(No Model.) 3 Sheets—Sheet 1.

J. J. WOOD.

ELECTRIC TRANSFORMER.

No. 511,574. Patented Dec. 26, 1893.

FIG. 2.

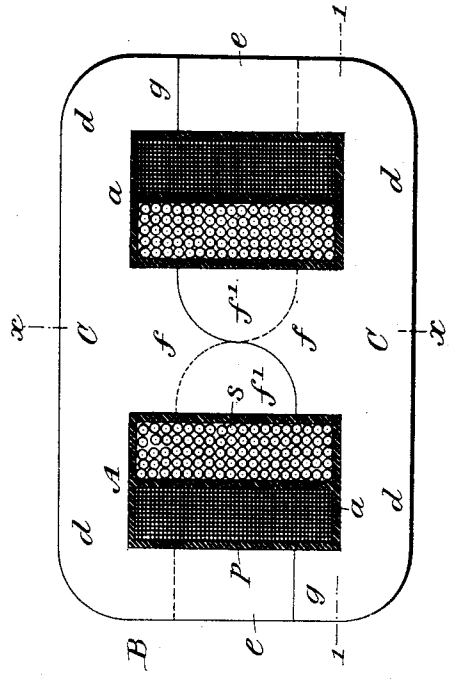


FIG. 3.

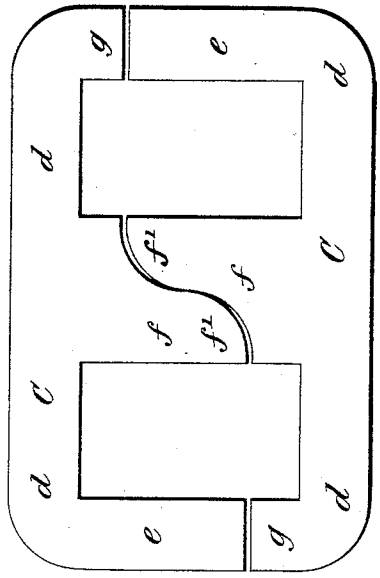
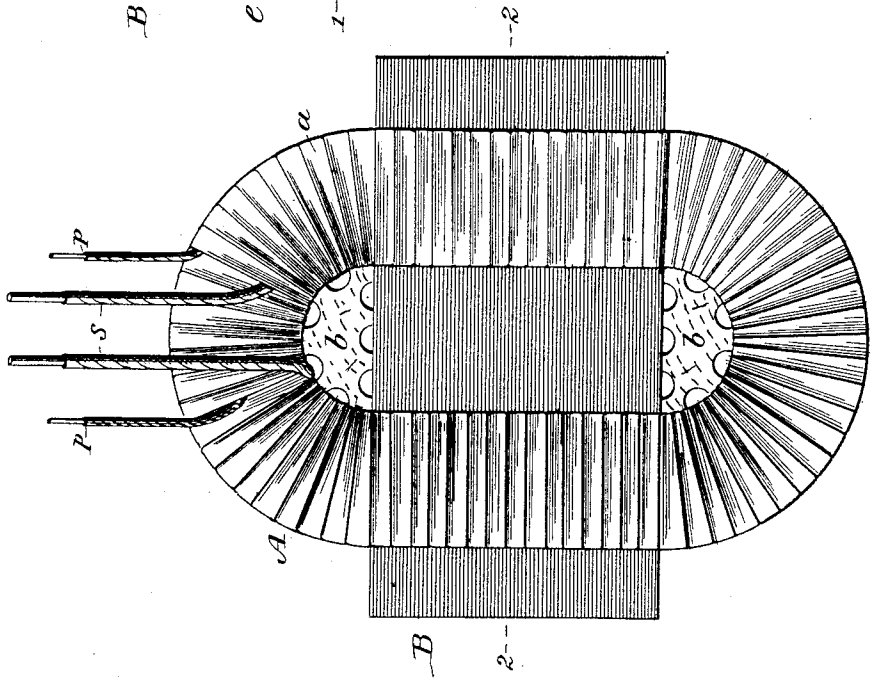


FIG. 1.



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(No Model.) 3 Sheets—Sheet 2.

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FIG. 4.

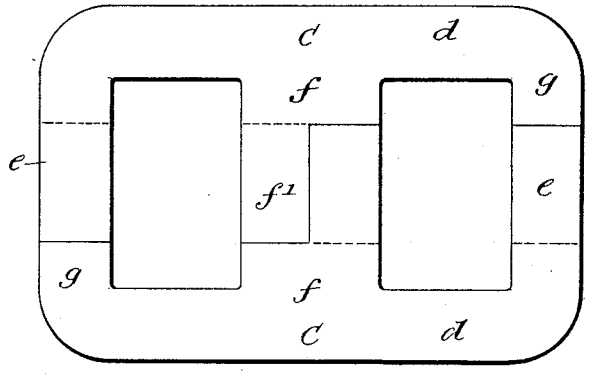

FIG. 5.

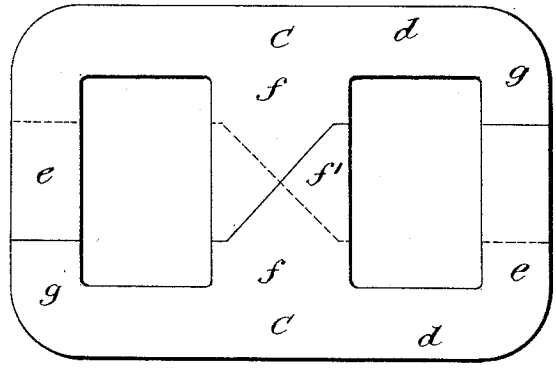

FIG. 6.

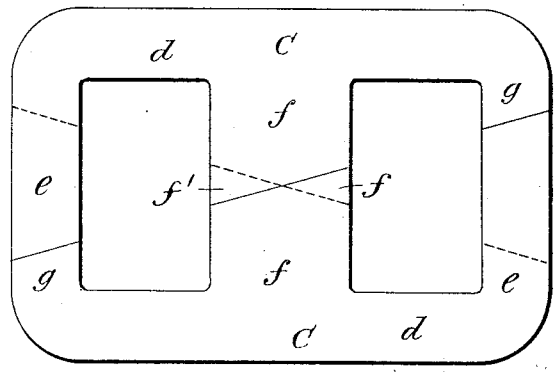

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FIG. 7.

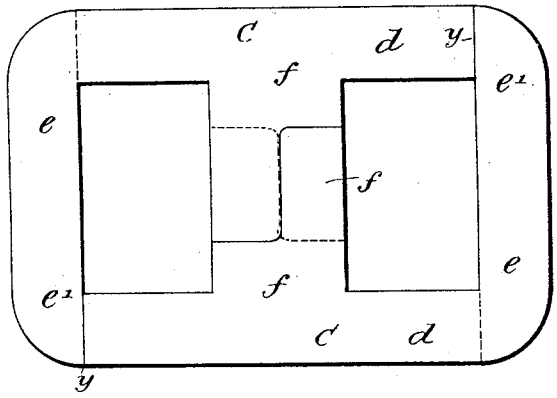
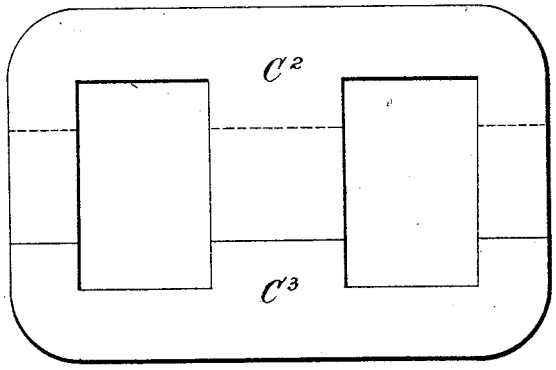


FIG. 8.



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UNITED STATES PATENT OFFICE.

JAMES J. WOOD, OF FORT WAYNE, INDIANA.

ELECTRIC TRANSFORMER.

SPECIFICATION forming part of Letters Patent No. 511,574, dated December 26, 1893.

Application filed May 19, 1893. Serial No. 474,761. (No model.)

To all whom it may concern:

Be it known that I, JAMES J. WOOD, a citizen of the United States, residing at Fort Wayne, in the county of Allen and State of Indiana, have invented certain new and useful Improvements in Electric Transformers, of which the following is a specification.

This invention relates to the construction of transformers or converters, called "closed magnet-circuit transformers," for use with alternating currents, to transform a current of high electro-motive force on a main or line circuit, into one of lower electro-motive force but greater volume on a secondary or local circuit. Such transformers are commonly constructed with the primary and secondary coils wound together in any suitable arrangement, and with a laminated iron envelope entering between and surrounding the coils or the greater portion thereof, transformers as thus constructed being known as "iron-clad" transformers. In the construction of such transformers the coils are usually first wound and the laminated iron envelope is afterward applied. In some constructions each layer or lamina of the envelope is made of a single sheet iron punching, which in order to enable it to be applied to the coil is slitted across or cut open on one side so that its legs may be bent or sprung apart to pass them around the coil, alternate laminæ being applied from opposite sides so as to break joints; this construction is objectionable because of the difficulty of thus applying the laminæ to the coil, which makes the building up of the laminated envelope unduly expensive. According to other constructions the laminated envelope is made in two or more sections, each of which is built up of sheets or punchings before being applied to the coil, and the sections being applied from opposite sides so as to fit together with abutting joints. Constructions of this character are objectionable by reason of the interruption to the magnetic circuit caused by the complete break in the metallic connection at the abutting joints, whereby the magnetic resistance is increased and the efficiency of the transformer is reduced.

My invention aims to provide an improved construction of the iron envelope which shall combine the lowest magnetic resistance with the least expense in assembling the parts of the transformer.

To this end my invention provides an improved subdivision of the respective lamina of the envelope of an iron-clad transformer in the manner hereinafter fully described.

Figure 1 of the accompanying drawings is a sectional elevation of a transformer of the character to which my invention is applicable, the iron envelope being partly in section in the plane of the line 1—1 in Fig. 2. Fig. 2 is a transverse section thereof in the plane of the line 2—2 in Fig. 1. Fig. 3 is a plan of the two punchings constituting one lamina of the iron envelope. Figs. 4 to 8 inclusive are similar views to Fig. 3, showing modified shapes of punchings forming the laminæ.

In Figs. 1 and 2, let A designate the wire coils, and B the magnetic envelope. The coils consist of a primary coil *p* and a secondary coil *s*, as shown in section in Fig. 2, separated and inclosed by insulating layers *a* according to any suitable construction, and the primary and secondary being arranged together in any manner known in the art, either in the manner shown in Fig. 2, or by winding the primary inside the secondary, or by winding them alongside of each other, or in alternate layers, or in any other way desired, the winding of the coils being immaterial to my invention. I have shown the rounded ends of the coils beyond the magnetic envelope as being supported on grooved blocks *b b* as usual.

The magnetic envelope B is built up of any suitable number of superposed layers or laminæ of sheet iron, of any suitable or usual thickness or quality. Each layer or laminæ consists of two punchings, shown separately in Fig. 3, and lettered C C. The two punchings C are applied on opposite sides of the coils A, and their meeting edges abut in planes between the opposite side planes of the coils. Each punching consists of an outer band *d d* extending from end to end, and of limbs *e f* and *g* projecting from it in the manner shown in the preferred construction in Fig. 3. Preferably the two punchings are exactly alike, one of them being reversed relatively to the other, and the conformation of the ends of their limbs being such that when thus reversed they will fit together with a close joint, as

shown in Fig. 2. The limbs *e g* together constitute the portion of the envelope surrounding the outer side of the coil, while the limbs *f f* together constitute the core or middle portion of the envelope which lies within the coils. The limbs *e f g* of each punching are of unequal length on opposite sides of the axial plane of the coils (this plane being denoted by the line *x x* in Fig. 2), so that by reversing the alternate or successive pairs of punchings, the limbs are overlapped so as to break joints, in the manner shown by a comparison of the full and dotted lines in Fig. 2.

In order that the limbs may be of unequal length on opposite sides of the axial plane of the coils, the middle limb *f* is made of a greater length on one side of its middle than on the other side thereof, so that when two pairs of punchings or laminæ are reversed and superposed, the elongated portions *f'* of their middle limbs overlap each other, as shown in Fig. 2. The middle limbs *f* are preferably made in a reverse curve, as shown in Figs. 2 and 3, in order to avoid any angles, and to bring the superposed joints where they cross each other nearly into line with the magnetic lines of force.

The form of punching shown in Fig. 3 is preferable, as it affords a considerable economy of metal, avoiding undue waste in the process of punching from a plate or strip, and because it secures the maximum overlap of the middle limbs of the laminæ, as well as avoiding any continuity of the superposed joints where they cross. Other forms are shown in Figs. 4, 5 and 6, which are nearly as effective. In Fig. 4 the limbs *e* and *g* are the same, but the limb *f* is different in that instead of its meeting edge being formed with a reverse curve it is formed angularly as shown, so that the longer portion *f'* thereof is rectangular. In Fig. 5 the outer limbs *e g* are the same, but the middle limb *f* is cut diagonally, as clearly shown. In Fig. 6 all three limbs *e f g* are cut diagonally on the same line, a construction which is less desirable than the preceding, because it greatly reduces the amount of overlap of the opposite side portions of the middle limb *f*, as is apparent.

Fig. 7 shows a further modification in which the short end limbs *g* are entirely suppressed, their place being taken by a corresponding elongation lettered *e'* of the long end limbs *e*. With this modification the middle limb *f* might be of the form shown in either of the four preceding figures. As here shown this middle limb is most nearly like that shown in Fig. 4, differing therefrom only in that the corners or angles are rounded.

The shape of punching shown in Fig. 7 is somewhat less desirable than the preceding, because the end joints *y y* cannot be forced into close contact by pressure applied flatwise at the opposite sides of the coil and in line with the axial plane thereof, but require a diagonal pressure between its corners.

In assembling either shapes of punchings shown in Figs. 3 to 7, in all of which each lamina is made up of two like punchings relatively reversed so as to fit to each other, it is only necessary for the operative to bring the two punchings together from opposite sides of the coil until they come in contact edge to edge and complete one layer or lamina, and then for the next lamina to bring together two punchings relatively reversed so as to break joints, as shown by a comparison of the full and dotted lines indicating the abutting joints in the several figures, and to repeat this operation of alternating or reversing every successive layer until the magnetic envelope is built up to the desired height.

While it is preferable to reverse every alternate layer in order to most completely break joints, yet it will answer if two, three or more of the laminæ are superposed with their joints in coincidence, and then the next two, three or more laminæ are superposed with their joints in coincidence with each other but reversed so as to break joints with the first series of laminæ, and so on. This, however, is not recommended, but is mentioned only to call attention to a possible and immaterial variation in arrangement.

Fig. 8 shows an additional modification wherein each lamina is made of two unlike punchings lettered C^2 C^3, applied at opposite sides of the coils and having limbs of unequal length as compared with one another, the three limbs of each punching, however, being of like length. As shown, the punching C^2 has three limbs which project beyond the middle of the coils for a certain suitable distance, while the punching C^3 has three limbs which project to an equal distance less than the middle of the coils, so that by bringing together these two punchings edge to edge, and then superposing upon them another pair of like punchings relatively reversed, as shown in dotted lines, the respective joints are broken or alternated. This construction is less desirable than those previously described, because of the requirement of two different punchings, it being practically of great advantage to have but one kind of punchings for each size of transformer envelope, thus necessitating only one set of dies for forming the punchings, and enabling the envelope to be assembled more rapidly because the workman has merely to see that the punchings are properly arranged, and has not to select from different kinds of punchings.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. In an iron-clad transformer, the laminated iron envelope 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.

2. An iron-clad transformer, the laminated envelope 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.

3. In an iron-clad transformer, the laminated iron envelope 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.

4. An iron-clad transformer punching having limbs of unequal length with its middle or core limb formed in a reverse curve longer on one side of its middle than on the other.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JAMES J. WOOD.

Witnesses:
OCTAVIA STEWART,
H. J. MILLS.