(No Model.) 3 Sheets—Sheet 1.

J. J. WOOD.

ELECTRIC TRANSFORMER.

No. 524,188. Patented Aug. 7, 1894.

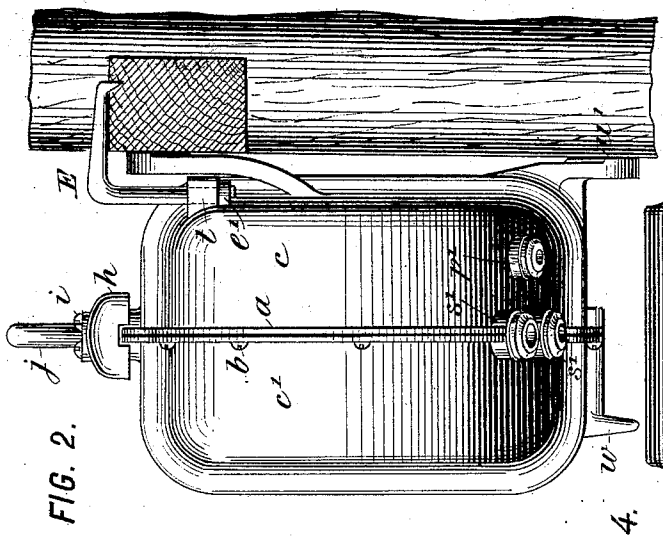


FIG. 2.

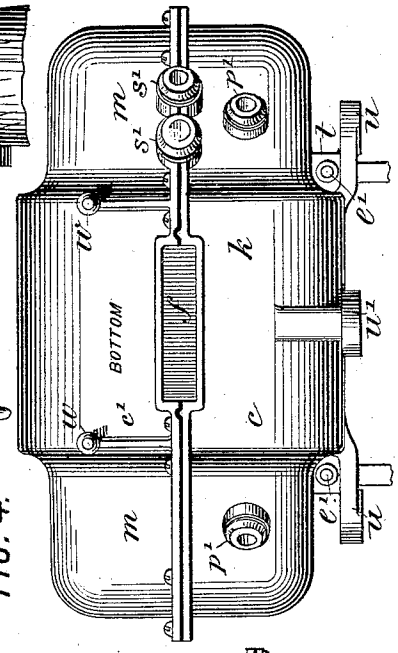


FIG. 4.

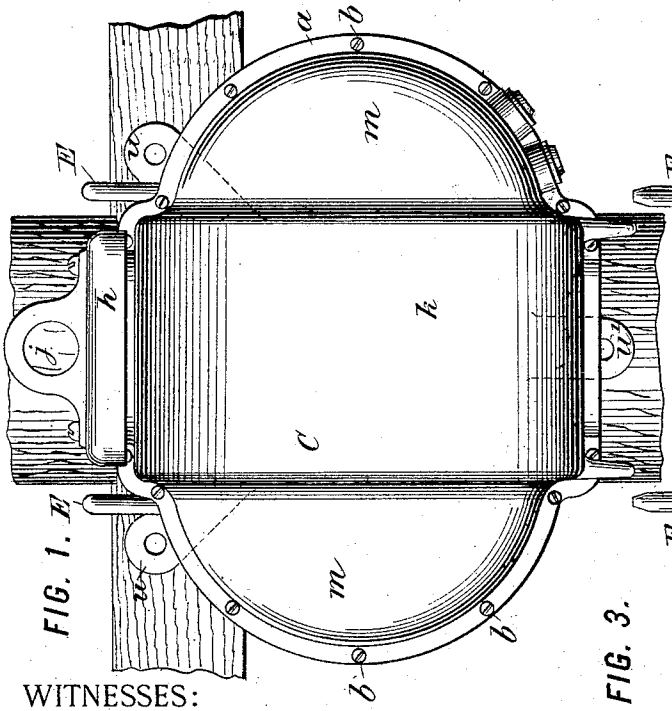


FIG. 1.

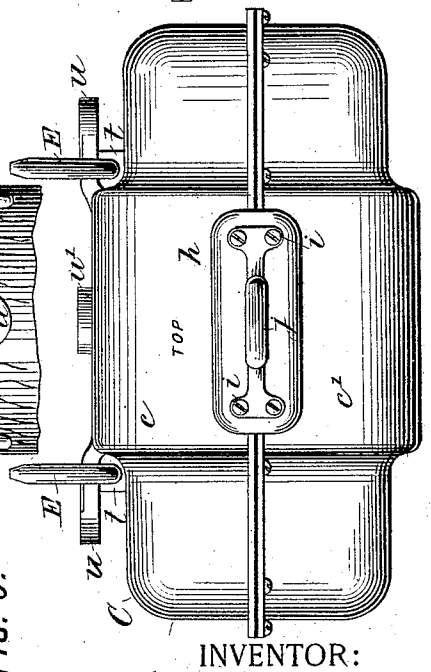


FIG. 3.

WITNESSES:
Fred White
L. K. Fraser

INVENTOR:
James J. Wood,
By his Attorneys,
Arthur G. Fraser

(No Model.) 3 Sheets—Sheet 2.

J. J. WOOD.

ELECTRIC TRANSFORMER.

No. 524,188. Patented Aug. 7, 1894.

FIG. 6.

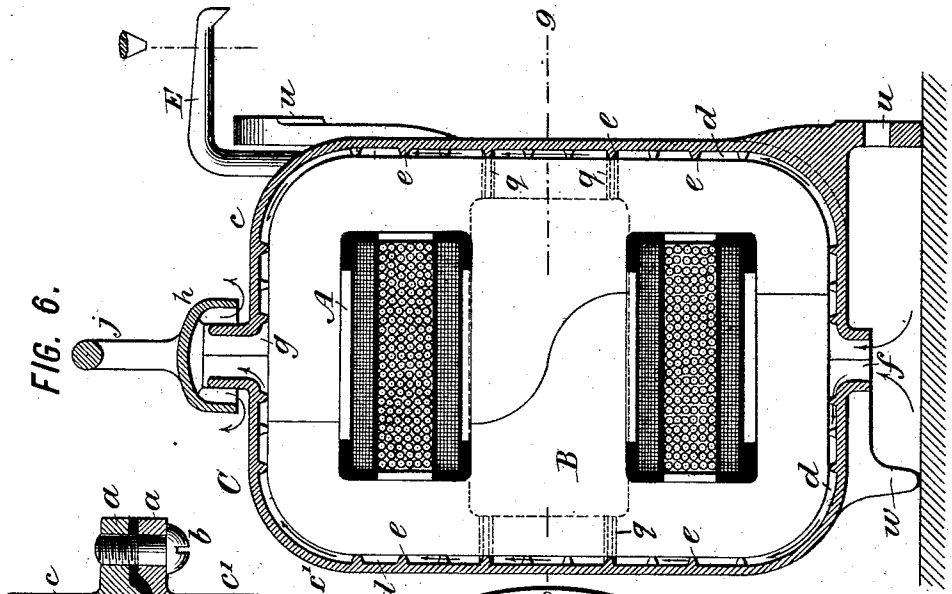


FIG. 7.

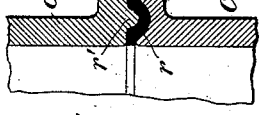


FIG. 5.

WITNESSES:
Fred Whitz
C. K. Fraser.

INVENTOR:
James J. Wood,
By his Attorneys,
Arthur C. Fraser & Co.

(No Model.)

3 Sheets—Sheet 3.

J. J. WOOD.

ELECTRIC TRANSFORMER.

No. 524,188. Patented Aug. 7, 1894.

FIG. 8.

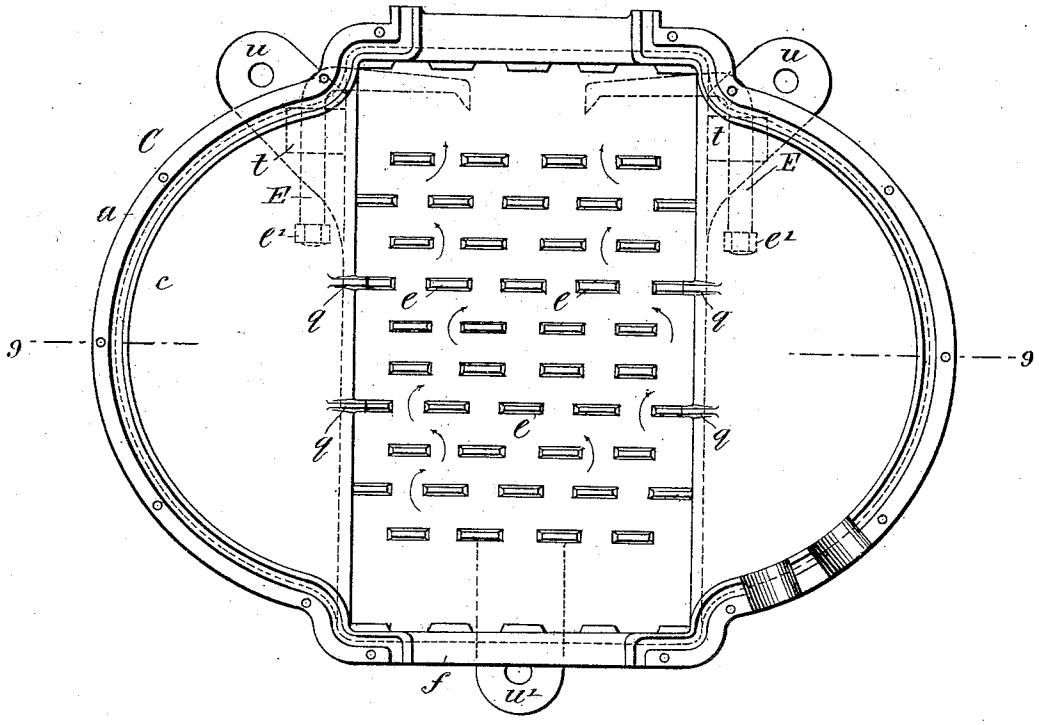
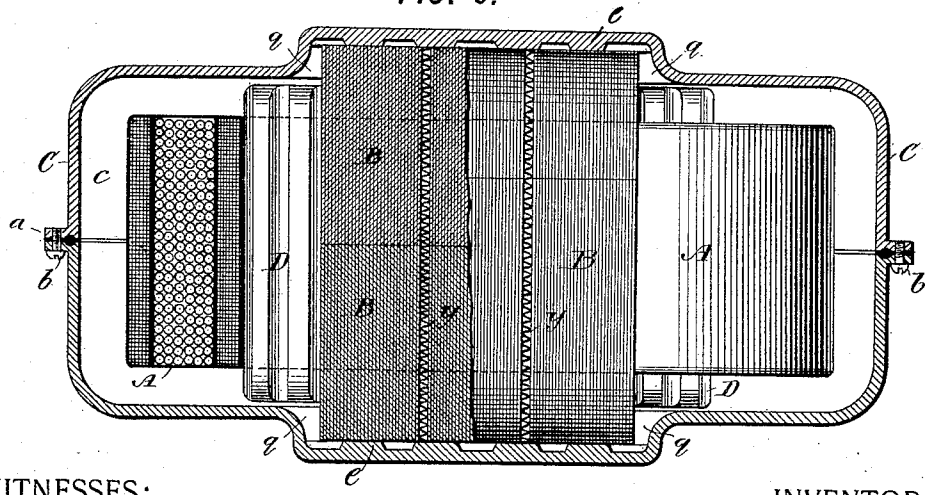


FIG. 9.



WITNESSES:

Fred Whitz

C. K. Fraser.

INVENTOR:

James J. Wood,

By his Attorneys,

Arthur C. Fraser & Co

UNITED STATES PATENT OFFICE.

JAMES J. WOOD, OF FORT WAYNE, INDIANA.

ELECTRIC TRANSFORMER.

SPECIFICATION forming part of Letters Patent No. 524,188, dated August 7, 1894.

Application filed March 19, 1894. Serial No. 504,184. (No model.)

To all whom it may concern:

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

This invention relates principally to the construction of the inclosing case for transformers, its objects being to render the incased transformer more compact, to provide improved ventilation for facilitating the cooling of the transformer, and to provide improved and more convenient means for facilitating the hanging or attachment of the transformer to buildings, or to cross arms on poles.

The preferred embodiment of my invention is that shown in the accompanying drawings, wherein—

Figure 1 is a front elevation of the transformer case showing it as hung upon a cross-arm of a pole. Fig. 2 is a side or end elevation thereof. Fig. 3 is a plan or top view of the transformer. Fig. 4 is a bottom view thereof. Fig. 5 is a vertical mid-section viewed from the front, the front half or shell of the case being removed. Fig. 6 is a vertical transverse mid-section. Fig. 7 is a fragmentery section through the joint on a larger scale. Fig. 8 is an elevation of the interior of the back half or shell of the case, the transformer coils and core being removed. Fig. 9 is a horizontal section on the lines 9—9 in Figs. 5 and 6.

Referring to the drawings, let A indicate as a whole the coils of the transformer, including the primary and secondary wires, these being wound together according to any suitable or customary arrangement; let B designate as a whole the laminated iron core of the transformer; and let C designate the inclosing case as a whole.

My present invention has no reference to the mode of winding of the coils A, or to the construction of the laminated core B, except as to the latter in respect of one feature of improvement for aiding in the ventilation and cooling of the core in large transformers, and which will be hereinafter set forth.

In the ordinary construction of transformers, the coils are first wound, and the successive laminæ of the core are then applied to the coils, as for example by forming the laminæ in sections or punchings which fit together from opposite sides of the coils. The laminated core being thus built up, curved blocks or filling pieces D D (Figs. 5 and 9) are driven into the coil on opposite sides of the core to hold the laminæ in place. In order to keep the opposite sections or punchings of the iron core together and in proper and close contact with one another, it is customary to press the core together by means of a clamp consisting of plates of metal laid against opposite sides of the core, and drawn toward each other by bolts. The inclosing case is made large enough to provide room for this clamp, the transformer coil, core and clamp being fastened in place within the case. The result of this construction is that the case is necessarily made disproportionately large, being clumsy and unwieldy, and although ventilating openings are made in the bottom and top of the case, yet difficulty is experienced in efficiently cooling the transformer by such ventilation.

According to my invention I dispense with the clamp for holding the opposite sections of the core together, and in lieu thereof I construct the inclosing case C so that it shall fit closely against the opposite sides of the core, and form the case in two parts so that as they are drawn together they shall press the opposite core sections together into close contact. Thus the case is made itself to serve the purpose of a clamp, and the employment of a separate clamp inside the case is avoided. At the same time provision is made for circulation of air between the case and the core, conducting away the heat that is generated, and the case is also brought at intervals into metallic contact with the core, and being made of metal, which is a good conductor of heat, it serves itself to draw off the heat from the core and radiate it from the outer surface of the case. To these ends the case C is made of two halves or shells, the one constituting the back half lettered *c*, and the other the front half lettered *c'*, and united by abutting flanges *a a*, through which screws *b b* are passed at intervals to draw them together.

The case is made to fit closely around the core B, being only slightly larger than the

core so as to leave an intervening air space *d* for circulation of air between the shells of the case and the core. The interiors of the two shells are formed at intervals with projecting lugs *e e* which come against the exterior of the core and bear upon it to maintain the separation by which the air space *d* is constituted. These lugs *e e* are formed as elongated projections extending transversely to the planes of the laminæ of the core, in order that they shall cross the laminæ, and the successive rows of lugs are arranged to extend at their ends somewhat past one another, in order that in the vertical planes occupied by the laminæ there shall be no spaces in which the lugs will not engage the laminæ, and consequently no opportunity for any of the laminæ to become displaced and drop into spaces between the lugs. The successive lugs are so staggered or alternated in the manner shown in Fig. 8 as to leave opportunity for the circulation of air between them, as shown by the arrows.

The case is formed with a bottom opening *f* (Figs. 4, 5 and 6) through which air can enter, and with a top opening *g* through which the air can escape. This top opening is covered by a cap or hood *h* having overhanging flanges of the construction best shown in Fig. 6, and is fastened down over the two shells of the case by screws *i i*, and formed with an open ring or handle *j* by which to lift the transformer. The air enters at the bottom opening *f* and passes up the front and back sides of the casing through the air spaces *d*, following a tortuous course between the lugs *e e*, and finally passing out through the top opening *g* and emerging underneath the hood *h*. The air is kept in circulation by heating it, and the thin film of air thus circulating serves to conduct off considerable of the heat that is generated in the core. The middle portion of the case inclosing the core is thus constructed as a parallel zone or band, lettered *k* in Figs. 1 and 4, while the rounded end portions which inclose the half-round ends of the coils which protrude beyond the core are reduced to a smaller size than the band *k*, these portions being lettered *m m* in Figs. 1 and 4. These end portions *m m* do not closely embrace the coils, but leave ample space around the coils for the emergence from the coils of the terminal wires, which wires are lettered in Fig. 5 *p p* for the primary, and *s s* for the secondary. These wires pass out through insulating bushings *p'* and *s'* respectively, shown in Figs. 4 and 5.

Each of the halves or shells *c c'* is formed on opposite sides with two (more or less) lugs or stops *q q*, shown best in Figs. 8 and 9, the purpose of which is two-fold, first, to confine between them the outer or end laminæ of the core B at the middle thereof, or midway between the upper and lower sides, and thereby prevent any lateral displacement or separation of the laminæ at their back and front edges and beyond the ends of the fastening blocks D D; and secondly, to serve as stops for preventing any possible displacement of these fastening blocks.

The transformer proper, consisting of the coils A with the core B built up of laminæ applied to them, and the blocks D D holding them in place, is placed within the back half or shell *c*, its core fitting within the enlarged middle portion *k* of the shell and entering closely between the top and bottom lugs or internal projections *e e* thereof. The primary terminal wires *p p* are then passed out through the bushings *p'*. The front shell *c'* is then applied, a layer of cement being placed between the two flanges *a* to make a tight joint. The two shells are then drawn tightly together by means of their fastening screws *b b*, during which operation any excess of cement is forced out from the space between the two flanges, and the shells are thus drawn together until their front and back lugs *e e* by bearing against the laminæ of the core B, have forced the front and back sections of the core tightly together so as to secure close and intimate contact between them. By this means the case C serves as a clamp for forcing together the opposite sections of the core, while at the same time the important advantage is realized that by the metallic contact of the lugs *e e* with the core, a large proportion of the heat generated within the core is conducted away from the core into the metal of the case, and is rapidly radiated from the extended exposed outer surface thereof to the surrounding air. The hood *h* is lastly fastened in place over the two shells of the case. For facilitating the making of a tight joint between the flanges *a a*, one of them is formed with a groove *r* and the other with a rib *r'* fitting partly into the groove but leaving a wide space between to be filled with the cement, in the manner shown clearly in Fig. 7.

It is usual in mounting transformers to either attach them to the wall of a building or to hang them on a cross-arm of a pole, or to stand them on a level supporting surface. For facilitating the attachment of my improved transformer case to a pole, I provide it at the back with two suspending hooks E E, the construction of which is clearly shown in Figs. 2 and 3. These hooks consist of rods bent into L-shape and having their ends turned down and pointed forming sharp spurs, while a headed nut or enlargement *e'* is riveted or otherwise fixed on their lower ends. The rods pass freely through openings in lugs *t t* formed on the rear face of the case. When in use the hooks are elevated as shown in Figs. 1 and 2, so that by projecting rearwardly beyond the case they may overhang the cross-arm of an electric light pole and serve for temporarily supporting the transformer thereon in the manner indicated in Figs. 1 and 2. When not in use the hooks can be turned sidewise to the position shown in dotted lines in Fig. 8. The hooks are thus a permanent part of the transformer case, so

that they cannot be lost, as is apt to occur with separate hooks that are temporarily attached to the case when it is desired to hook the transformer on a cross-arm, while at the same time they are so arranged as to be equally out of the way when not wanted by being turned aside against the back of the case, as shown in Fig. 8. The hooks have also the advantage that they can be turned at an angle to the rear of the plane of the case if desired, in order to catch on thin strips of wood fastened to the side of a building, so that the transformer may be hung from such strips while being permanently fastened.

To enable the transformer to be fastened against a wall, or to an electric light pole, its rear shell *c* is formed with three projecting legs having eyes or holes through which bolts or spikes may be passed, of which legs two lettered *u u* are at the top and arranged to project to opposite sides as shown in Fig. 1, while the third lettered *u'* is at the bottom and in the middle. This arrangement is important, since it has the advantages, first, of presenting three substantially equidistant points of attachment in order that in fastening the transformer to any irregular surface no difficulty need be experienced. By the projection of the upper legs *u u* they are brought to such position that bolts or spikes may be put through their holes to fasten them to the cross-arm of a pole, while the lower leg being central, admits of receiving a bolt or spike for fastening it to the middle of the pole itself, instead of requiring a separate cross-piece to be fastened to the pole, as would be necessary were two fastening legs provided at the bottom. The position of these fastenings is clearly shown in Fig. 1, where the transformer is shown hanging to the cross-arm by the hooks E E, and ready to be permanently fastened thereto by means of bolts entering through the legs *u u u'*. The outward projection of the legs *u u* also serves the purpose of holding the hooks E E in place and preventing them from accidentally swinging around outwardly, since in order to so swing them it is necessary to lift them to their highest position in order that they may be swung over the tops of the legs *u u*. Heretofore the suspending hooks have been fastened to the upper bolting legs in such way as to preclude the bolting or spiking of the transformer through its legs when it is hung from the hooks, the advantage of my improved construction being apparent in that it permits of the transformer being either hung from the hooks, or fastened by bolting through the legs, or by both means together.

To provide for supporting the transformer when it is set on a level surface, its case is formed with three feet projecting downwardly from the bottom. Of these the leg *u'* already referred to constitutes one, which is arranged in the middle and as far back as possible, while in addition the front shell *c'* is formed with two projecting feet *w w* which project downwardly to the same extent as the leg *u'*, so that the three feet thus provided serve for giving a steady support to the transformer, notwithstanding any irregularities in the surface on which it is placed. An important advantage of these feet is that they elevate the transformer case sufficiently to permit air to enter the bottom opening *f* when the transformer is placed on a level surface, thus preventing the admission of air from being cut off when the transformer is set down.

In the construction of large transformers where considerable heat is generated, I provide an additional means for ventilating the core consisting in the formation of one or more air spaces through the body of the core itself, in the manner best shown in Figs. 5 and 9, where the air spaces are lettered *y y*. These air spaces are formed by omitting a few laminæ of the core, and putting in their place a corrugated sheet, either of iron or other suitable material, by which the laminæ on opposite sides of this sheet are kept spaced apart in the manner shown in Fig. 9. The corrugations are arranged to extend vertically, so that within them are formed small air flues through which an upward circulation of the heated air takes place. I have shown two such air spaces *y* traversing the core, but one, three or more spaces may be employed, depending upon the amount of heat generated which it is desired to conduct away in this manner. For small transformers the arrangement of these air spaces is not necessary.

For so called central station transformers the suspending hooks E and fastening legs *u u* are omitted, and the case is formed with suitable feet or legs at its bottom for supporting it upon the level floor of the building.

My invention is not necessarily limited to the precise form and construction shown in the drawings, as these may be varied considerably in practice. For example, the external shape of the case shown although that which most compactly incloses the transformer, is not essential, and may be considerably departed from. Those features which are believed to be essential to my invention are hereinafter defined in the claims.

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

1. A transformer having its iron core formed of sections put together from opposite sides of the coils, combined with an inclosing case made in two parts or shells, with means for drawing them together against the opposite sections of the core, whereby the case serves as a clamp for holding the core sections pressed together.

2. The combination with a transformer of a case made in two parts or shells, with means for drawing them together against the opposite sides of the core, and formed with a thin air space between the shells and the core, and with bottom and top air openings for causing

a circulation of air through the case against the external surfaces of the core.

3. The combination with a transformer of an inclosing case formed with internal lugs or projections in direct contact with the surface of the core, and adapted to conduct heat therefrom to the exterior of the case from which it is radiated, whereby to assist in the cooling of the core.

4. A transformer case formed with air inlet and outlet openings, and with internal lugs or projections adapted to touch the core of the inclosed transformer, and arranged to leave tortuous air passages between them for permitting a circulation of air within the case over the surfaces of the core.

5. The combination with a transformer having a laminated core, of an inclosing case formed internally with elongated lugs adapted to bear against said core and arranged to extend transversely to the planes of said laminæ, and to overlap each other so as to leave tortuous air passages between, while supporting all the laminæ constituting the core.

6. The combination with a transformer, of an inclosing case having air inlet and outlet openings and formed internally with projecting lugs *e e* bearing against the sides of the core, to hold it centrally within the case and with stop projections *q q* engaging the opposite ends of the core for preventing endwise displacement thereof.

7. The combination with a transformer comprising coils A, laminated core B and fastening blocks D D, of an inclosing case formed internally with projecting lugs *e e* bearing against said core, and with stop projections *q q* engaging the opposite ends of the core and arranged to confine the ends of said blocks D D between them.

8. The combination with a transformer of an inclosing case made in two parts or shells formed with reciprocal flanges *a a* and screws for drawing said flanges together, and with a yielding packing interposed between said flanges adapted to admit of drawing the shells together to tightly clamp the transformer core between them.

9. The combination to form a transformer case of two shells *c c'* formed with an air inlet opening *f* at the bottom and an air outlet opening *g* at the top, and a hood *h* fastened over said top opening covering the joint between the shells and having downward flanges adapted to leave a tortuous passage for the escape of air while excluding rain.

10. A transformer case formed on its back with three projecting fastening legs of which two lettered *u u* project on opposite sides at the top, and a third *u'* projects downwardly from the bottom at the middle whereby it is adapted to be fastened to a pole and cross-arm, by bolting the legs *u u* to the arm and the leg *u'* to the pole.

11. A transformer case formed on its back with projecting fastening legs *u u* and *u'*, and having adjustable supporting hooks E E permanently connected to it, whereby the case can be hung in position by the hooks, or permanently fastened by the legs.

12. The combination with a transformer case having projecting fastening legs *u u u'* and perforated lugs *t t* on its back, of L-shaped suspending hooks E E passed freely through said lugs, and provided with heads beneath the lugs whereby said hooks may be turned to either side in said lugs.

13. A transformer case having a ventilating opening at the bottom, and formed on its back with fastening legs *u u* and *u'* for fastening it to an upright support, and with downwardly projecting feet *w w* co-operating with the legs *u'* for supporting it on a level surface and preventing obstruction of said ventilating opening.

14. A transformer having a laminated iron core formed with a ventilating space through it, maintained by means of a corrugated sheet interposed between the laminæ to hold them apart and forming air spaces in its corrugations.

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

JAMES J. WOOD.

Witnesses:
JOHN W. HALL,
WILLARD C. KNIGHT.