(No Model.)

E. THOMSON.

INDUCTION COIL.

No. 409,714. Patented Aug. 27, 1889.

Fig. 1.

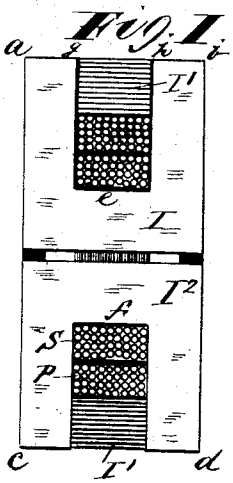


Fig. 2.

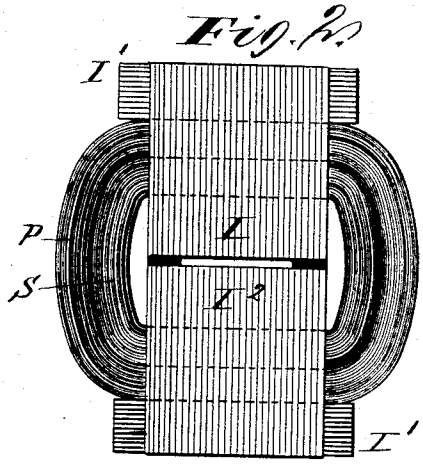


Fig. 3.

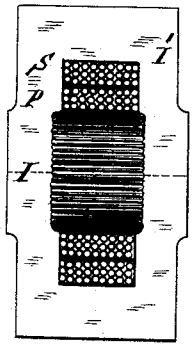


Fig. 7.

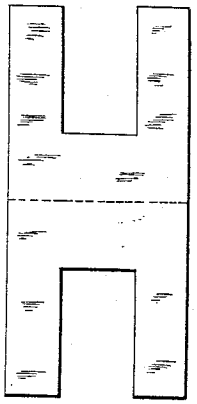


Fig. 4.

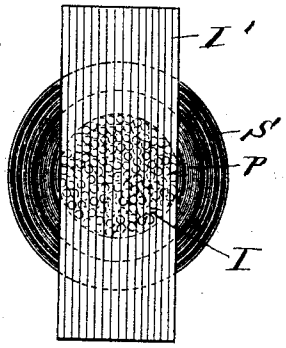


Fig. 5.

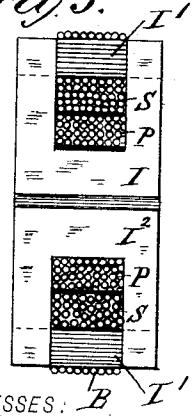
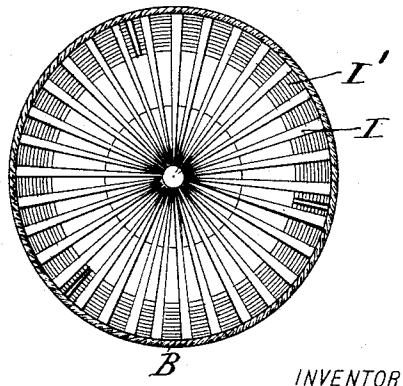


Fig. 6.



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UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF LYNN, MASSACHUSETTS, ASSIGNOR TO THE THOMSON-HOUSTON ELECTRIC COMPANY, OF CONNECTICUT.

INDUCTION-COIL.

SPECIFICATION forming part of Letters Patent No. 409,714, dated August 27, 1889.

Application filed February 12, 1887. Serial No. 227,445. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, and a resident of Lynn, in the county of Essex and State of Massachusetts, have invented a certain new and useful Induction-Coil, of which the following is a specification.

My invention relates to those forms of electro-magnets in which a coil or coils are wound upon a subdivided iron core made up of separate plates or laminæ.

My invention is designed more particularly as an improvement in the construction of those forms of magnet which are provided with two coils, one of which bears the relation to the other of a primary coil of a converter or induction-coil.

The object of my invention is to secure cheapness and ease of construction, together with high efficiency of action, due to the particular proportion of coils and core hereinafter described, and to the fact that the iron mass is as nearly as possible solid.

In the accompanying drawings, Figure 1 is a vertical section of an apparatus embodying my invention, and Fig. 2 is a side elevation of the same. Figs. 3 and 4 are respectively vertical U-sections and a side elevation of a modification. Figs. 5 and 6 show my invention in another modified form. Fig. 7 shows another form of U-shaped plate adapted to my invention. Figs. 1 and 2 show the preferred construction.

Sheet-iron punched into U-shaped pieces of preferably square form (seen at I and I^2, Fig. 1) are used to build up a core. (Seen on edge, Fig. 2, $I I^2$.) In the notches are wound the two coils P and S, as indicated, and together they form approximately a square section, the four sides of which are of square length.

The winding may be accomplished readily by revolving the parts of the core $I I^2$, held in suitable clamps, and feeding the wire of the coils thereon, as usual. The coils pass through the grooves or between the legs of the U-pieces and over the ends, as seen in Fig. 2, and of course are insulated thoroughly from the iron pieces $I I^2$ by interposed layers of insulating material. The sheet-iron pieces themselves may be insulated by interposed thin paper pieces of the same form. After the coils are in place there should be sufficient iron projecting beyond them to permit the introduction of bundles of sheet-iron pieces I′, adapted to fit closely in the space between the projections and to make a butt-joint, with their edges against the internal edges of the legs of the pieces $I I^2$ at the part thereof lying beyond or to the opposite of the coils P S. The magnetic sections of the bundles I′ I′ should be approximately equal to the magnetic section of the four pieces $I I^2$. It will be seen that by this construction of iron core and magnetic circuit-closing bundle I′ no spaces are required to be left between individual spaces I to form gaps for the insertion of plates or pieces of the bundle I′, and that therefore the greatest practicable mass of iron consistent with a proper magnetic subdivision may be obtained in a given space. When the coils P S, &c., occupy a square figure in combined section, Fig. 1, the best proportioning demands that the outer lines of I I′ and of I^2 I′ be also square—*i. e.*, the pieces $I I^2$ should be punched out square except where the slots for the coils P S and for I′ exist. It is also preferred to economize the material (copper) of the coils P and S by using a large proportion of iron. If the coils P and S occupy a square figure of two inches on the side, the pieces $I I^2$, including I′, may be of a square of six inches on the other side, or the total external dimensions of the parts, Fig. 1, will be rectangular six inches from *a* to *b* and *c* to *d* and twelve inches from *a* to *c* and *b* to *d*, while the iron all around the coils P S will represent a layer two inches thick. As will be observed, each leg of the U-shaped plate projects beyond the body of the coil to a distance substantially equal to the width of each leg. A larger proportion of sheet-iron would require larger outside dimensions and would involve the use of a layer of iron of greater depth around the coil and through its center. Thus with the section of coils P S occupying a square figure of two inches as before, and with a diameter from *e* to *f* of six inches, the iron layer may be made three inches thick, which would make the dimensions from *a* to *b* eight inches and from *a* to *c* sixteen inches.

By the particular proportions of coils and magnetic masses hereinbefore described I obtain the maximum efficiency with the minimum amount of material and space required for the coil. A thin layer of material—such as hard paper or other insulation—may be interposed, if desired, between the edges of I′ and I, but should not be sufficiently thick to interfere greatly with the magnetic continuity.

Figs. 3 and 4 show a modification in which the core I is short and composed of sheet-iron or wires dressed off at the ends to fit into a frame I′ after the coils P and S have been placed upon the core I^3. The frame I′ is composed of sheet-iron pieces of double-U form, the legs of the two U's being joined integral. The plates are laid together laterally and serve to effect external closure of the magnetic circuit of the core I.

The material which is used to separate the various plates I, I^2, and I^3 from one another may consist of paper interposed between the flat surfaces of such plates.

Figs. 5 and 6 show a modification, in which the pieces I I^2 are set radially and fitted together by tapering their inner edges, or by making them of varying dimensions, so as to nearly fill the center of the coils. Externally they (I I^2) are joined, as before, by bundles of sheet-iron strips properly insulated. The construction gives a circular form to the whole, but has no special advantage over the form shown in Figs. 1 and 2 for practical purposes.

It is obvious that plates of the double-U form shown in Fig. 7 might take the place of the plates I I^2, Figs. 1 and 2.

The special form shown in Figs. 3 and 4 of the accompanying drawings forms the subject of specific claims in an application filed by me September 29, 1887, Serial No. 251,072, and constituting a division of the present application.

I do not claim herein the combination, with the coils, of U-shaped iron plates or pieces, between whose legs the conductor and coil lie, and yoke-pieces connecting the two legs, so as to complete a magnetic circuit around the circumferential axis of the coil; nor do I claim herein the combination, with one or more electric coils, of a magnetic envelope formed at the sides of the coil, of two masses of iron subdivided in lines transverse to the line of the coils, but substantially parallel to the plane of winding, and yoke-pieces connecting the iron at the sides of the coil on the outer periphery thereof, as these features form the subject of claims in another application for patent filed of even date herewith, Serial No. 227,446.

What I claim as my invention is—

1. The combination, with an electric coil, of a bundle of U-shaped iron plates or pieces, between whose legs the conductors of the coil lie, in combination with yoke-pieces consisting of bundles of iron plates fitted into the space between the projecting ends of the legs of the U, and forming a butt-joint with the internal edges of said legs, so as to complete a solid magnetic circuit around the circumferential axis of the coil.

2. The combination, with an electric coil, of an enveloping iron mass consisting of a bundle of iron plates passing through the axis of the coil and around the outside thereof, together with a bundle of sheet-iron plates insulated from one another and fitting into the space between the extensions of the first-named iron mass and forming a butt-joint with the edges of the plates making up such mass, as and for the purpose described.

3. The combination, in an induction-coil or converter, of primary and secondary coils whose combined cross-section is a square figure having four sides of equal length, in combination with a series of superposed U-shaped plates passing through said coil, and having legs which project beyond the coils to a distance substantially equal to the thickness of such coil, and a magnetic circuit-closing bundle of iron plates placed between the legs and having a width equal to the width of the legs.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 7th day of February, A. D. 1887.

ELIHU THOMSON.

Witnesses:
J. W. GIBBONEY,
E. WILBUR RICE, Jr.