

(No Model.)

E. THOMSON.
ELECTRIC TRANSFORMER.

No. 581,873.

Patented May 4, 1897.



Fig. 1.



Fig. 2.

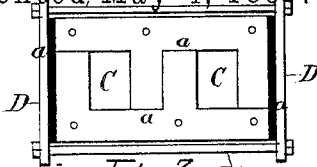


Fig. 3.

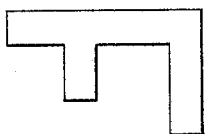


Fig. 4.

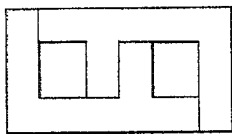


Fig. 5.

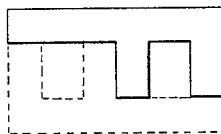


Fig. 6.

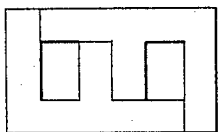


Fig. 7.

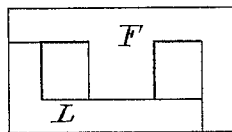


Fig. 8.

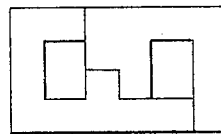


Fig. 9.

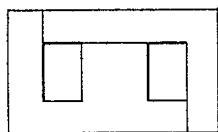


Fig. 10.

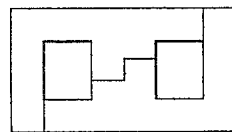


Fig. 11.

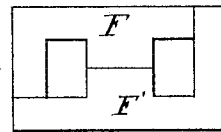


Fig. 12.

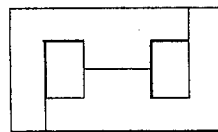


Fig. 13.

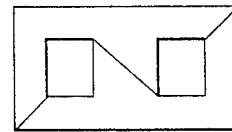


Fig. 14.

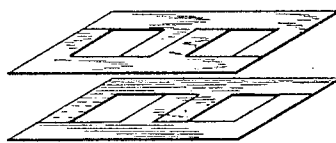


Fig. 15.

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ELECTRIC TRANSFORMER.

SPECIFICATION forming part of Letters Patent No. 581,873, dated May 4, 1897.

Application filed January 29, 1890. Serial No. 333,525. (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 certain new and useful Transformers, of which the following is a specification.

My present invention relates to transformers, self-inductive coils, and other similar forms of electromagnet in which there is a practically closed or endless magnetic circuit of iron formed through the axis of the coil and around the outside thereof by a mass of iron laminæ or sheet-iron plates.

My invention applies not only to cases where the iron mass is continuous, but to cases where there is a break, provided such break is insufficient to permit the coil to be slipped into place after winding, or, in other words, the form of the iron core or circuit is such as to provide an opening or openings through which the coils would have to be threaded if the core were constructed first and independent of the coils.

The object of my invention is to facilitate the construction of such apparatus by permitting the electric coil or coils to be separately constructed and the iron mass forming the closed or endless magnetic circuit to be afterward applied to the coil or coils.

My invention is especially applicable to those cases where the core or iron mass has two openings or spaces in which opposite sides of the coil or coils lie; and it consists, essentially, in building up the core from F-shaped sheet-iron plates assembled as hereinafter described and properly secured together in position.

My invention consists also of an F-shaped sheet-iron blank or plate for use in building up the iron core or closed magnetic circuit. Two F-shaped plates, or two sets of F-shaped plates, may be used, or the F shape may be conveniently used with other forms, as will hereinafter appear. The plates or laminæ lying against or upon one another are bolted or secured together in any desired way, as well understood in the art, and the whole core structure, after being built up in and around the coil or coils, is secured in position by

clamping plates and bolts or by other means which may be varied indefinitely.

Figure 1 shows in side elevation a form of electric coil and iron cores or magnetic circuit therefor to which my invention is applicable. Fig. 2 shows an F-shaped blank which may be used, as shown in Fig. 3, in building up a core of the form shown in Fig. 1. Figs. 3 to 15 show various modifications in the shape or proportion of the F-pieces and the manner of assembling them or combining them with other pieces to make the iron core.

The F-pieces, Fig. 2, may be combined, as shown in Fig. 3, so that the lines of junction or abutment between the plates in the two bundles will be, as at *aa a*, horizontal or parallel to the plane of winding. The plates may be applied singly and afterward bolted together, or two bundles may be first constructed and then slipped into place. Clamping plates and bolts, as indicated at *E D*, may hold the structure intact after completion. It will thus be seen that very great ease of application is secured, since these pieces may be readily applied to any helix or coil previously wound on a frame which fills, or nearly fills, the space left at *C C* in the figure.

Fig. 4 shows a slightly-modified form which, when two pieces are employed or clamped together, gives the compound piece or pile, Fig. 5, which differs from Fig. 3, already shown in the direction of some of the lines of junction relatively to one another.

Fig. 6 shows another modification which differs from that shown in Fig. 3 simply in the relation of the middle prong-piece of the half form, as will be seen on inspection.

Fig. 7 is a form differing only from Fig. 5 in the relation of the middle pieces of the F-figures composing the plate.

Fig. 8 shows the magnetic circuit made up by an upper F-shaped piece and a lower L-shaped piece placed adjacent thereto, the F-shaped figure being marked *F* and the L-shaped pieces in the figure being marked *L*. These separate pieces of metal are cut out or punched to shape and applied thereon in bundles or successively one after the other in forming the core.

Fig. 9 shows a similar arrangement in which

the forms of the F-shaped piece are somewhat distorted or changed.

In Fig. 10 a piece somewhat similar to Fig. 8 is slightly modified, and there is an F-shaped piece and an L-shaped piece matched.

In Fig. 11 a still further modified form is seen in which two F-shaped pieces are fitted together, the central prong or projection being made in a form as indicated, so as to give an interlocking fit.

In Fig. 12 the arrangement is modified, so that the upper F-shaped piece to the left fits into a larger or longer F-shaped piece to the right, and the pieces are marked, respectively, F F'.

Fig. 13 shows that Fig. 10 may be virtually composed of two F-shaped matched pieces not differing greatly from the arrangement Fig. 5, except that the middle division between the F-shaped pieces is put horizontal instead of remaining vertical, as in the case in Fig. 5.

In Fig. 14 the F-shaped pieces are shown with beveled outlines at their meeting-points and locked together in the position shown in the figure, the lines which join the corners of the figures being made in a direction diagonal thereto and those which join the portion of the figure at the center being made in a direction oppositely.

In building up a core of any of the forms of pieces indicated the corresponding pieces may be built up in a pile or block and bolted together with insulation between the coils put thereon and the remaining piece placed on as a facing and the whole bolted together in a suitable frame or in any other way secured in position, or, as indicated in Fig. 15, the laminæ may be built up separately and applied separately to the coils, the said figure indicating a reversed position of alternating lamina or alternate sets of laminæ, the general form of each of which corresponds to that of Fig. 3. When the successive layers are thus reversed, their arms or limbs will overlap and break joints, as shown. In this way the laminæ of different planes may be made to break joint one with the other, so that the continuous portions of the plates in one plane will lie opposite or against the junctions of laminæ in other planes.

What I claim as my invention is—

1. In an iron-clad transformer, the laminated iron envelop having its laminæ made each of two sheet-iron punchings fitting together from opposite sides of the coils, and each having a middle limb entering within the coils and the two punchings having arms at each side of the central limb which meet each other out of coincidence with the middle of the coils, and with successive laminæ reversed so that by the unequal length of their limbs they shall break joints.

2. In an iron-clad transformer, the laminated iron envelop having its laminæ made each of two sheet-iron punchings fitting together from opposite sides of the coils, and

each having a middle limb entering within the coils and the two punchings having their relatively-abutting limbs of unequal length at the points where they abut, so as to meet each other out of coincidence with the middle of the coils, and with successive laminæ reversed so that by the unequal length of their limbs they shall break joints.

3. An iron-clad transformer, the laminated envelop of which is built up of laminæ made each of two sheet-iron punchings fitting together from opposite sides of the coils, each punching having a middle limb entering within the coils, their middle limbs being of unequal length on opposite sides of the axial plane of the coils, and with successive laminæ reversed to break joints.

4. In an iron-clad transformer, the laminated iron envelop built up of like sheet-iron punchings fitting together from opposite sides of the coils, said punchings having each a middle limb entering within the coils and having their limbs of unequal length on opposite sides of the axial plane of the coils, with successive laminæ reversed to bring the limbs of unequal length into juxtaposition, whereby the superposed punchings overlap to the extent of the inequality in length of their limbs.

5. A magnetic frame for an inductorium or converter, formed of two separable sections which together compose a frame built up of plates or layers, each plate or layer consisting of two elements, one for each of said sections, being placed together so as to form a symmetrical closed frame with a cross-strip formed of the middle limbs or projections from the plates to constitute a core, adjacent layers or groups being reversed so as to break joints and form overlapping and interlocking portions between the two sections.

6. A magnetic frame for an inductorium or converter, formed of two separable sections, which together compose a frame built up of plates or layers, each plate or layer consisting of two elements, one for each of said sections, being placed together so as to form a symmetrical closed frame with a cross-strip to constitute a core, adjacent layers or groups being reversed so as to break joints and form overlapping and interlocking portions between the two sections, means for holding the elements of each section together, and means for holding the two sections against separation from one another.

7. A core for transformers composed of laminæ having an F shape reversed with respect to one another and facing in opposite directions so as to produce a rectangular figure in which the central opening is divided equally by the shorter limbs of the F-shaped pieces for the reception of the transformer-coil.

8. A laminated core for a transformer each lamina composed of two pieces of sheet-iron approximating in shape the letter F or its equivalent as described, and having, there-

fore, a portion extending at right angles to another portion, said pieces being placed face to face so as to form a rectangular figure with a break at the opposite ends of a diagonal, and having extensions or projections in the middle of one or both pieces to form the central bridge surrounded by the coils of the transformer.

9. A core for transformers composed of sheet-iron laminæ, each lamina composed of two pieces approximating in shape the letter F, or its equivalent as described and having a portion extending at right angles to another portion, said pieces being placed face to face so as to form a rectangular figure with a

break at the opposite ends of a diagonal, and having extensions or projections in the middle of one or both pieces to form the central bridge surrounded by the coils of the transformer, the laminæ being reversed in relative position successively in building up the core, substantially as described.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 24th day of January, A. D. 1890.

ELIHU THOMSON.

Witnesses:

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ALBERT L. ROHRER.