(No Model.)

4 Sheets—Sheet 1.

W. F. BRITTIN.

ELECTRIC TRANSFORMER.

No. 545,670. Patented Sept. 3, 1895.

Fig. 1.

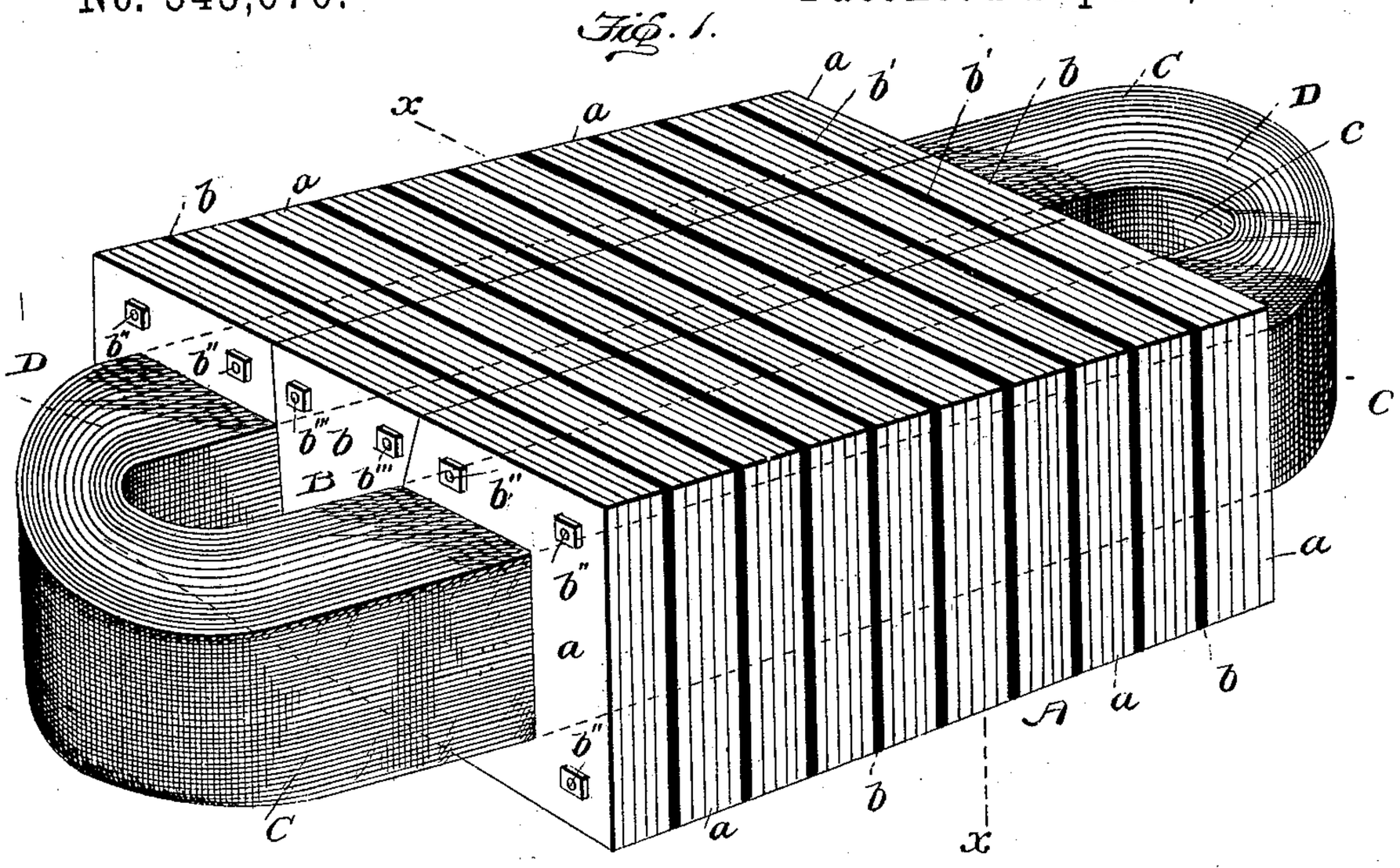
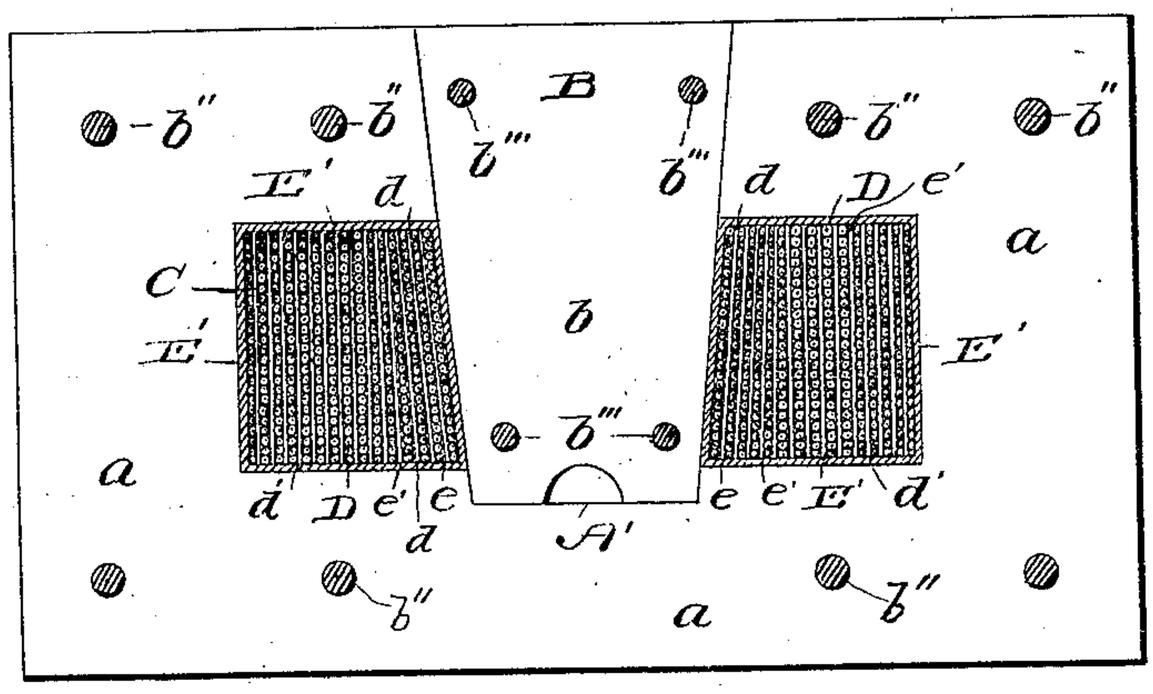


Fig. 2.



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(No Model.)

4 Sheets—Sheet 2.

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ELECTRIC TRANSFORMER.

No. 545,670. Patented Sept. 3, 1895.

Fig. 3.

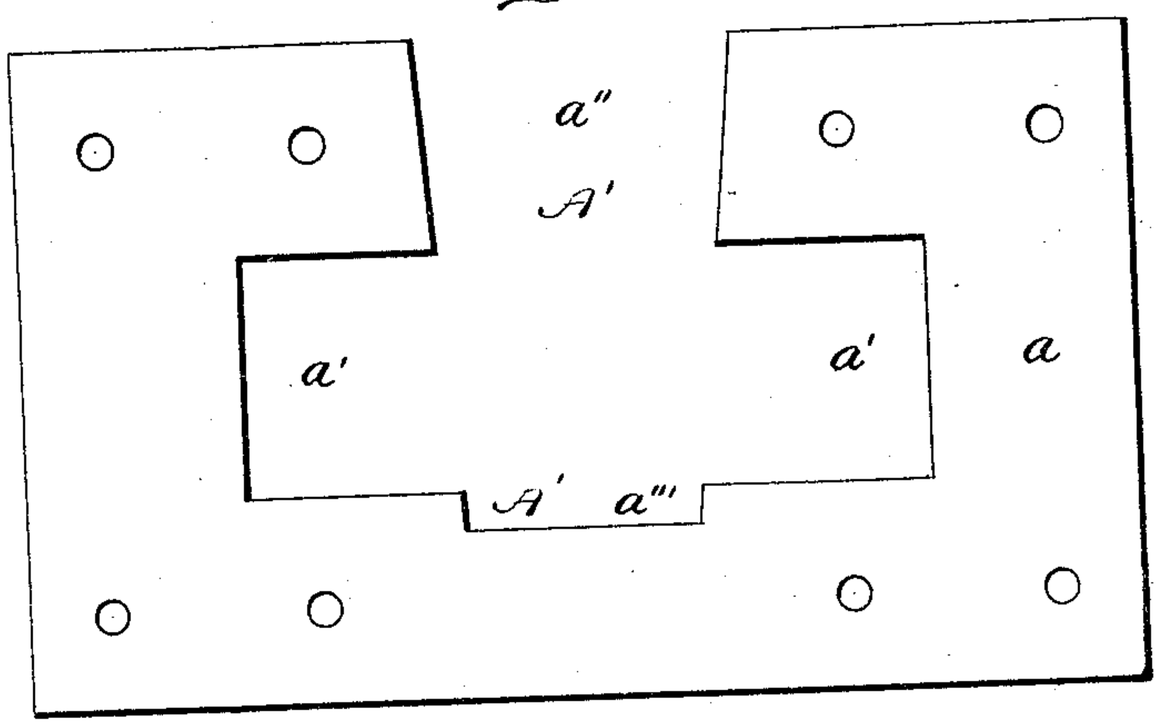


Fig. 4.

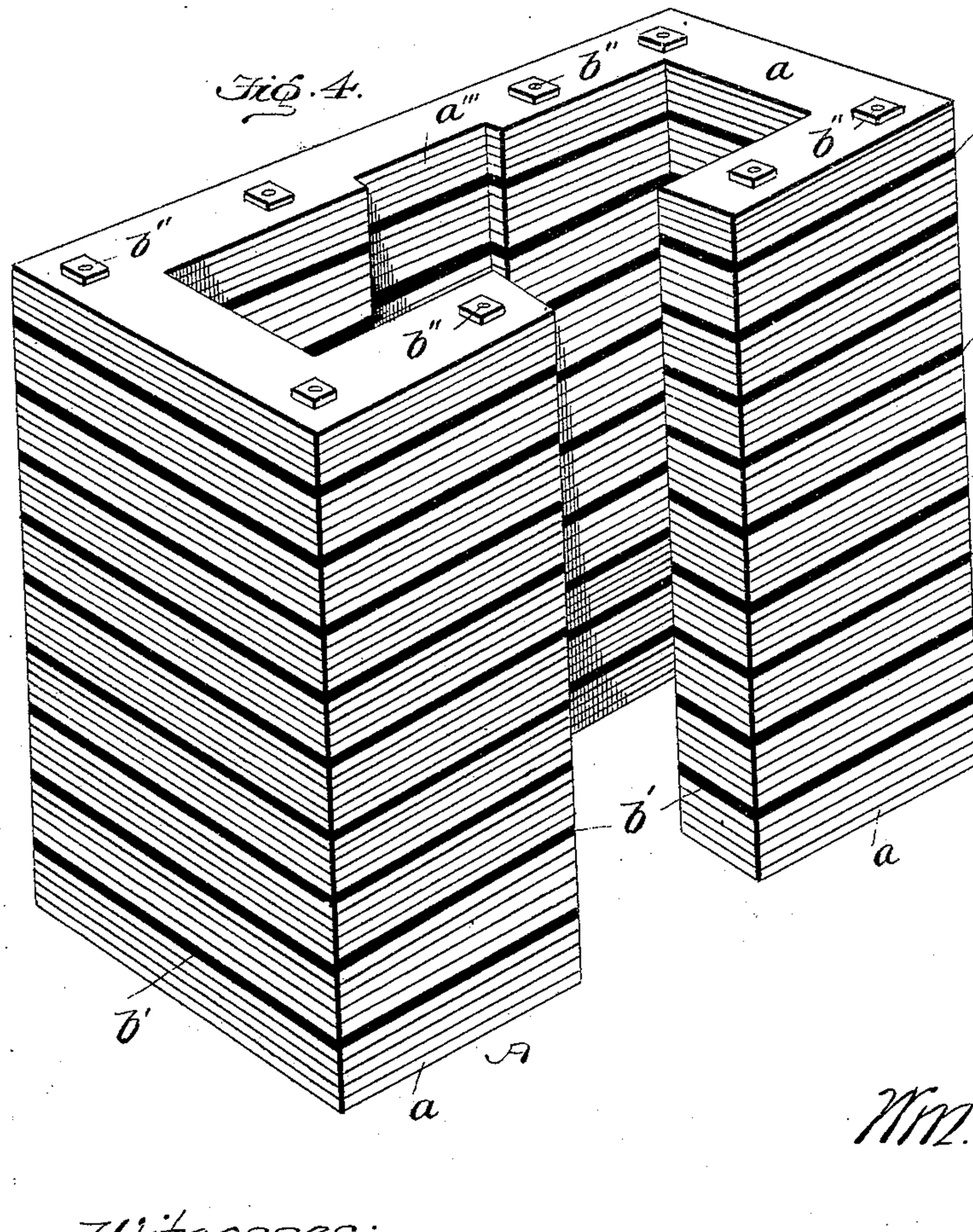
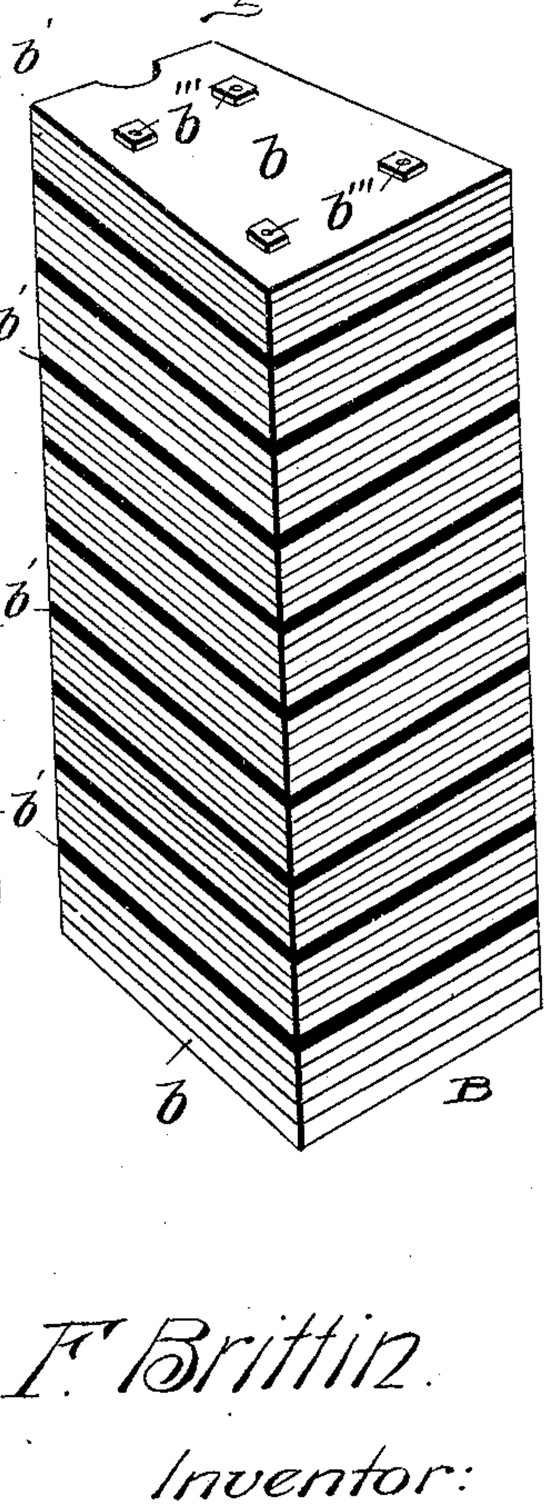


Fig. 5.



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(No Model.) 4 Sheets—Sheet 3.

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ELECTRIC TRANSFORMER.

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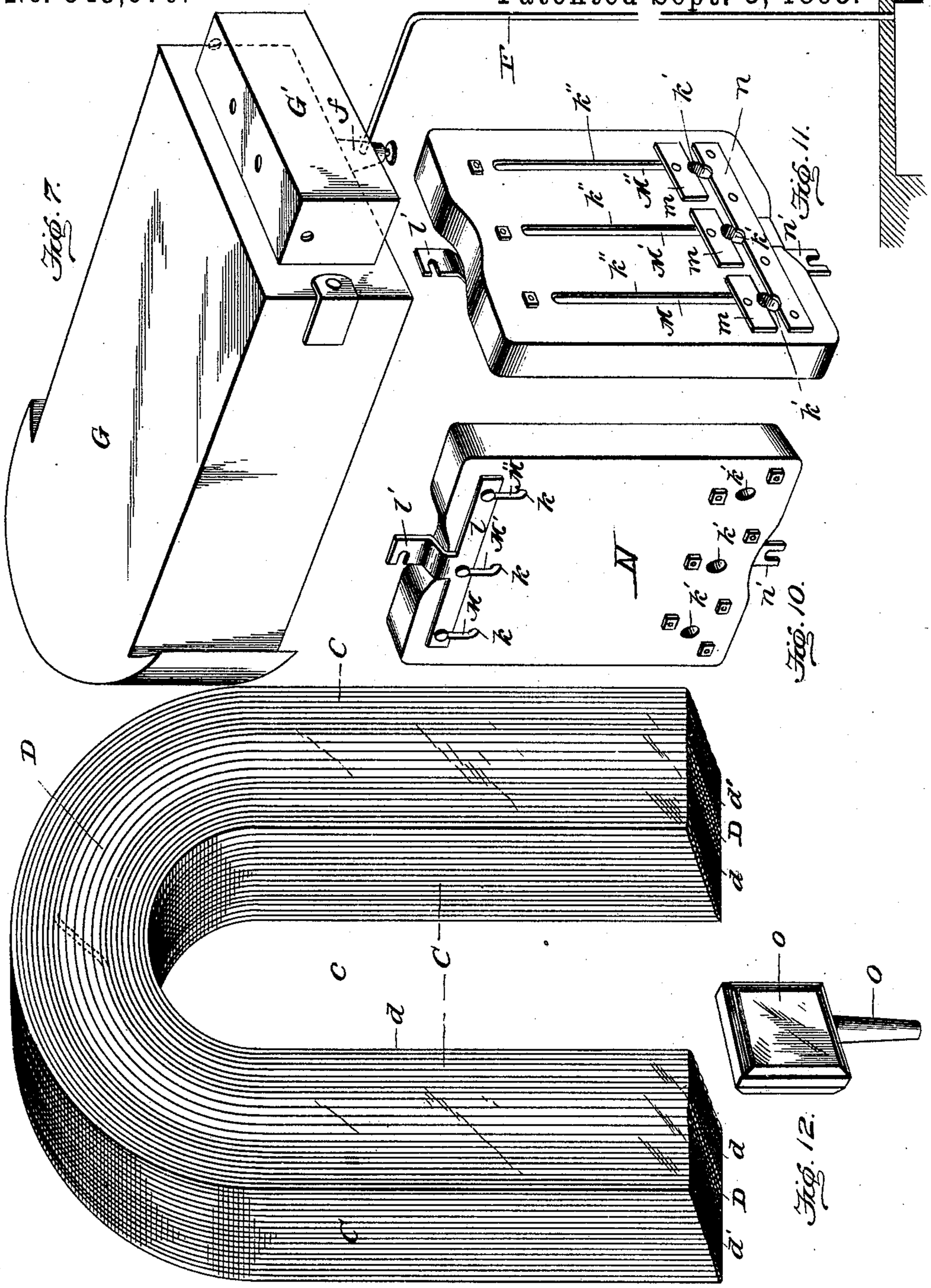
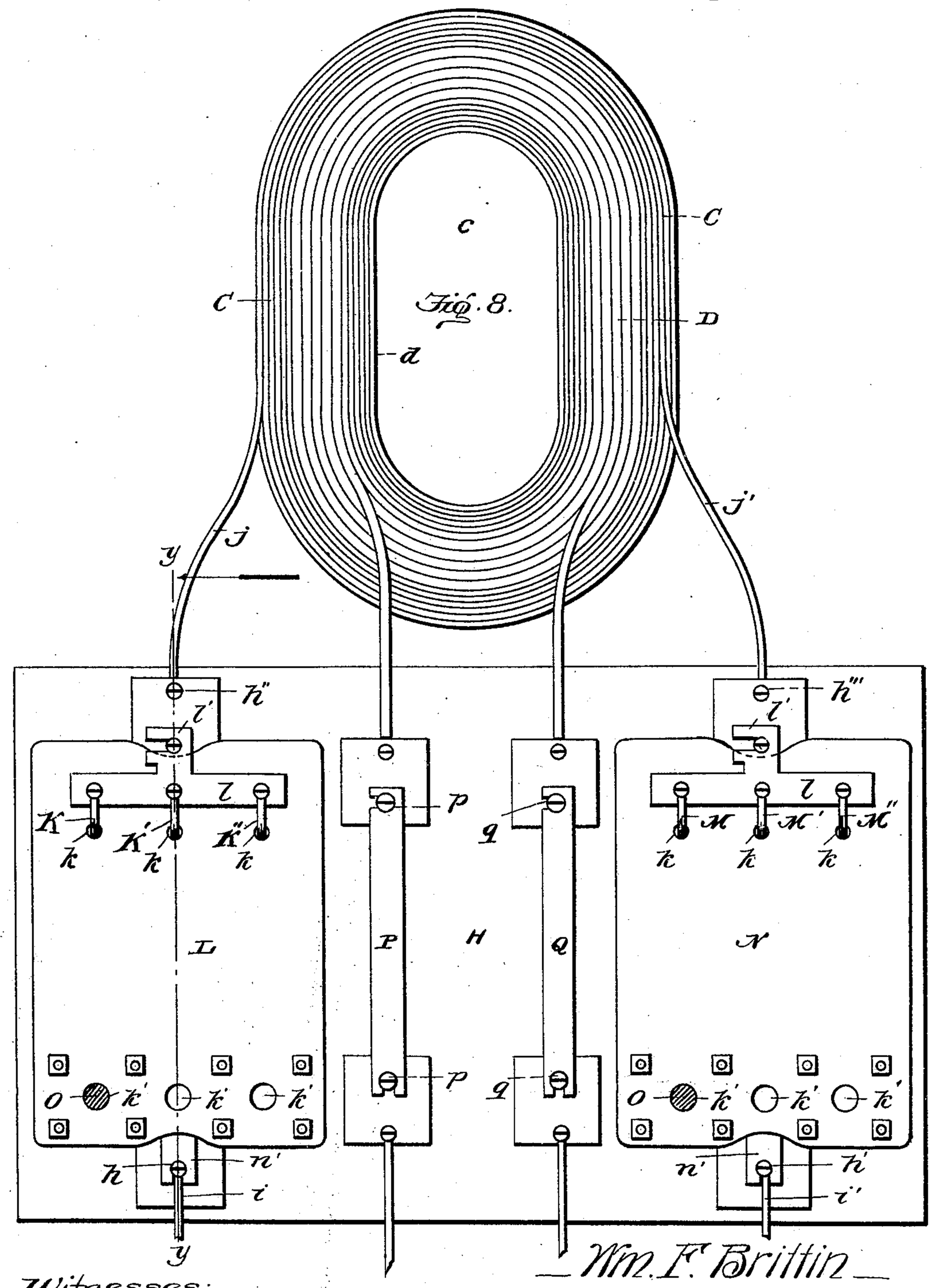


(No Model.) 4 Sheets—Sheet 4.

W. F. BRITTIN.

ELECTRIC TRANSFORMER.

No. 545,670. Patented Sept. 3, 1895.



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UNITED STATES PATENT OFFICE.

WILLIAM F. BRITTIN, OF ALLEGAN, ASSIGNOR OF ONE-HALF TO EDWIN N. HOWE, OF COLDWATER, MICHIGAN.

ELECTRIC TRANSFORMER.

SPECIFICATION forming part of Letters Patent No. 545,670, dated September 3, 1895.

Application filed November 16, 1894. Serial No. 529,030. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM F. BRITTIN, a citizen of the United States, residing at Allegan, in the county of Allegan and State of Michigan, have invented certain new and useful Improvements in Electric Transformers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in electric transformers of that class which employ stationary coils in connection with a stationary laminated iron core; and the objects of the invention are, first, to provide for the ready and expeditious removal of a defective or burned-out coil without necessitating the separation of the laminations of iron forming the core; secondly, to so construct the core that it will, to a great extent, overcome the heating caused by the magnetic disturbance of the molecules of iron; thirdly, to secure greater efficiency and closer regulation of the transformer by a peculiar disposition of the windings for the secondary between portions of the primary; fourth, to provide a novel form of fuse device especially adapted to the transformer, by which the operation of plugging a new fuse to complete the circuit can be safely and quickly accomplished without danger to the operator and without permitting the melted fuse-wire to drop on the operator's hand and burning it while in the act of plugging the new fuse-wire in the circuit, which operation can be accomplished at any time by an unskilled person without taking out the fuse-block or the employment of any tool whatever; and to so construct the fuse mechanism and the primary line-terminals that there is no possibility of an arc or short-circuit being formed between the primary line-terminals and the primary coil-terminals when the fuse-wire is melted or "blown," thereby obviating a short circuit on the dynamo and rendering it impossible for a short circuit to be formed between opposite terminals of the main line.

With these ends in view, and such others as pertain to my invention, it consists in the construction of the core forming a part of the transformer, in the construction and arrangement of parts forming the fuse devices, and in the novel combination and organization of parts, which will be hereinafter fully described and claimed.

To enable others to understand my invention, I have illustrated the preferred embodiment thereof in the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a perspective view of the core and coils forming the transformer. Fig. 2 is a cross-sectional view on the plan indicated by the dotted line *x x* of Fig. 1. Fig. 3 is a detail view of one of the plates of which the core is made. Figs. 4 and 5 are detail views of the primary core-section and the removable wedge-shaped section of the core, respectively. Fig. 6 is a detail view of the coils, showing the primary and secondary in transverse section. Fig. 7 is a perspective view of the connected casings in which the transformer and fuse devices are housed. Fig. 8 is a detail view of the fuse devices detached from the casing. Fig. 9 is a cross-sectional view on the plane indicated by the dotted line *y y* of Fig. 7. Figs. 10 and 11 are detail perspective views of the fuse-block detached from the base and showing the front and rear sides thereof, respectively; and Fig. 12 is a detail view of the removable plug by which either of the fusible conductors can be brought into the primary line-circuit.

Like letters of reference denote corresponding parts in all the figures of the drawings.

I will first proceed to a detailed description of the construction of the transformer and the method of making the same, reference being had more particularly to Figs. 1 to 6, inclusive.

The core is shown at A, provided with a removable wedge-shaped section B, the winding of wires forming the primary coil at C and the other wire-winding forming the secondary at D.

The core consists, properly speaking, of two parts A B, the latter of which is made wedge-shaped, as shown by Fig. 4, and removably fitted in the main part A, so as to form a part of the magnetic circuit and to permit said part B to be readily detached or removed, by the aid of a suitable tool, in order that the

coil C D may be removed with ease when it is burned out or becomes defective from any cause, such removal of the section B and the transformer-coils C D being effected without disturbing or loosening the laminations or plates forming the members A B of the metallic core. The principal member A of the core is built up of a series of plates *a* of the form shown by Figs. 2 and 3—that is to say, each plate *a* has an oblong hole or slot *a'* cut through the middle thereof, and another hole or slot *a''* of tapering form cut through one side thereof, the last-named or tapering slot *a''* extending from the central oblong slot *a'* to and through one edge of the plate *a*, a recess *a'''* being produced in the inner edge of the plate opposite to and in line with the transverse tapering slot *a''*. These plates *a* are preferably made from a sheet of soft charcoal-iron, and they are cut or stamped out of the sheet metal, in the form shown and described, by suitable dies. The plates *a a* are laid or superimposed one upon the other, and they are assembled together so that the slots *a' a''* and the recesses *a'''* coincide to produce through the core the longitudinal passage that receives the coils of the transformer and the longitudinal tapering seat A' that receives the removable wedge-shaped member B of the core, the member B fitting tightly in said seat A' to have its laminations or plates in good metallic or electrical contact with the plates or laminations *a* of the member A to form a part of the metallic circuit through the core A B, and said member B passing between or within the coils C D, so that the inner smaller end thereof will fit or be received in the recesses *a'''* of the member A, as clearly shown by Fig. 2. The member B of the core is built up of a series of continuous plates or laminations *b*, each of which is stamped or cut out in a single piece from a sheet of soft charcoal-iron, and each plate *b* is made somewhat tapering—that is, wider at one end than at the other—so that when the plates *b* are properly assembled the member B presents the elongated body, wedge-shaped in cross-section, whereby the member B is made to conform to the shape and dimensions of the tapered seat A' provided in the principal member A to receive the detachable member B. The laminations of the core members A B are arranged in groups and insulated from one another by heat-resisting layers *b'*—as, for instance, by sheets of asbestos. Each group of plates *a* or *b* may consist of three, four, five, or more plates, and the heat-resisting insulating-layer of asbestos *b'* is placed between two adjacent groups of plates, so that the edges of the asbestos layers are flush with the edges of the plates or laminations, and the plates or laminations and the asbestos insulating-layers forming each member of the core are rigidly bound or held together by means of longitudinal bolts *b''* *b'''*, the bolts *b''* for the member A passing through the laminations *a* and the series of insulating-layers *b'*, and the bolts *b'''* for the member B passing through the mass of iron plates *b* and the insulating-layers *b'*, as clearly shown. By arranging the mass of plates *a b* in groups and insulating the adjacent groups from each other by heat-resisting insulations, the heating of the core, caused by the magnetic disturbance of the molecules of iron, will be overcome to a great extent.

The coils C D of the transformer are made of wires appropriate for that purpose, and they are wound in the manner shown by Figs. 2 and 6 of the drawings to produce the opening or space *c*, through which the removable member B of the core is passed. I have arranged the winding forming the secondary coil D within and between layers of wire forming the primary coil C to secure greater efficiency and closer regulation in the operation of the transformer, and the wires forming the primary and secondary C D are coated with a peculiar composition and insulated by mica insulations, and combined with a grounded conductor, in order to make it virtually impossible for lightning shocks or short circuits to burn or rupture the coil.

In preparing the coil I first make a series of primary windings (indicated at *d*) in the form of continuous loops and with the opening or space *c*. As each layer of wire is wound to form either the primary or secondary coil, I apply thereto by a brush a composition consisting of extract of logwood and gum shellac, the same being put on in a warm or heated condition, and between each layer of windings I insulate with layers or sheets of mica, as at E'. I then coil the secondary windings D around the latter C of primary windings, and between the secondary winding D and the first layer *d* of primary windings is interposed a sheet or layer of heat-resisting insulating material *e*, preferably of mica, the solution of logwood and gum shellac being applied to each winding of the secondary coil and the insulating-sheets E' of mica being interposed between each layer of wire forming the secondary coil. A layer *e'* of heat-resisting insulating material—as, for instance, sheet-mica—is now wrapped or laid around the secondary winding D, and after this is done the final layer or winding *d'* of the primary coil is placed around the secondary coil D, with intermediate sheets of mica E' between each layer of wire, and the liquid composition of logwood and gum shellac applied to each coil of the final primary winding *d'*. The coil is now immersed in a bath composed of gum shellac and extract of logwood, so as to thoroughly coat the coil windings, and the entire coil of primary and secondary windings is placed in an oven and baked until the liquid solution has become thoroughly dry. The composition is applied to the layers of wire forming the windings for the primary and secondary, in order to insulate the layers of wire one from the others, and to effect this insulation more thoroughly the sheets of

mica are interposed between the layers of wire of both primary and secondary coils.

My object in employing the insulating composition of logwood and shellac, instead of using shellac alone, is to overcome verdigris on the coils of wire. When shellac is used alone as an insulator on wire coils, the shellac in time produces a sort of verdigris on the wire, which in time destroys the cotton braid forming the usual insulator, and the verdigris produced by the change in the shellac coating forms a partial conductor for the current, thus damaging or burning out the coil. The logwood extract being a good insulator, by using it in connection with shellac and applying it as described I overcome the formation of verdigris. The shellac is used to set and harden the logwood, and as both the shellac and logwood are good insulators the coils are protected by a better and safer insulator, which is more resistible to heat than shellac alone.

In assembling the transformer the primary and secondary coils are placed longitudinally within the passage formed by the slots *a'*, formed by the assembled plates *a*, and so that the opening or space *c* of the coil is in line with the tapering seat A' of the principal member A of the core. The removable wedge-shaped member B of the core is now fitted in the tapered seat A' of the member A, and it is forced or pressed therein until its inner smaller end passes through the space *c* of the coil and enters the recess *a'''* of the core member A, the laminations *b* of the member B being forced into close contact with the plate or laminations *a* of the principal member A, so as to form a part of the closed metallic circuit. The primary and secondary of the transformer when placed within the core are insulated by sheet-mica E from the two members of the core.

By preparing the coil in the manner herein described and interposing the mica insulations between the primary and secondary windings, and between the coil D and the core, and by using a brass binding-post *f* in the transformer box or casing, with a conductor F leading from said binding-post to the ground and well grounded therein, the coils are not exposed to injury or rupture by a shock of lightning or by the current from the primary line conductors being short-circuited.

I will now proceed to a detailed description of the construction of the fuse devices and the casings in which the transformer and the fuse devices are housed. The transformer is housed within a metallic casing G, in which it is suitably fixed by devices which insulate the transformer from the casing, and to the bottom of the casing G is attached the smaller casing G', which contains the fusible connections and the binding-posts by which the primary and secondary circuit conductors or wires are led to the primary of the transformer and from the secondary thereof, said casing G' having the brass binding-post *f* attached to the outside of the casing. Within the casing G' is fixed the base H, on which are fixed the fuse-blocks and the several binding-posts for the primary and secondary circuit terminals and for the terminals of the primary and secondary coils of the transformer. This base H is made of a suitable insulating material—as, for instance, hard fiber or porcelain—and passing through the board H, near the four corners thereof, are the binding-posts *h h' h'' h'''*. These binding-posts are thus separated some distance from each other, and to the posts *h h'*, near opposite corners of the base, are connected the respective terminals of the conductors *i i'*, forming the primary line or circuit, while to the opposite posts *h'' h'''* are connected the terminals *j j'* of the primary coil of the transformer. The binding-posts *h h''* are connected in series by means of any one of a series of fusible conductors K K' K'' on a removable fuse-block L of porcelain or other insulating material, so that the current from the inleading primary line conductor *i* can pass through either of said fusible conductors to the conductor *j* of the primary coil of the transformer. The other set of binding-posts *h' h'''* are likewise connected by any one of a series of fusible conductors M M' M'' on an insulating fuse-block N, made of porcelain or other insulating material, and the current passing through the transformer-primary is led back to the main line through the conductor *j'*, one of the fusible conductors, and the binding-post *h''*, to which the primary line-terminal *i'* is electrically connected.

The insulated fuse-blocks L M and their fusible conductors for the two sets of binding-posts are precisely the same in construction and mode of operation, so that a description of one will apply equally as well to the other; and although I have shown each fuse-block as provided with three fusible conductors, yet I would have it distinctly understood that I do not restrict myself to the employment of any particular number of these fusible wires, because the number may be increased or diminished at the option of the manufacturer. Each fuse-block is made of a single piece of insulating material, with a series of transverse conductor-apertures *k* near one end, a series of plug-receiving apertures *k'* near the other end, and a series of longitudinal grooves *k''*, which are formed in the rear face of the block, to extend from one series to the other of the transverse apertures *k k'*. The fusible conductors are laid or fitted in these longitudinal channels or grooves and led through the apertures *k* at one end of the fuse-block; and said fusible conductors are attached at one end to the common plate *l*, fastened to the blocks by means of brass screws, and having a projecting tongue *l'*, which is fitted in electrical engagement with the primary line-terminal binding-post *h* or *h''*, while the other ends of said fusible con-

ductors are electrically connected to a series of independent contact-plates *m*. These independent contact-plates are spaced at suitable intervals from one another on one side of the series of plug-receiving apertures *k'* in the fuse-block to which the plates *m* are affixed by brass screws or other suitable fastenings, and opposite to these series of independent plates *m* is a continuous contact-plate *n*, which is fastened to the fuse-block by suitable brass screws or other devices, and which continuous plate *n* has a bent tongue *n'*, that extends along one edge of the fuse-block and connects electrically with one of the primary-coil binding-posts *h'* or *h'''*, as shown. The independent plates *m* and the continuous plate *n* are recessed in their opposing edges and arranged in such proximity to the apertures *k'* that an electrical conducting metallic plug O can be inserted through one of the apertures *k'*, so as to be in electrical contact with the continuous plate *n* and with one of the independent plates *m*, to complete the circuit through one of the fusible conductors and the terminals of the primary-line circuit and the primary of the transformer, said metallic plug O having a head *o* of suitable insulating material, to enable the operator to change the plug into another aperture of the series *k'*, when one of the fusible conductors M or K is blown or melted by short circuit of the current or an excessive charge of electrical energy from any source.

On the middle part of the base H, between the two removable fuse-blocks L N, which are fastened to the base by suitable screws or other devices, are provided the two sets of binding-posts *p p'* and *q q'*, and the posts *p p'*, forming one set, are electrically connected by the metallic bridge-plate P, while the other set of posts *q q'* are electrically connected by another bridge-plate Q. The terminals or conductors of the secondary coil D of the transformer are connected to the posts *p q*, and the terminals of the conductors forming the secondary circuit are electrically connected to the posts *p' q'*, so that the bridge-plates P Q serve to complete the closed secondary circuit between the two sets of binding-posts, to which are attached the respective terminals of the transformer-secondary and the secondary-circuit conductors. Assuming that the removable plug O is inserted in the first of the series of apertures *k'* in each fuse-block and that it is in contact with the first plate *m* and with the plate *n*, the current from the conductor *i* of the primary line-circuit passes through the post *h* of the fuse-block L, the plate *l*, the fusible conductor K, the plate *m*, plug O, and plate *n* to the post *h''*, thence through the conductor J to and through the primary coil C, thence through the conductor *j* to the post *h'''* of fuse-block N, the plate *n*, plug O, the first plate *m* of the series of independent plates, the fusible conductor M, the plate *l*, and post *h'* to the other primary-line conductor *i'*, thus forming the complete circuit. Should either of the fusible wires K or M be blown or burned out by a short circuit of the current or from an excessive charge of electrical energy from any source, it is only necessary for a person to remove the plug from the burned-out conductor and insert in another aperture *k'* to again establish and complete the circuit through another of the series of fusible wires. By having the fuse-wires on the back of the fuse-block, the melted wire cannot drop on and burn the operator's hand should one of the fuse-wires be melted while plugging a new fuse in the circuit. The terminal and binding-posts for the primary line or circuit and for the transformer-primary being arranged on opposite sides of the insulated fuse-block and at opposite ends thereof, there is no possibility of an arc or short-circuit being produced, when the fuse is melted, between the primary-line terminal and the primary-coil terminal, thus obviating a short circuit on the dynamo. The primary-line terminal binding-posts *h h''* are placed near the extreme ends of the base H, in order to make it impossible for a short circuit to be formed between the terminals of the conductors *i i'* of the primary line or main circuit.

One of the chief advantages of my improved fusing device is that any unskilled person can remove the plug from a burned-out fuse and place it in connection with a new fuse without requiring the fuse-block itself to be taken out in order to replace the burned-out fuse and without the use of any tool whatever; and this operation of plugging in a new fuse can be quickly performed with entire safety to the operator, who is not compelled to come within dangerous contact with the transformer.

The construction of the fuse-block and the method of connecting the fuses are such that the operator can at any time, day or night, or in stormy weather, change the plug to bring a new fuse in the circuit with perfect safety.

I am aware that changes in the form and proportion of parts and in the details of construction of the mechanisms herein shown and described as an embodiment of my invention can be made by a skilled mechanic without departing from the spirit or sacrificing the advantages of my invention, and I therefore reserve the right to make such modifications and alterations as fairly fall within the scope of my invention.

In winding the layers of wire to produce the primary and secondary of the transformer I employ the ordinary cotton-covered wire of commerce, which of itself is not sufficient insulation for the layers of wire, and to thoroughly insulate the layers of wire one from the other, and to insulate the wires forming each winding or layer one from the others, I apply the composition to them and interpose the layers or sheets of mica E' between each layer of wire of both the secondary and primary of

the transformer. By my method of preparing and treating the coils forming the primary and secondary the cotton covering of the wires absorbs the composition which is spread all through the coils, and after the coils have been thus treated and dried all the wires are thoroughly insulated and the coverings thereof will not absorb moisture. The windings of wire forming the inside layer *d* of the primary are connected electrically by the short conductor *d''* with the outside wires forming the outer wrapping or envelope *d'* of the primary, to form a continuous path for the current passing through the primary of the transformer, such connection *d''* being made after the transformer-coils are wound.

The grounded wire F and the brass binding-post *f* on the outside of the transformer and fuse-block casings serve as a lightning-arrester to carry off the electrical energy resulting from a stroke of lightning.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A transformer core composed of a mass of slotted iron plates or laminations which are superimposed one upon the other and arranged in groups, each group consisting of a series of plates in metallic contact with each other, and each group insulated from an adjacent group or groups by layers of asbestos as heat resisting insulations, said plates or laminations having one side cut away to produce the seat, and a removable section fitted in the seat formed by the slotted plates and composed of plates or laminations which are also disposed in groups, each consisting of a series of plates in metallic contact with each other and each group insulated from adjacent groups by layers of asbestos which are bound with the plates, in combination with the primary and secondary coils which are arranged within the slotted plates and around the removable section, substantially as and for the purposes described.

2. In an electric transformer, the primary and secondary coils each coated with a solution of gum shellac and logwood extract and with the secondary coil wound within and insulated from the primary coil, in combination with a core around which the coils are wound, substantially as and for the purposes described.

3. The method of preparing the primary and secondary of an electric transformer which consists in winding a layer *d* of the primary and coating the same with a solution of gum shellac and extract of logwood; then winding the secondary coil upon said primary coil layer *d*, and coating the same with the before mentioned solution; then winding another layer *d'* of the primary coil upon said coil of secondary winding and applying said solution to the primary coil winding *d'*; immersing the primary and secondary windings in a bath of the solution, and finally drying the structure, substantially as and for the purposes described.

4. The method of preparing the primary and secondary of an electric transformer which consists in winding the secondary within layers of the primary, coating the windings with a solution of gum shellac and extract of logwood, and finally drying the coatings, substantially as and for the purposes described.

5. In an electric transformer, the secondary coil wound within the primary coils and insulated therefrom by mica insulations, combined with a core around and within which the coils are arranged, and mica insulations between the layers of wire forming said coils and between the coils and the core, substantially as and for the purposes described.

6. In an electric transformer, the combination of a core composed of iron plates or laminations insulated in groups by heat resisting insulations, and each group consisting of a series of plates in electric contact with each other, and the primary and secondary coils insulated from each other and from the core by mica insulations, substantially as described.

7. The combination with binding posts, of a fuse block, the continous plates at the ends of said fuse block and said plates having tongues which are electrically engaged with said binding posts, a series of fusible conductors attached to one of said plates, a series of independent plates attached to said fusible conductors and arranged close to the other continuous plate, and a removable plug, substantially as and for the purposes described.

8. The combination with spaced posts, of a channeled fuse block, a terminal plate on one side of the fuse block and in electrical contact with one of the posts, a continuous contact plate in electrical connection with the other post and arranged on the opposite side of the fuse block, a series of independent contact plates opposite to the continuous contact plate, a series of fusible conductors attached to the continuous terminal plate and to the independent contact plates, and a plug, substantially as and for the purposes described.

9. The combination with the spaced posts, of a fixed fuse block provided with the longitudinal channels and a series of transverse plug receiving apertures, a continuous terminal plate in electrical connection with one post, a continuous contact plate in electrical connection with the other post and fixed to the fuse block on one side of the plug receiving apertures, a series of independent contact plates fixed on the other side of said apertures, opposite to the continuous contact plate, a series of fusible conductors, and a plug, substantially as described.

10. The combination with spaced binding

posts, of a fixed fuse block having the apertures, k, k' and the longitudinal channels on one face thereof, the continuous contact and terminal plates n, l, fastened to opposite sides of said block and in electrical connection with the respective binding posts, a series of independent contact plates fixed to the fuse block opposite to the continuous plate, a series of fusible conductors, and a plug, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM F. BRITTIN.

Witnesses:
OLIN M. GRICE,
ED. M. GAY.