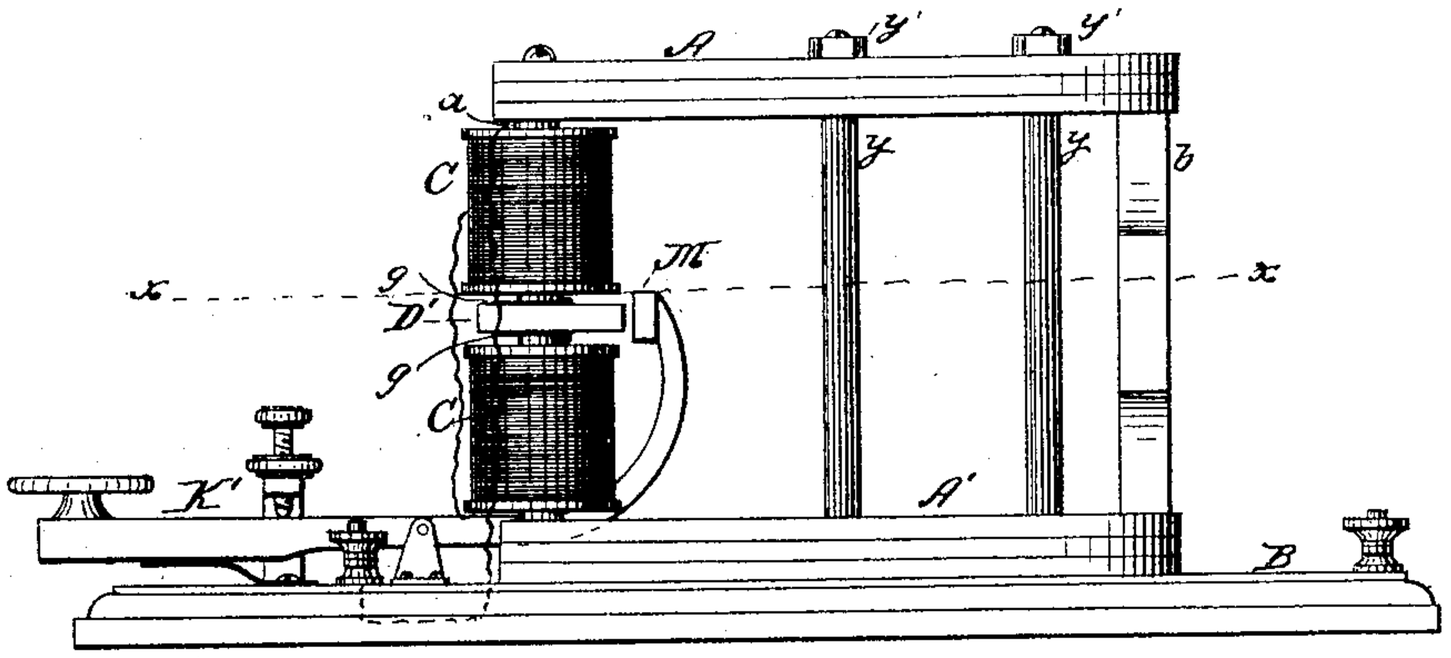
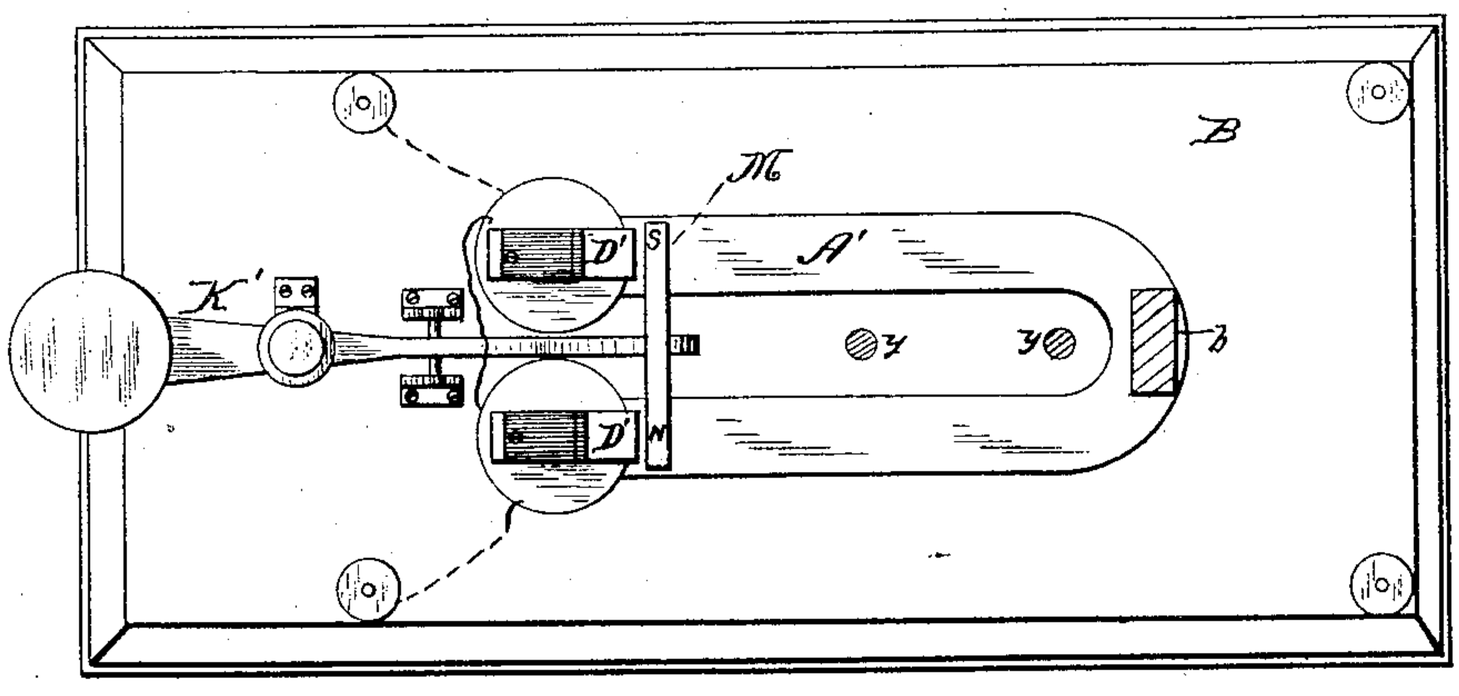


Fig. 5.



WITNESSES
W. B. Hale
P. W. Hale,

INVENTOR
John C. Ludwig,
By his Attorney,
John Newton Jr

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

JOHN C. LUDWIG, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR OF THREE-FOURTHS TO LOUIS A. GARNETT, OF SAME PLACE, AND JOHN HEWSTON, JR., OF BROOKLYN, CALIFORNIA.

GENERATION OF INDUCED CURRENTS FOR TELEGRAPHIC AND OTHER PURPOSES.

SPECIFICATION forming part of Letters Patent No. 315,428, dated April 7, 1885.

Application filed January 3, 1885. (No model.)

To all whom it may concern:

Be it known that I, JOHN C. LUDWIG, a citizen of the United States, residing at San Francisco, in the county of San Francisco and State of California, have invented certain new and useful Improvements in the Art of Generating Induced Electric Currents for Telegraphic and other Purposes, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to an improvement in the art of producing induced electric currents for telegraphic and other purposes, for the carrying out of which improvement I have invented an apparatus for which I have heretofore filed an application for patent on the 23d day of June, 1884, said application bearing the Serial No. 135,842.

The special object of my invention is to provide strong and highly-efficient electric currents for telegraphy, while obviating the maintenance of large and continuously-expensive voltaic batteries and ponderous power-driven mechanical generators. The currents produced by my improvement are the result of magnetic induction, and are different from those produced by ordinary induction-coils as heretofore used in telegraphy. They approach more nearly in character the currents from magneto or dynamo electric machines; but the mode of their production is very different from that practiced with such machines, in that in these machines the expenditure of a large amount of power is necessary for revolving or otherwise rapidly moving an armature through a magnetic field and against the attraction of the field-magnets, while in my improvement no such expenditure of power is required, the simple magnetization and demagnetization, or otherwise varying the magnetic character of a stationary body of metal adjacent to the magnetic cores of suitable coils of wire, serving to induce in said coils, when properly connected in circuit, powerful currents, which will traverse a line-wire alternately in opposite directions, and actuate relays or other receiving-instruments constructed for operation by such reversed currents.

In the machine or apparatus which I have invented for carrying out my improvement in the art, I vary the magnetic character of the stationary body of metal in different manners; and I do not of course confine myself to any particular mechanism, though I prefer the form shown in my application heretofore filed.

My invention will be readily understood from the following particular description and definite claims, in connection with the accompanying drawings, in which—

Figure 1 is a side view of a current generating and transmitting apparatus constructed according to my invention. Fig. 2 is a top view, and Fig. 3 and end elevation, of the same. Fig. 4 is a side elevation of a differently-constructed instrument for carrying my improved method into practice; and Fig. 5 is a section on line *x x*.

Referring to Figs. 1, 2, and 3, the letters A and A′ indicate two permanent magnets of the ordinary horseshoe form, arranged flatwise with relation to each other and at a suitable distance apart, one being above the other in the present instance, though such relative positions are non-essential. Between the permanent magnets, near their curved ends, stands a block of wood, *b*, or other isolating material, which serves to keep them separated a proper distance at these ends. Each pole of both permanent magnets is provided with a laterally-projecting soft-iron pole-piece, *a*, the pole-pieces of one magnet extending toward those of the other and separated therefrom a suitable distance. Each pole-piece is surrounded by a coil, C, of insulated fine wire about the size, preferably, of ordinary Morse relay-wire. The coils of each magnet are connected in a pair by their inner terminals, and the two pairs are connected together between two similar outer terminals, as shown, by the wire *c*—that is, the coil on one south pole-piece has its outer extremity connected to the outer extremity of the coil on the other south pole-piece. The outer extremities of the other two coils are to be connected to earth E and the line L, respectively. The coils are all similar in their winding, and the manner of their connection brings the winding in proper relation to the respective pole-pieces. For in-

stance, if a current in a given direction should enter a coil of one magnet by its outer extremity, it would leave by its inner extremity, and pass to the inner extremity of the opposite coil of the same magnet, and then, leaving this coil by its outer extremity, it passes to the outer extremity of the similarly-situated coil of the other magnet. By this arrangement induced currents similarly produced in all the coils by the north and south pole-pieces are caused to flow in the same direction, while, if the coils were connected so that the outer extremity of one joined the inner extremity of another, the simultaneous inductive influences of opposite poles would neutralize each other in the coils and no current would flow.

The letter D indicates an electro-magnet having coils of large wire, so that its cores will be promptly and efficiently magnetized when said coils are traversed by an electric current. The yoke-piece *d* of the cores of this electro-magnet is fastened to the block *b*, and the polar portions of said cores, as shown clearly at *f* in Fig. 2, are somewhat flattened, and extend between the tips of the opposed pole-pieces of the permanent magnets, being prevented from touching said pole-pieces, however, by thin interposed plates *g* of isolating material, such as hard rubber, wood, or paper. One of the coil-terminals of the electro-magnet D is connected to a binding-post, *p*, and the other to a similar post, *p'*, on base-board B. The apparatus is secured to the base-board by suitable bolts, *y*, and bars *y'*. The binding-post *p* is connected with one pole of a small voltaic battery, X, the other pole of which is connected with the anvil or circuit-closing contact of an ordinary transmitting-key, K, the key itself being connected with the binding-post *p'*.

The permanent magnets A and A' have poles of opposite character arranged opposite each other—that is, the tip of the north pole-piece of each magnet faces and is adjacent to the tip of the south pole-piece of the other magnet—and in the space between each opposed pair of tips, and also in a limited contiguous space, is comprised an intense magnetic field. If a piece of soft iron or a magnet were moved through this field athwart and between the opposed polar tips, currents would be induced in the coils; but with a view to obviating the necessity of moving an armature with relation to the pole-pieces I have arranged permanently between the soft-iron poles of the permanent magnet the poles of an electro-magnet, and I have found that alternate magnetization and demagnetization of the cores of the electro-magnet effect in an increased degree the purpose which would be accomplished by moving an armature through or alternately into and out of the magnetic field. In other words, the intermittent magnetization of the electro-magnet, or, better still, reversing its magnetic polarity by currents alternately in opposite directions through its coils, results in the induction of very powerful currents alternately in opposite directions in the coils of fine wire C which surround the pole-pieces of the permanent magnets, the strength of such currents depending, first, on the strength of the permanent magnets; secondly, on the size of the wire used on the spools C; and, thirdly, on the battery-power used. The stronger the permanent magnets the more intense the currents produced, and the intensity is also enhanced in proportion as the wire of the spools is finer. A single small-size bichromate-of-potassium cell is sufficient battery for all ordinary purposes, and will produce a proper magnetization to induce a current sufficient to overcome a resistance of more than forty thousand ohms, which is the resistance of about two thousand miles of No. 10 galvanized iron wire such as commonly used in practical telegraphy.

It will of course be understood that, in using the reversed currents produced by my improved method for telegraphing by the Morse code, a suitable receiving-instrument must also be used, and such an instrument I have illustrated in an application for Letters Patent filed by me June 23, 1884, and numbered 125,842.

The apparatus shown in Figs. 4 and 5 differs from that first described in that, instead of arranging the tips of the cores of an electro-magnet between the magnetic cores *a* of the coils C, I arrange between said magnetic cores *a* simply soft-iron plates D' D', and on the base-board I arrange a key-lever, K', the upturned inner arm of which carries a transversely-arranged permanent magnet, M, the poles of which lie adjacent to the two soft-iron plates D' D', respectively. The key-lever is normally so held by the spring *s* that the poles of the magnet M will be out of contact with the soft-iron plates D' D', and at such distance therefrom that no very powerful magnetizing of said plates is caused. When, now, the key-lever is operated in a manner similar to that usual in sending telegraphic messages, the magnet M will be thrown alternately into and out of contact with the said plates D' D', thus varying their degree of magnetism, so that they act in a similar manner to the cores of electro-magnet D for inducing currents in coils C, the currents, however, being not so strong as those produced by the first-described form of apparatus.

In both forms of the apparatus the manipulation of the signaling-key is the only mechanical positive action performed.

Having now described my improvement in the art of producing induced electric currents, I claim—

1. The herein-described improvement in the art of generating induced electric currents for telegraphic and other purposes, the same consisting in varying the magnetic character of a stationary body of metal adjacent to magnetically-polarized cores surrounded by coils of wire included in a circuit, whereby currents of alternately-opposite direction are induced

in said coils and flow upon the circuit, essentially as set forth.

2. The herein-described improvement in the art of generating induced currents of electricity for telegraphic and other purposes, which consists in alternately magnetizing and demagnetizing a stationary body of iron within inductive proximity to magnetically-polarized cores surrounded by coils of wire in circuit, whereby reversed currents are set up in said coils and caused to traverse the circuit, essentially as set forth.

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

JOHN C. LUDWIG.

Witnesses:

J. S. FITZGERALD,

GEO. I. N. MORRELL.