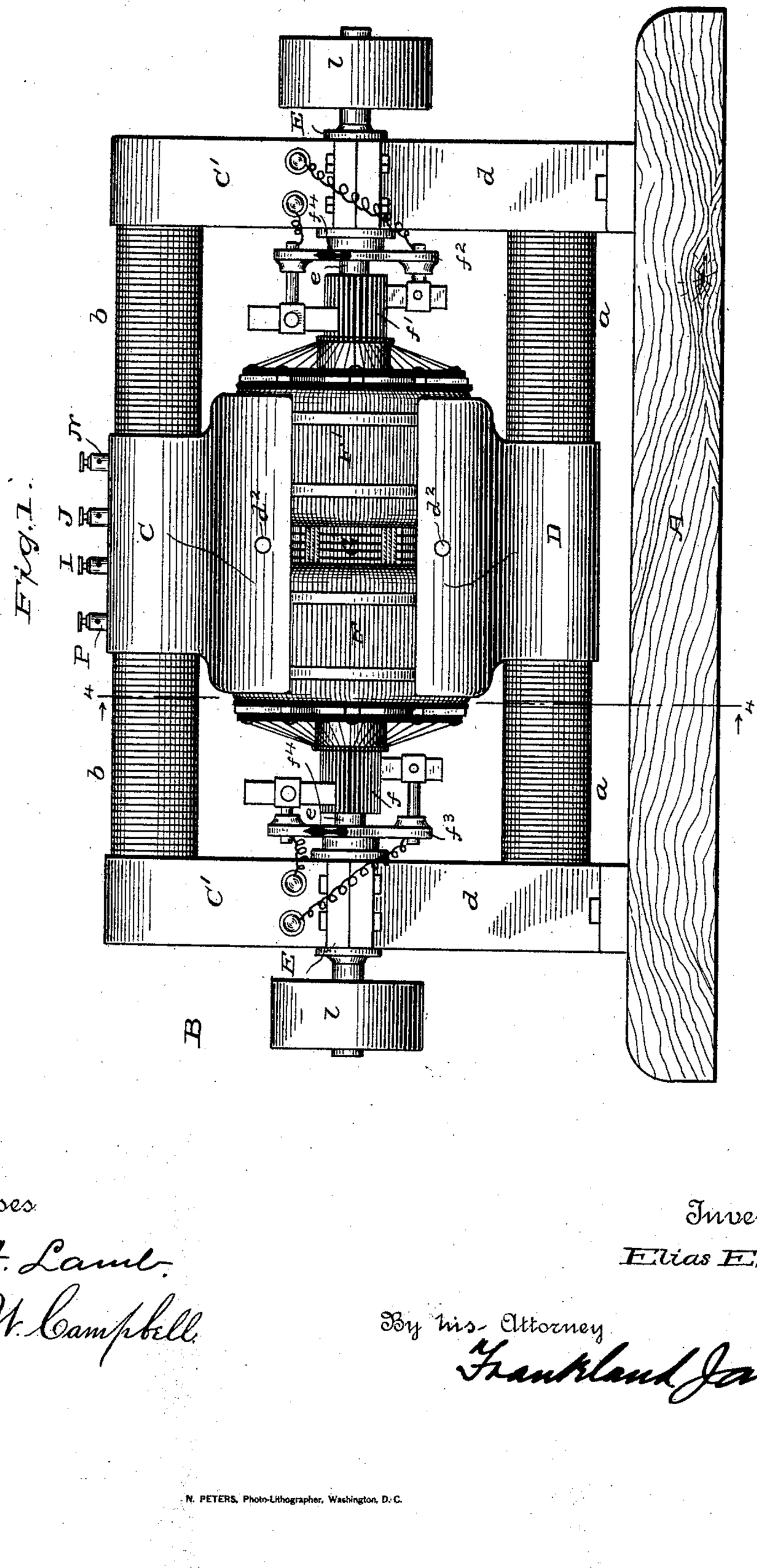
(No Model.) 5 Sheets—Sheet 1.

E. E. RIES.

DYNAMO ELECTRIC GENERATOR.

No. 381,421 Patented Apr. 17, 1888.



Witnesses
H. C. St. Laud.
Geo. W. Campbell.

Inventor
Elias E. Ries.

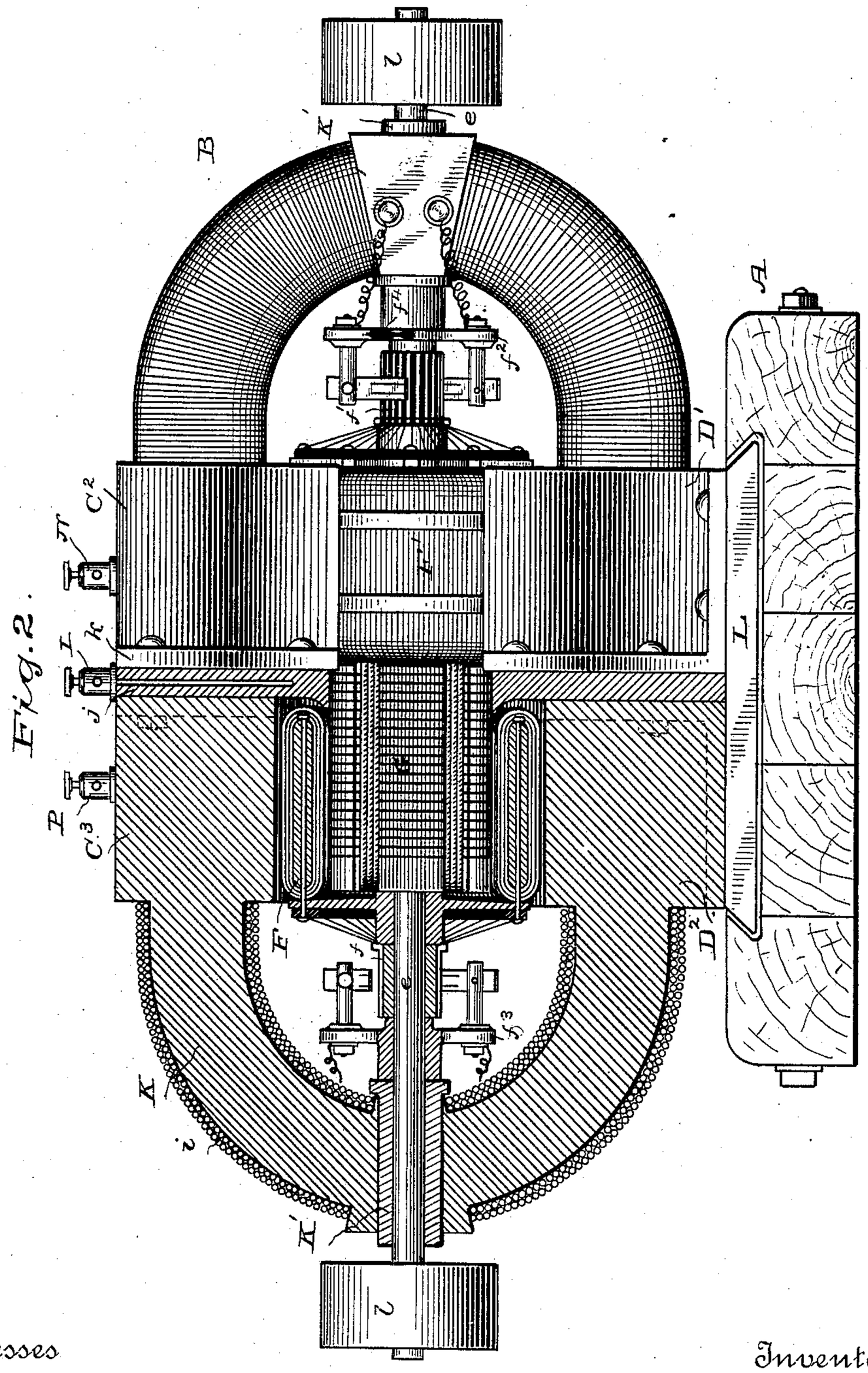
By his Attorney
Frankland James.

(No Model.) 5 Sheets—Sheet 2.

E. E. RIES.

DYNAMO ELECTRIC GENERATOR.

No. 381,421. Patented Apr. 17, 1888.



Witnesses
H. A. Sault.
Geo. H. Campbell.

Inventor
Elias E. Ries
By his Attorney
Frankland James.

(No Model.) 5 Sheets—Sheet 3.

E. E. RIES.

DYNAMO ELECTRIC GENERATOR.

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Fig. 4.

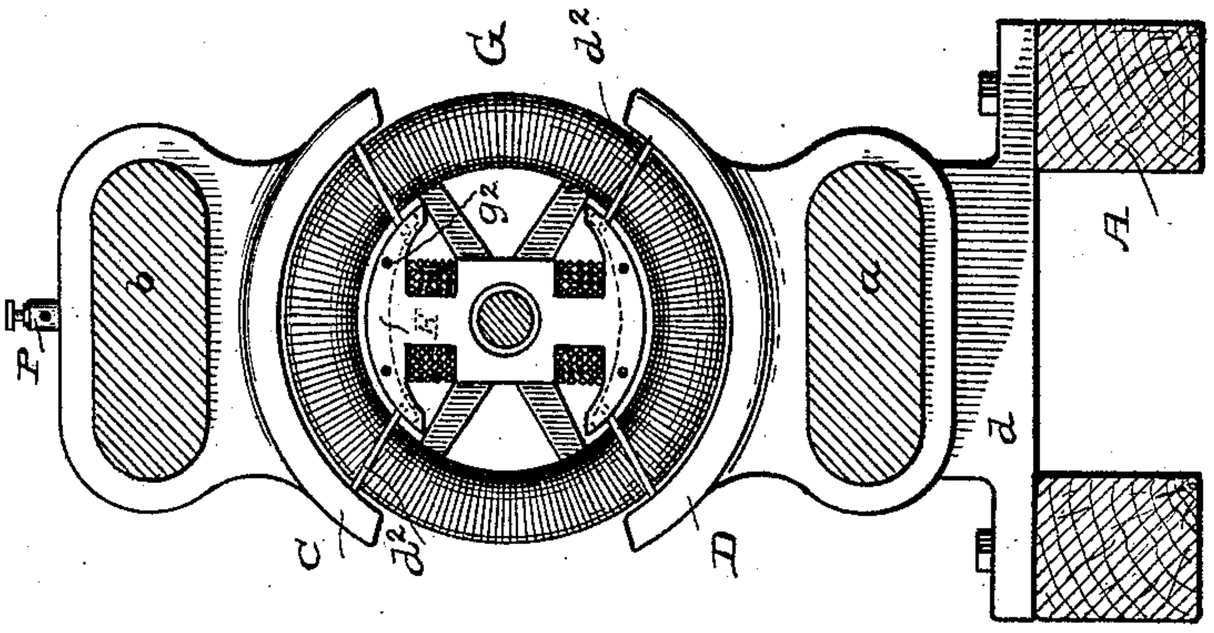


Fig. 3.

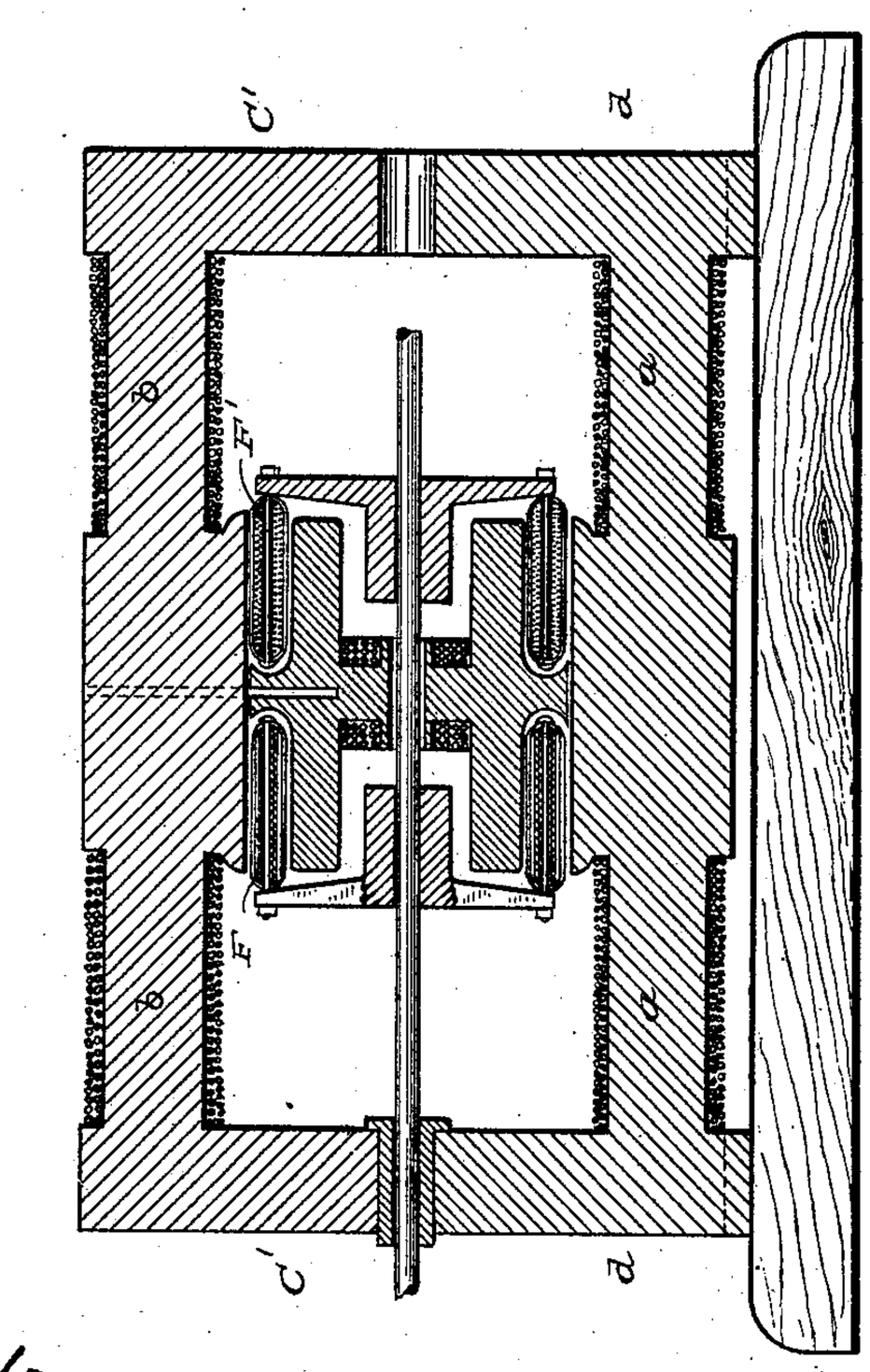
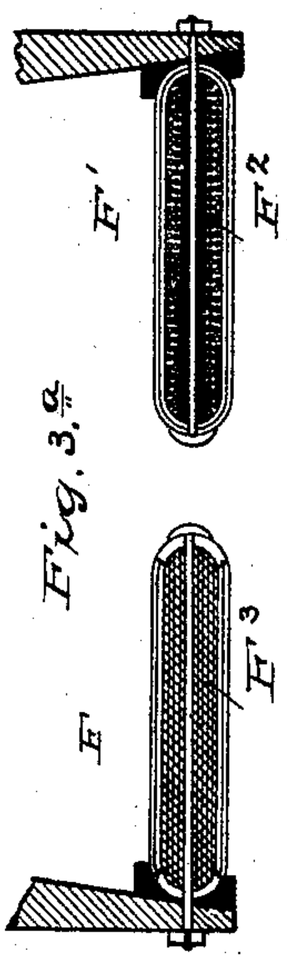


Fig. 3, a.



Witnesses
H. A. Lamb.
Geo. H. Campbell.

Inventor
Elias E. Ries.

By his Attorney
Frankland James.

(No Model.) 5 Sheets—Sheet 4.

E. E. RIES.

DYNAMO ELECTRIC GENERATOR.

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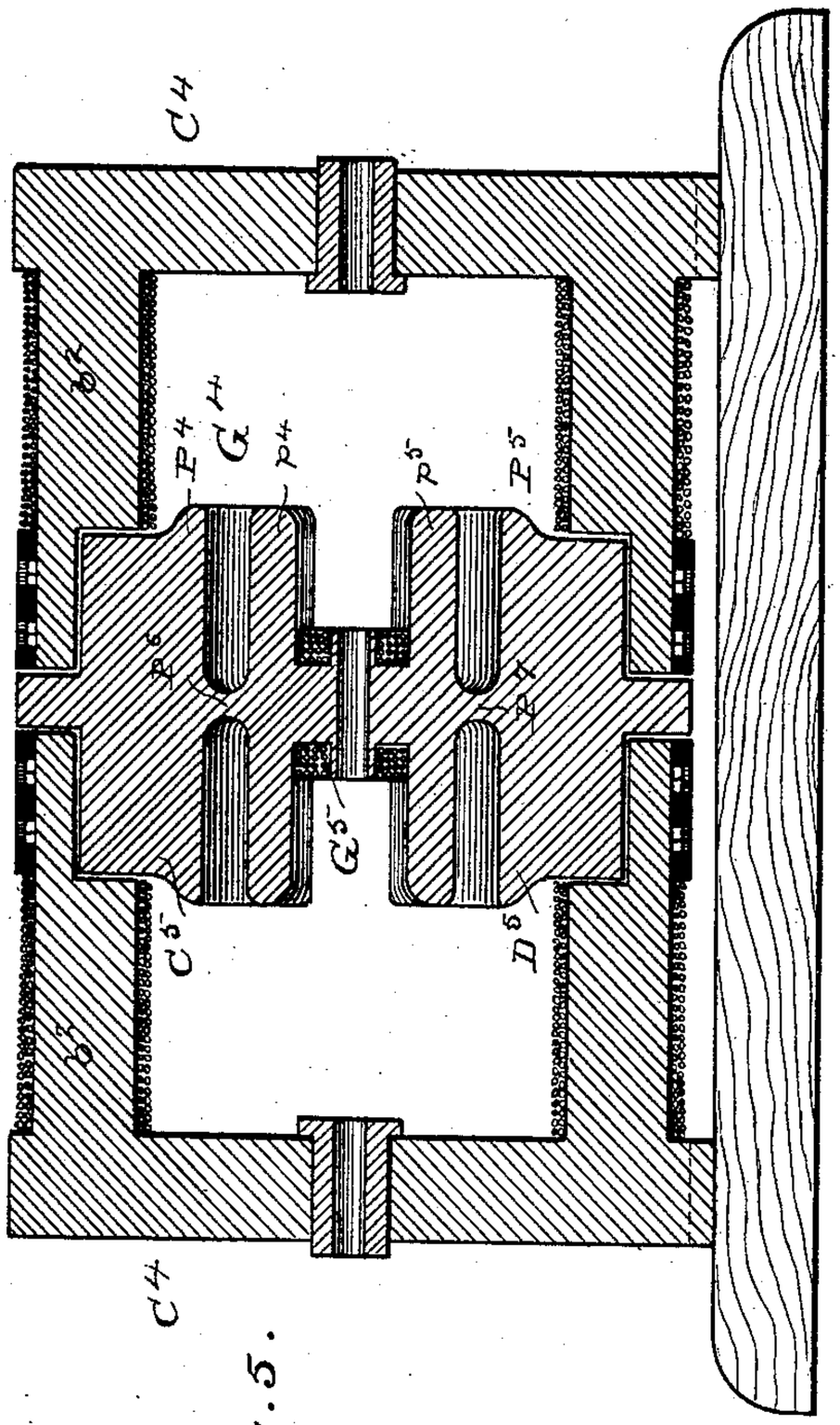

Fig. 5.

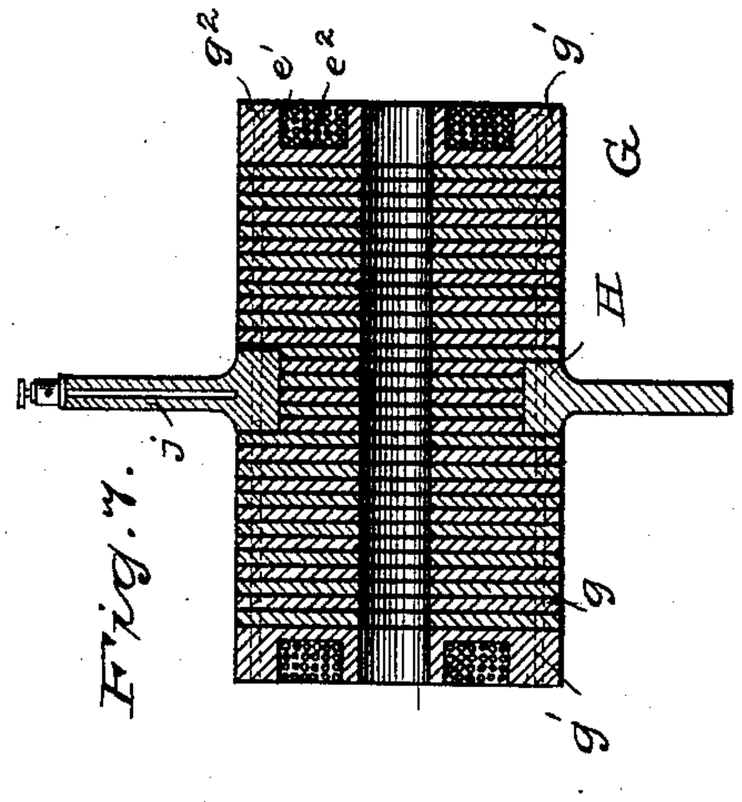

Fig. 4.

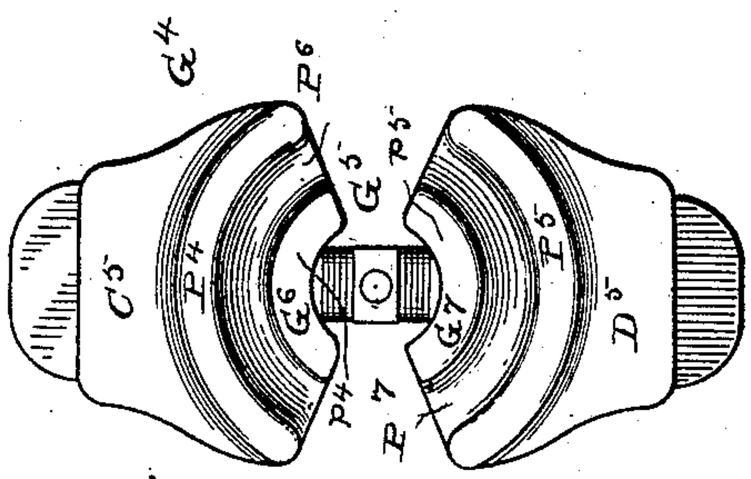

Fig. 6.

Witnesses
H. A. Lamb.
Geo. H. Campbell.

Inventor.
Elias E. Ries.
By his Attorney
Frankland James.

(No Model.) 5 Sheets—Sheet 5.

E. E. RIES.

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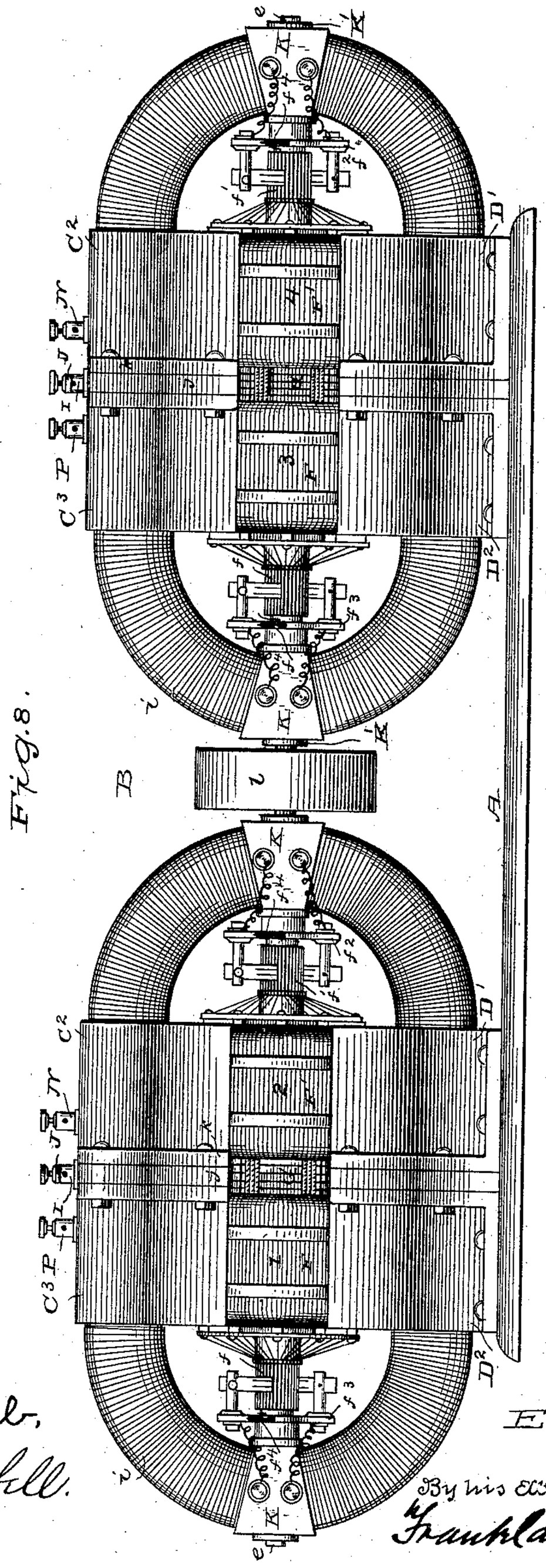

Fig. 8.

Witnesses.
H. A. Lamb.
Geo. H. Campbell.

Inventor.
Elias E. Ries.
By his Attorney
Frankland James.

UNITED STATES PATENT OFFICE.

ELIAS E. RIES, OF BALTIMORE, MARYLAND, ASSIGNOR OF ONE-HALF TO ALBERT H. HENDERSON, OF SAME PLACE.

DYNAMO-ELECTRIC GENERATOR.

SPECIFICATION forming part of Letters Patent No. 381,421, dated April 17, 1888.

Application filed April 28, 1887. Serial No. 236,386. (No model.)

To all whom it may concern:

Be it known that I, ELIAS E. RIES, a citizen of the United States, residing at the city of Baltimore, State of Maryland, have invented certain new and useful Improvements in Dynamo-Electric Generators, of which the following is a description.

My present invention relates to improvements in dynamo-electric generators; and it consists in so thoroughly and completely enveloping the armature-coils with magnetic influence that the greatest possible number of lines of force will be cut by said coils during their movement within the magnetic field, and the interior portion of the coils of a ring-armature be enabled to do as much work in the production of electric current as any other part of the armature. This result is effected by providing interior as well as exterior field-magnets, the coils of the armature projecting into the space between said magnetic systems and rotating in the very powerful field of force there existing, produced by the conjoint efforts of the two magnetic systems. It also consists in mounting two armatures upon a single shaft forming a compound-armature generator, the open portions of both facing toward each other and projecting into the interpolar space—that is, the space between the interior and exterior field-magnets from opposite directions, occupying it as much as possible while allowing sufficient space between the inner edges of the armatures for a free circulation of air and for expansion of the parts, &c.

It further consists in constructing and proportioning the armatures to produce a variety of electrical results both singly and in combination, and one form of my improved generator includes a duplex-compound machine—that is, one having four armatures and two magnetic systems, all on one driving-shaft, the armatures being so wound as to produce power and incandescent-lighting or battery-charging currents during the day, and when properly combined to produce arc-lighting currents at night, thus giving the widest possible range of usefulness to one machine, which can be belted direct to its source of power.

By my invention the form and shape of the generator are very much simplified and condensed, the field-magnet cores being so disposed or formed as to carry at their neutral points journal-bearings for the armature-shafts, the commutator-brushes, &c., being arranged and disposed between the said bearings and the central portion of the machine. The cores of the main field-magnets extend around the machine so as to practically constitute its frame, the auxiliary field-magnet being suspended between the polar extensions. The auxiliary field-magnets may be arranged in a variety of ways to produce the best structural effects, several of the more preferable methods of arrangement being shown in the drawings by way of illustration.

It further comprises sundry details of construction and arrangement, relating, for example, to the core of the interior field-magnet and to the general structure and arrangement of the machine, as will be hereinafter fully set forth.

In the accompanying drawings, Figure 1 is a view in elevation showing a dynamo-electric generator embodying my improvements. Fig. 2 is an elevation, partly in section, of a machine somewhat different in outline, although electrically the same as that shown in Fig. 1. Fig. 3 is a sectional elevation of the machine shown in Fig. 1, the commutators, &c., and driving-pulleys being omitted. Fig. 3^a is an enlarged detail sectional view of the cores of the armatures in Fig. 3. Fig. 4 is an end view of the frame of the generator on the line 4 4 of Fig. 1. Fig. 5 is an elevation, partly in section, showing a modified construction of the frame of the generator shown in Fig. 1. Fig. 6 is a detail view showing the interior field-magnet core and pole-piece and the main polar extensions combined in a single casting. Fig. 7 is a longitudinal vertical section showing the interior field-magnet separately. Fig. 8 is a view in elevation showing a modification of the principal feature in the form of a duplex compound-armature generator.

Similar letters denote like parts throughout.

Referring to Fig. 1, A is a base or stand, upon which is mounted a dynamo-electric generator, B, provided with field-magnet cores *a a* and *b b*, the said cores being respectively integral with polar extensions C and D and end pieces, *d* and C′, the said end pieces, C′ *d*, being fitted to unite at or about the axial line of

the machine, where they are provided with journal-bearings E, within which rotates the armature-shaft *e*, upon which are mounted two ring-armatures, F F′, which face in opposite directions. The commutators *f f′* and commutator-brush-holding yokes f^2 f^3 are arranged in the space between the said armatures, and the end pieces, C′ *d*, being adjustably mounted upon the inner portion of the bearings of the armature-shaft, so as to be capable of being set in any desired position with respect to their commutators, suitable hand-levers, f^4, being provided for that purpose.

The armatures F F′ are arranged facing each other, and within the space between them and their hollow interiors is arranged an auxiliary field-magnet, G, which almost completely fills up the space there existing and exercises its influence against the inside of the coils of the said armatures, the outside of the said coils being acted upon by the lines of force emanating from the main polar extensions C and D. The core of the interior field-magnet, G, may be cast in a single piece, as indicated in Figs. 3, 4, and 6; or it may be, as shown in Figs. 1, 2, and 7, constructed of thin plates of iron, of the shape shown in Fig. 4, and any desirable thickness, and held together by transverse bolts g^2, the end plates, *g′*, being made considerably thicker than the plates *g*, and formed with grooves *e′* to receive and hold the magnetizing-coils e^2, which are then wrapped transversely around the laminated core, as indicated. (See Figs. 1, 2, 4, and 7.)

As shown in Figs. 1 and 3, the cores *b* and *a* of the main field-magnets are integral with their polar extensions C and D, and the auxiliary field-magnet is fitted in between them and securely fixed in position by means of bolts d^2, extending from the exterior of the pole-pieces therethrough and into centrally-located blocks H, securely fixed in the material of the said core in order to receive them. The wires wound upon the said core G for energizing the interior field-magnet are passed down through a suitable aperture in the center of the pole-piece C, their terminals being represented by binding-posts I J, the terminals of the main field-magnets being represented by similar binding-posts, N P.

In Fig. 2 the generator is shown as having substantially U-shaped cores K, the magnetic frame of the machine being composed of two of these cores placed end to end, so that their pole-pieces will extend together and constitute a double central field of force, within each of which turns one of the armatures F F′. The winding *i* is placed on the exterior of the curved portions of the cores and acts to produce a north and a south pole at their respective extremities. The interior field-magnet is in this instance provided with extensions *j*, of brass or other non-magnetic material, which are secured to the core in place of or as a continuation of the blocks H, and have the same outline as and are placed between the ends of the cores K, the bolts by which the two portions of the generator are united passing through flanges K and through the body of the extensions *j*, firmly uniting the parts and at the same time supporting the entire field-magnet G in the desired position between the pole-pieces C^2 and D′ and D^2 and C^3. The upper one of the extensions *j* is also suitably bored to carry the conductors leading to and from the winding of the exterior field-magnet, said terminals being represented by binding posts I J. The U-shaped cores K are provided with suitable journal-boxes E′, which are fitted in solid blocks of metal K′, left projecting at their neutral or central portions, and the armature-shaft *e* is mounted in the bearings so provided at each end of the machine.

The lower sides of the pole-pieces D^2 D′ are bolted down to or formed integral with an extension, L, which fits into a suitable grooved base, A′, within which it is arranged to slide for the purpose of loosening or tightening the driving-belts by which the armatures are rotated through the medium of pulleys *l*, provided upon the driving-shaft *e*, the said extensions L serving to firmly hold the machine in position within its base and permit it to be moved therein without danger or inconvenience. The winding of the interior field-magnet is intended to produce magnetism therein of equal force to that in the exterior field-magnet, and to that end its winding will be of such resistance as to permit a sufficient quantity of current to flow therethrough to accomplish the desired purpose.

In Fig. 5 is shown a frame composed of five pieces, each core being integral with one half, C^4, of an end piece, and the entire central portion, G^4, consisting of polar extensions C^5 D^5 and internal field-magnet, G^5, being cast in one single piece, to which the ends of all four cores are securely bolted, the division-line of the end pieces uniting on the axial line of the machine to form a strong metallic magnetic frame, substantially as therein shown.

The contour of the central portion is indicated by Fig. 6, and is substantially the same as that in the other machines already described, and in which the pole-pieces are integral with the main field-magnet cores. Instead, however, of the interior field-magnet being composed of laminated sections bolted together, it constitutes the connecting-link between the pole-pieces C^5 D^5, its own polar extensions being shown at G^6 G^7, between the exterior of which and the interior of the main polar extensions C^5 D^5 exists the interpolar space, within which the armatures F F′ are rotated.

The magnetism of the main field-magnet cores is concentrated in the main polar extensions P^4 P^5, and that of the auxiliary field-magnets in the extensions p^4 p^5. The lines of force flow from one set of the polar extensions to the other through the coils of the armatures rotating in the segmental grooves between them. Thin webs P^6 P^7 are left between the polar ex-

tensions and serve to unite, separate, and support them on the neutral line between the magnetic systems of the machine.

The armatures F F′ are not restricted to any particular construction or proportions in winding, it being designed to arrange them as may be most desirable and useful—for example, one being wound with large and one with small wire—so that the current may be taken from one and used to energize the field-magnets of the machine and so produce in the other current of constant potential; or they may be both wound alike and coupled to feed into one circuit and produce different results, the field being then either in series or shunt, as found desirable; or they may be constructed so as to most fully utilize the capacity of the polar space by omitting the usual large proportion of iron which in the form of a core is used to support the coils, and in that case the armature-coils will be wound upon a thin diamagnetic ring or core only large and strong enough to afford them an efficient mechanical support.

In Fig. 3 is shown a pair of armatures mounted upon the same shaft and for use in the same machine, the core F^2 of one being of diamagnetic material, as just described, while that of the other, F^3, is of the usual construction. These armatures are most particularly suited to the operation of the machine as a combined generator and motor, the non-magnetic core forming a most efficient generator when used in connection with an interior field-magnet, and the armature containing the magnetic core being specially adapted for use as a motor when the machine is taking current from its source of supply. Ordinarily, however, I propose to use pairs of armatures of similar construction, so far as their magnetic properties are concerned, although in most instances the winding of the different armatures in the same machine will be of different resistances.

With the construction so far described it will be readily seen that, in addition to the advantages already pointed out as resulting from the employment of interior as well as exterior field-magnets, a very compact and at the same time extremely useful generator is the result of my improvements. In many cases electric-lighting stations find it necessary to possess generators of different capabilities for the sake of being prepared to supply current for different purposes—as, for example, the operating of motors and incandescent lamps on day circuits and then the operation of arc lamps at night, also the charging of storage-batteries, these various requirements calling for currents of different character. A generating-plant supplied with dynamos embodying my improvements will be capable of supplying a greater variety of consumers with fewer machines than when supplied with generators of ordinary construction, because, as will readily be understood, I am enabled to make a variety of combinations with each separate machine. For example, let both armatures be wound to produce a current of similar quantity and potential, the currents therefrom can be used separately on low potential circuits, or by connecting the armatures in series a different result can be produced. Then again, one armature may be designed for continuous currents and the other for alternating currents, in which manner a self-exciting alternating-current generator is readily produced. By constructing all the generators so that the current produced by each armature would be a multiple of each of the others expressed in volts combinations can readily be made to suit almost any demand.

I construct my combined generator in a variety of forms, several of which have been described, and these forms again I still further combine, so as to produce what I have termed a "duplex compound-generator armature" having a very large range of capabilities. Such a machine is shown in Fig. 8, in which there are four armatures.

Without limiting myself to the exact porportions, it will be sufficient for the present purpose to state that, for example, the armatures of such a machine may be either all of the same electrical capacity and produce currents that are multiples of each other expressed in volts, or that they may also with equal facility be wound to produce currents of different electro-motive forces; and while absorbing substantially the same amount of power, so as to avoid mechanical injuries, the currents from the various armatures can be utilized for very different purposes, as will be readily understood by any practical electrician. For instance, armature No. 1 may produce currents of six hundred volts' pressure and its fellow No. 2 three hundred volts, the two together being a very useful combination for a power circuit during the day. Armatures 3 and 4 could then, for example, be either wound to produce currents of an electro-motive force of one hundred and fifty volts each, and could supply two separate incandescent circuits, while at the same time the electro-motive force of all four armatures could be thrown together at night to produce currents of twelve hundred volts' pressure, suitable for arc lighting. These figures are not intended as anything more than suggestions of the capabilities of the machine, and I further propose to increase or decrease the size of the armature, whether by increasing the size of the non-magnetic core and decreasing the amount of wire thereon, or making the armature of less width, so that still further combinations might be effected with only a single machine by changing armatures.

The machine as a whole, being driven by a single pulley, is capable of being conveniently belted direct to the driving-wheel of a high-speed engine, thus providing for an installation having a range of capacity hitherto entirely unknown, and with the smallest possible amount of mechanical complication, all line-shafting and counter-pulleys being dispensed with.

It will be obvious that many minor modifications and changes to adapt my improved generator to special conditions will readily occur to persons skilled in the art and without in any way departing from the spirit of my invention, and I therefore do not limit myself to the exact constructions shown and described.

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

1. In a dynamo electric machine, the combination, with a main exterior field-magnet system, of two ring-armatures arranged facing each other between the polar extensions thereof, and an auxiliary field-magnet secured to and supported by the exterior pole-pieces and extending between and into the interior of both armatures, substantially as described.

2. In a dynamo-electric generator, the combination of two ring-armatures and two commutators upon a single shaft, arranged facing each other, and exterior and interior field-magnets common to both armatures, substantially as described.

3. In a dynamo-electric generator, the combination, with a double set of field-magnets and pole-pieces united at or near the central portion of the machine, of a single armature-shaft, two armatures mounted upon said shaft within the influence of the said pole-pieces and facing each other, and an auxiliary field-magnet located within the armatures and in juxtaposition to the pole-pieces of the main field-magnets, substantially as described.

4. In a dynamo-electric generator, the combination of a double set of field-magnets facing toward each other, an armature-shaft, two armatures on said shaft facing each other and arranged to rotate within the field of force set up by said field-magnets, and an auxiliary field-magnet having projections or extensions therefrom of diamagnetic metal, said extensions being placed between the ends of the opposing main field-magnet cores, whereby the said auxiliary field-magnet is suspended in position to extend into the facing-armatures, substantially as described.

5. In a dynamo-electric generator, the combination, with the exterior field-magnet cores and a pair of ring-armatures arranged facing each other upon a main shaft parallel with said cores, of a pole-piece common to both armatures and having a comparatively thin web of metal at its neutral line, said pole-piece embracing both exterior and interior portions thereof and formed in one single piece, substantially as described.

6. A duplex pole-piece for dynamo-electric generators, having segmental grooves on each side for the reception of a pair of ring-armatures, as described, the said grooves being separated by a comparatively thin web of metal at the neutral line, substantially as set forth.

7. A dynamo-electric generator composed of two independent and separable U-shaped field-magnets, their extremities forming pole-pieces arranged to embrace, respectively, two separate armatures mounted on the same driving-shaft, said driving-shaft extending in a direction parallel to the arms of the U-shaped magnets and journaled in bearings at the neutral points thereof, substantially as described.

8. In a dynamo-electric generator, the combination, with the field-magnet cores and end or frame pieces, of journal-bearings mounted in said frames or end pieces at the neutral magnetic line, two or more armatures mounted upon the main shaft rotating in said bearings and facing toward each other, commutators for said armatures and commutator-brush carriers therefor located in the space between the journal-bearings and armatures, and auxiliary magnets supported from said field-magnet cores and extending between and into the armatures, substantially as described.

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

ELIAS E. RIES.

Witnesses:
LEOPOLD RIES,
ALBERT H. HENDERSON.