(No Model.) 2 Sheets—Sheet 1.

E. THOMSON.

ELECTRIC TRANSFORMER.

No. 528,188. Patented Oct. 30, 1894.

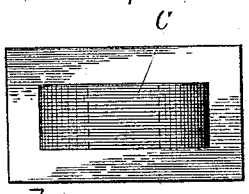

Fig. 1.

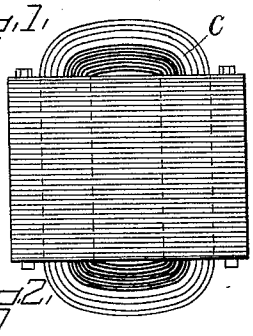

Fig. 2.

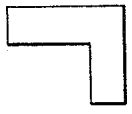

Fig. 5.

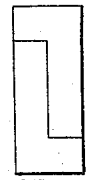

Fig. 3.

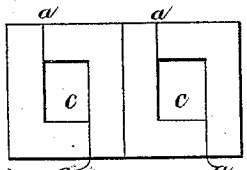

Fig. 4.

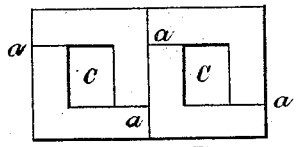

Fig. 6.

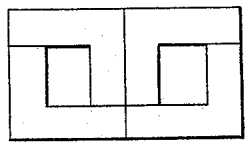

Fig. 7.

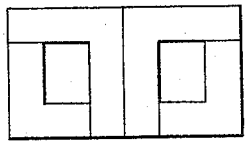

Fig. 8.

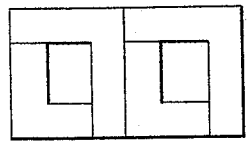

Fig. 9.

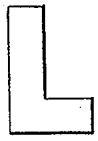

Fig. 10.

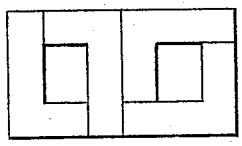

Fig. 11.

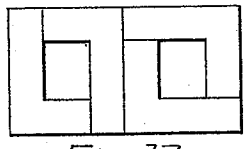

Fig. 12.

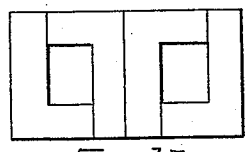

Fig. 13.

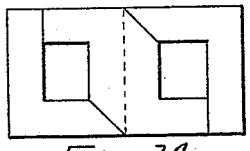

Fig. 14.

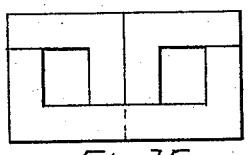

Fig. 15.

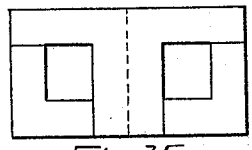

Fig. 16.

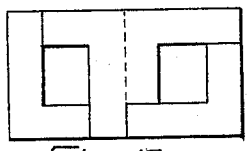

Fig. 17.

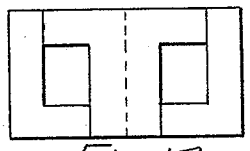

Fig. 18.

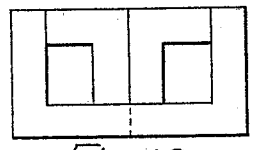

Fig. 19.

WITNESSES:

A. Hundley

F. F. Curtis

INVENTOR

Elihu Thomson

BY

H. C. Townsend

ATTORNEY.

(No Model.) 2 Sheets—Sheet 2.

E. THOMSON.

ELECTRIC TRANSFORMER.

No. 528,188. Patented Oct. 30, 1894.

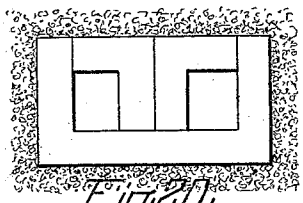

Fig. 20.

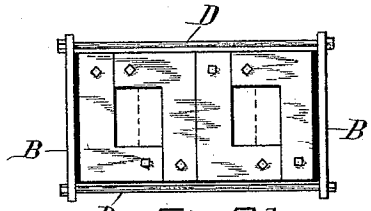

Fig. 21.

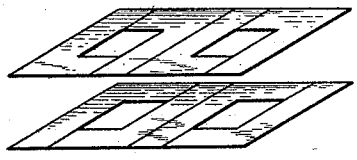

Fig. 22.

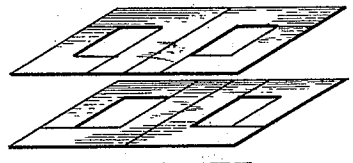

Fig. 23.

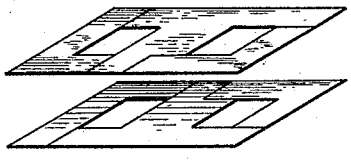

Fig. 24.

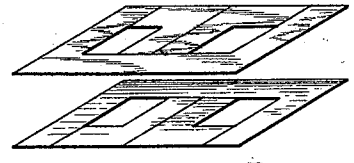

Fig. 25.

WITNESSES:

J. A. Hurdle

F. F. Courcy

INVENTOR

Elihu Thomson

BY

H. C. Townsend

ATTORNEY.

UNITED STATES PATENT OFFICE.

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

ELECTRIC TRANSFORMER.

SPECIFICATION forming part of Letters Patent No. 528,188, dated October 30, 1894.

Application filed January 29, 1890. Serial No. 338,524. (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 Transformer, of which the following is a specification.

My invention relates to the construction of the closed magnetic circuit in those forms of electro-magnets, such as converters or reactive coils in which the iron of the circuit passes through the coil and is completed around the outside of the coil, as now well understood in the art, and is composed of laminæ or plates of iron cut or punched into shape.

My invention consists essentially in a converter built up from L shaped sheet iron pieces disposed to form the core or magnetic circuit of the apparatus, and assembled, as hereinafter described, to have a solid central core piece passing axially through the electric coil.

In building up such core from L pieces the relative position of the several pieces is not a matter of particular consequence and may be greatly varied as will hereinafter appear.

The L shaped pieces may be assembled to form two openings so that the portion of the circuit passing through the middle of the coil may be completed around both sides of the same.

In the accompanying drawings:—Figure 1, shows in side elevation a common form of converter for building the core or magnetizable portion of which my invention may be employed. Fig. 2, is a plan of the same. Fig. 3, shows the manner of cutting two L shaped blanks from the same sheet of metal without waste. Figs. 4 to 20, inclusive, show various modifications in the dimensions of the L shaped pieces and the manner of assembling the same to form the magnetic circuit of iron through the center of the coil and around the outside thereof. Fig. 21, shows the manner of securing the L shaped pieces together. Figs. 22 to 25, inclusive, show various modifications in the relative disposition of the L shaped pieces in different planes of the same pile or bundle.

My invention is especially applicable to the construction of transformers or reactive coils such as shown in Figs. 1 and 2, in which the coils may be either a single coil for self-inductive action or a primary and a secondary coil or coils for induction from one circuit to another. In this form the openings through which the coil passes are of rectangular form to receive the correspondingly formed coil. Here there is present a central body of iron passing through the coil or surrounded by such coil and forming a part of a magnetic circuit of iron closed exteriorly around the outside of such coil.

The L shaped pieces may sometimes be combined in one piece as will be explained, and for a portion of the core only.

The piece of sheet metal of the form indicated in Fig. 3, may be cut into two L-shaped pieces without any waste of stock as indicated by the lines, the shorter portion being of a length equal to the width of the longer portion. The dimensions, however, of each L-shaped piece may obviously be considerably varied. By selecting the dimension properly such L shaped pieces may be assembled in various ways to form a core and inserted in place in the open space of the coil of wire marked C, Figs. 1 and 2. The manner of insertion may be varied considerably. A number of L shaped pieces may be applied together so as to form a pile of laminæ in which the pieces occupy the same relative position one on top of the other flatwise and when sufficient of these piles are made they can then be inserted into the coil and brought together. It is advisable to build the pieces up in the usual manner by inserting bolts through holes and drawing them together, and the pieces may be insulated by interposed paper or simply used without paper insulation especially when the surfaces are thoroughly oxidized. Four such piles of pieces may be put together as in Fig. 4, being at the same time inserted into the coil C, Figs. 1 and 2. When assembled as shown they may be held together by any suitable means, as well understood in the art, as for instance in a frame as indicated in Fig. 21, consisting essentially of end plates B, B, insulated preferably from the material of the core and drawn or held together by means of bolts D, D, or they might even be held in po-

sition in a mass of cement as indicated in Fig. 20. The manner of holding them in place is, however, not material and may be varied indefinitely.

Fig. 5, shows one of the L shaped pieces separated.

In Fig. 4, the L shaped pieces are put together with the lines of their joints parallel and vertical, as at the points *a*, *a*, *a*, leaving the spaces C, C, to be occupied by the coil.

Fig. 5, shows the L shaped blanks such as would be used in constructing the core as shown in Fig. 6. Here the lines of the joints of the meeting sections are horizontal as at *a*, *a*, *a*, or parallel to the plane of the coil to which they are applied, whereas in Fig. 4, the meeting sections are vertical to the plane of the coil.

Fig. 7, shows a slight change in the disposition of the L shaped pieces in which the joint lines are horizontal, but the half of the core to the right has been reversed up and down or one hundred and eighty degrees, in a vertical plane transverse to its own plane. In inserting these pieces I have described the bundling of them together and building into masses which are then matched into the interior or outside of the coil which has been previously wound on a suitable form. This procedure is by no means essential in building up the core as the pieces may be inserted into the coils singly, (each rectangular figure around the coils being complete for each single lamina,) in successive layers by insertion of one or several pieces only at a time. Part of such a core could be built up with the arrangement of the pieces as in Fig. 6, and another part of the same core with the arrangement shown in Fig. 7, and the alternating plates or planes of iron may be made of this or other forms built one on top of the other, so that the meeting ends of the plates in different planes will break joint, or in other words, the joints or points of abutment of the L shaped pieces in some planes will lie opposite the continuous portion of the L shaped pieces in other planes. This will be more fully explained after describing the various shapes. By using these forms the outlines, Figs. 8 and 9, are obtained, which outlines may be dealt with in substantially the same manner as the pieces in Figs. 6 and 7. In fact Figs. 8 and 9, may be regarded as a sort of compromise between the arrangement, Fig. 4, and the arrangements, Figs. 6 and 7, and will be seen to produce a form of core in an effective manner. These may be built up into core pieces or bundles or inserted separately into the interior of the coil C, or all of the various figures may be alternated in the same core in building it up.

Fig. 10, shows a simple L piece entering partly into the composition of such a figure as Fig. 11, which will be seen to differ from Fig. 4, only in the fact that the joints between the pieces are vertical on the left and horizontal on the right of half of the compound core piece.

In Fig. 12, the same arrangement exists with the exception of a reversed position for the right half, Fig. 11.

In Fig. 13, we have substantially a repetition of the left half of Fig. 11, one half reversed in a horizontal plane. All of these figures are built up of L shaped pieces solely and clamped together for use.

Fig. 14, shows that the central piece may be virtually composed of two L shaped pieces united back to back while the other portions are L shaped pieces applied thereto.

Fig. 15, shows that the lower portion of Fig. 7, might be united so as to have the L shaped pieces forming the lower boundary of one piece a sort of double L, L.

Fig. 16, shows that the upper pieces, Fig. 8, may be united back to back in one piece while the remaining corners are filled up by L shaped pieces.

Fig. 17, shows that in Fig. 11, the central portion may be united along the dotted line while the rest of the figure is made up of the L shaped pieces as shown.

Fig. 18, shows that the middle L shaped pieces, Fig. 13, may be united across the meeting portions as along the dotted line while the outer L shaped pieces complete the figure.

Fig. 20, shows a slightly modified form from that seen in Fig. 15, embodying substantially the same shaped parts.

Fig. 21, indicates the end appearance of a core built up and bolted together in a frame for holding the piles of sheets together.

Fig. 22, shows the relative arrangement of the plates, Fig. 4, when arranged in different planes so as to break joint at the meeting ends. This condition is attained by simply reversing the positions of the different layers so that the joint of one layer will lie opposite the continuous portions of the blanks or L shaped pieces of other layers as is obvious. As applied to Fig. 4, the effect is obtained by simply turning the two plates which make up the square figure, over in a horizontal plane. A number of plates might be laid up together, as the upper sheet, Fig. 22, and then a number succeeding built up as in the lower portion of Fig. 22, and in fact other arrangements may be employed for the same core structure, but in general it is better to confine the arrangement to but two positions of plates composed of the same pieces. The sheets are thus caused to break joint with one another in the succeeding laminæ or sheets.

Fig. 23, shows a form substantially like Fig. 8, when used in this reversed way.

Fig. 24, shows plates similar in arrangement to Fig. 17, reversed.

Fig. 25, shows plates similar to Fig. 19, alternately reversed. It is to be understood that alternating such compound plates or built up plates would form the core of a coil applied thereto and that they would be placed

close together, sometimes with insulation between them.

What I claim as my invention is—

1. A core for transformers built up of laminæ or plates of sheet iron assembled together, each plate having a shorter and a longer arm, the inner length of the shorter arm being made approximately equal to the width of the longer arm and two sets of said plates located in each lamina and the plates of each set placed with the ends of the shorter arms against the inner sides of the longer arms so as to leave two rectangular openings for the coils of wire.

2. A core for transformers having L-shaped pieces of sheet iron, in combination with other pieces which, together with the L-shaped pieces, form an approximately rectangular outline when laid in a plane, said figure having two rectangular openings therein, a number of such compound rectangular plates being assembled in a pile one above another, bolts passing through said plates for securing them together and a frame placed about the pile to secure the parts thereof against lateral displacement, 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:
JOHN W. GIBBONEY,
GEO. F. CURTISS.