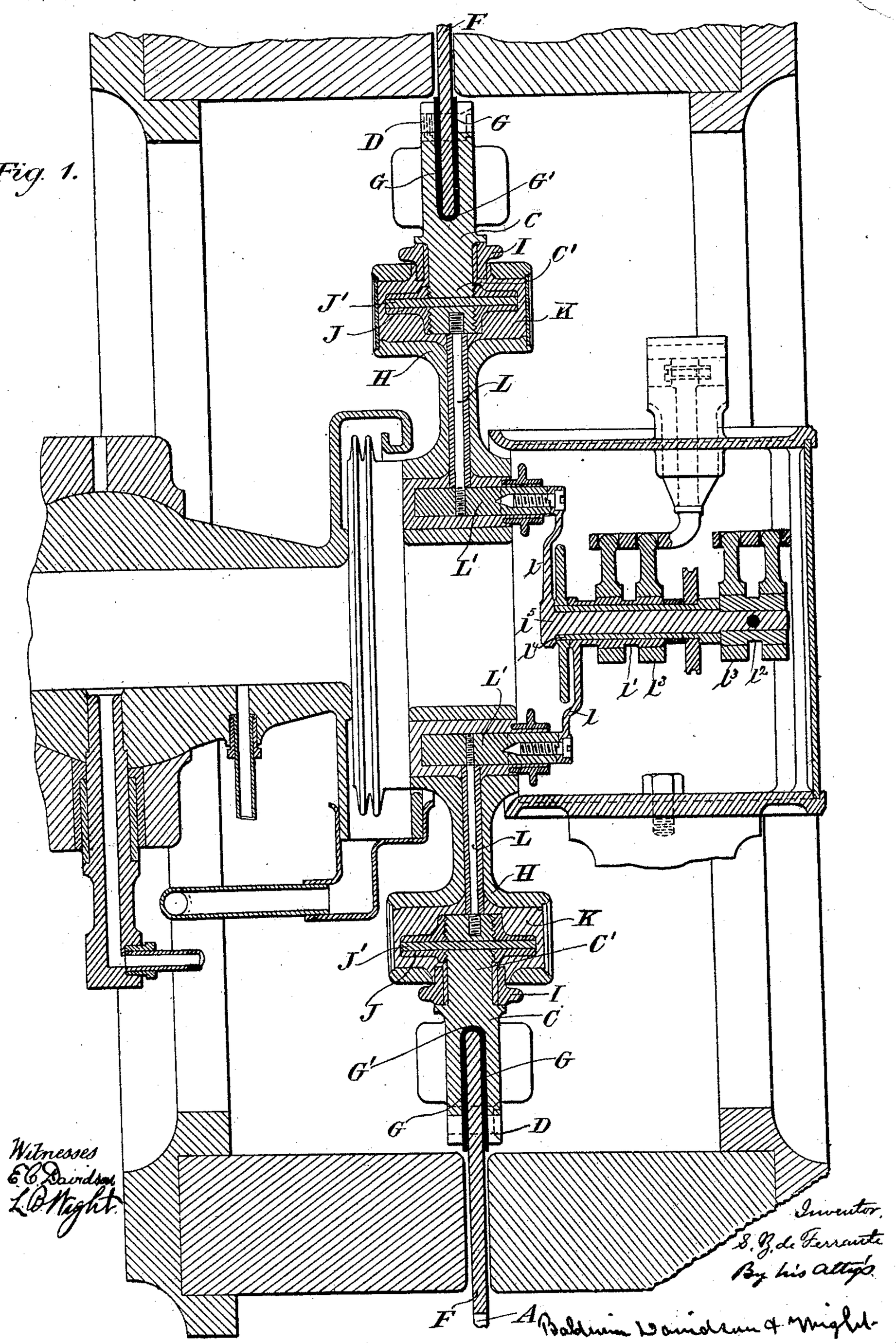
(No Model.) 6 Sheets—Sheet 1.

S. Z. DE FERRANTI.

DYNAMO ELECTRIC MACHINE.

No. 408,403. Patented Aug. 6, 1889.

Fig. 1.



Witnesses
E. C. Davidson
L. B. Wright.

Inventor.
S. Z. de Ferranti
By his attys
Baldwin Davidson & Wright.

(No Model.)

6 Sheets—Sheet 2.

S. Z. DE FERRANTI.

DYNAMO ELECTRIC MACHINE.

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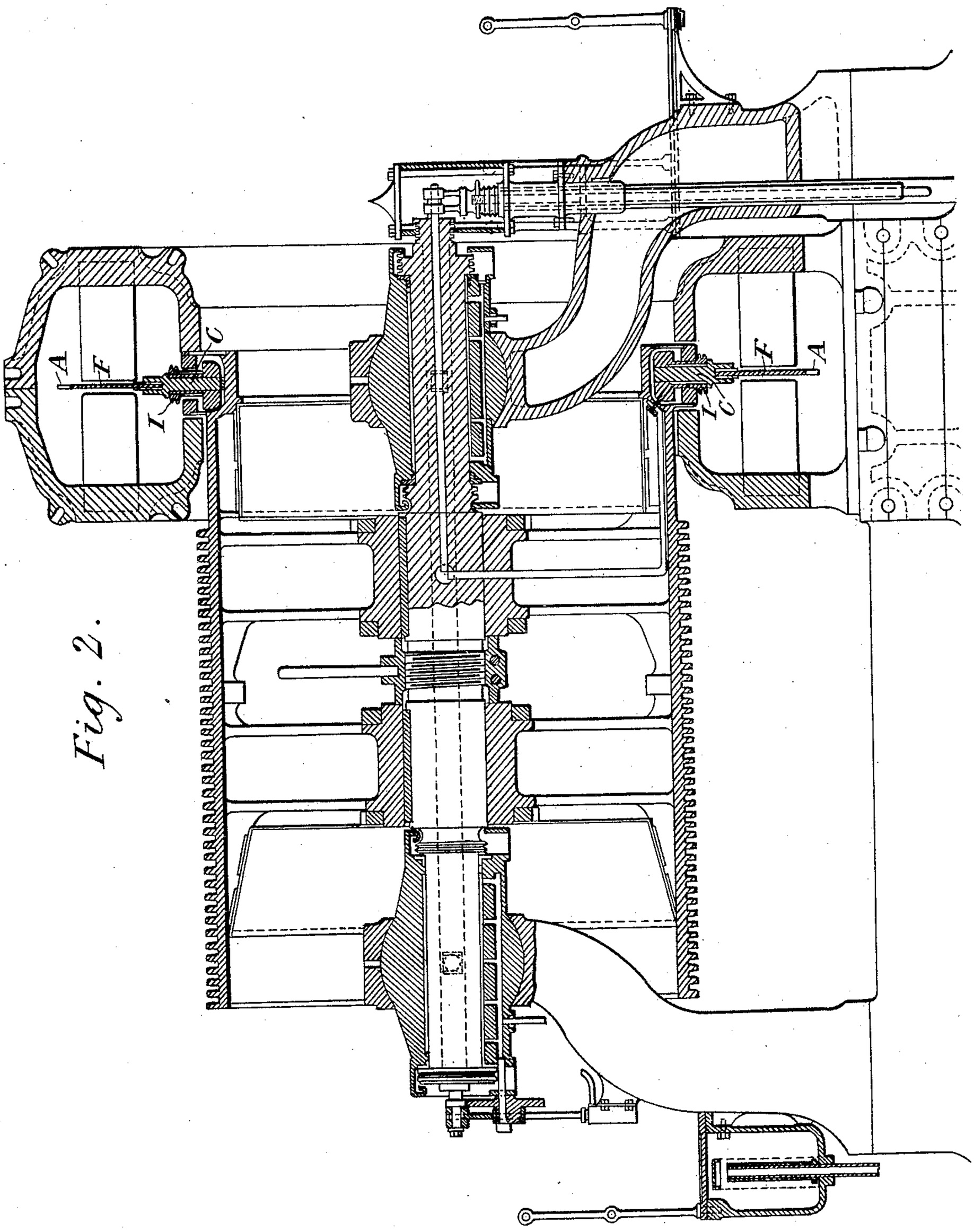

Fig. 2.

Witnesses
Edward C. Davidson
Lloyd B. Wright

Inventor
Sebastian Ziani de Ferranti
by his Attorneys
Baldwin, Davidson & Wright

(No Model.) 6 Sheets—Sheet 3.

S. Z. DE FERRANTI.

DYNAMO ELECTRIC MACHINE.

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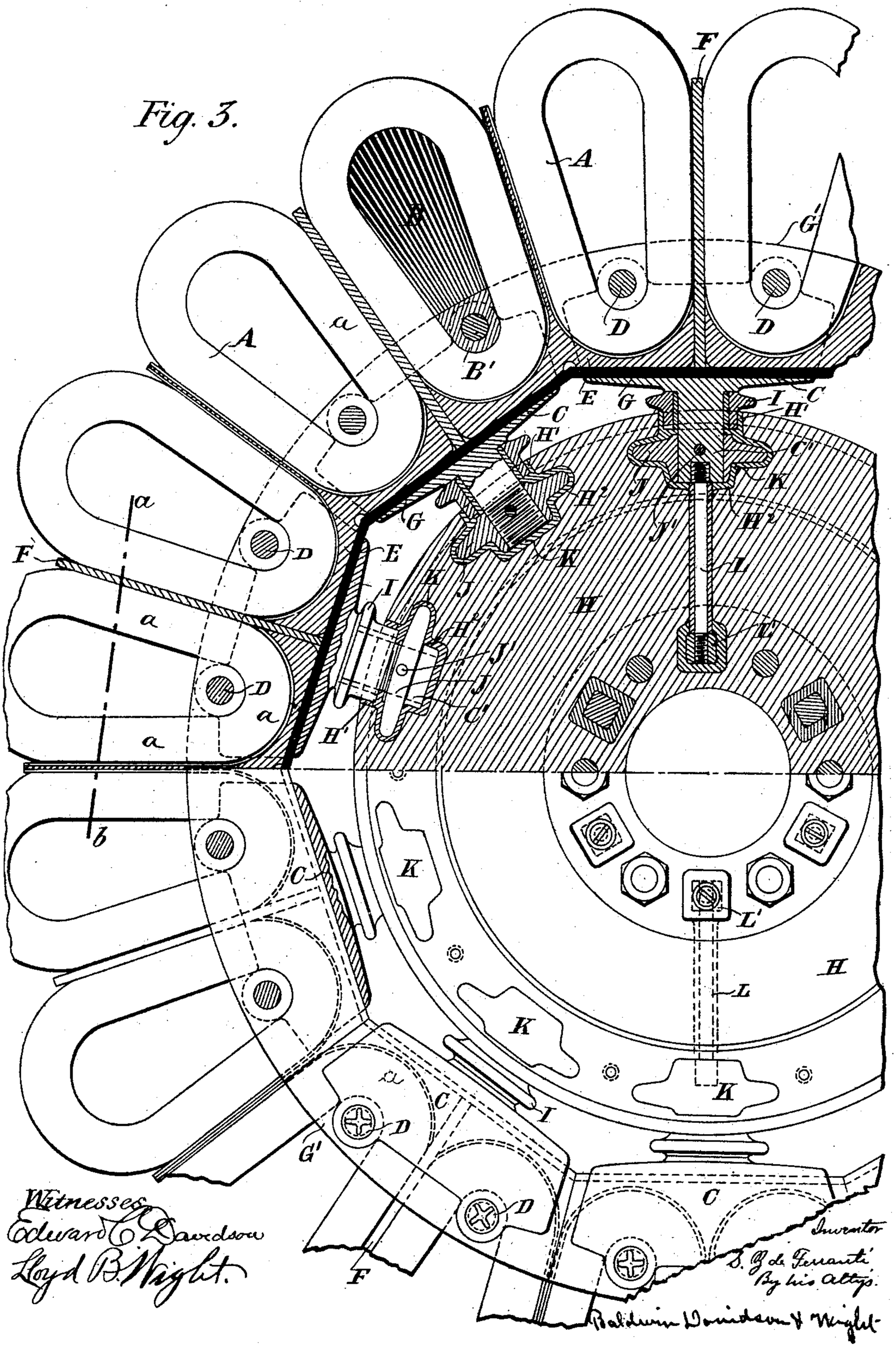
Fig. 3.



N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 6 Sheets—Sheet 4.

S. Z. DE FERRANTI.

DYNAMO ELECTRIC MACHINE.

No. 408,403. Patented Aug. 6, 1889.

Fig. 4.

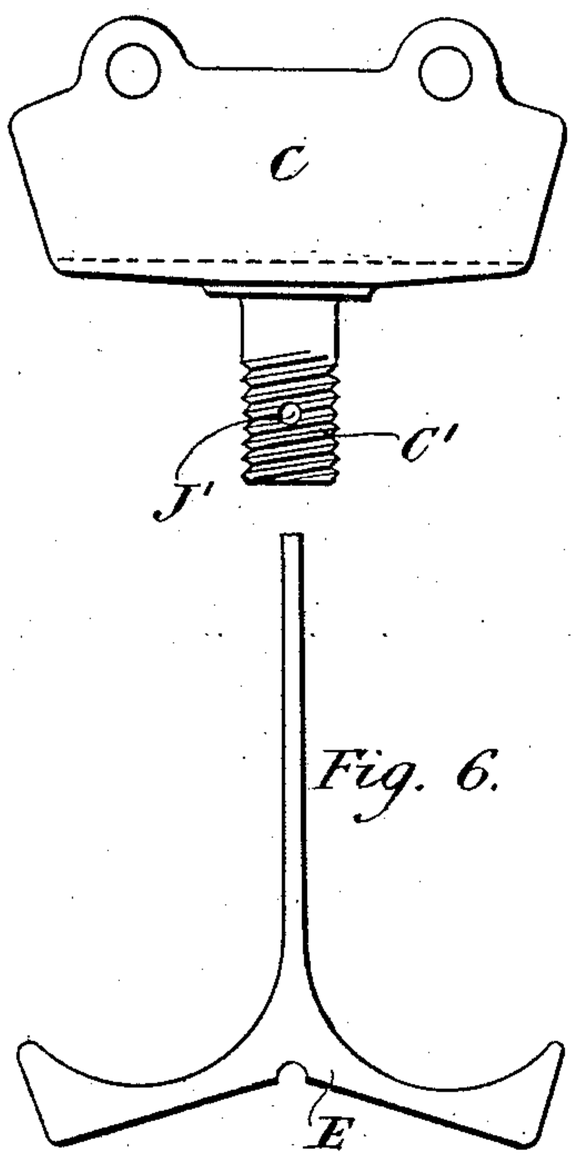


Fig. 5.

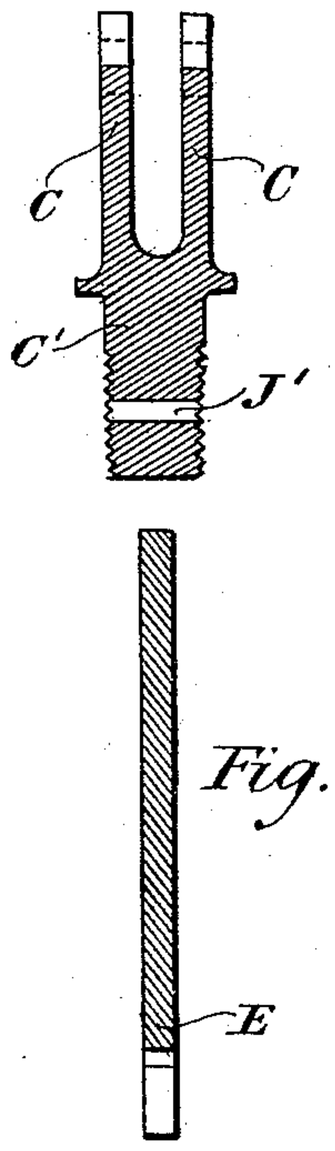


Fig. 6.

Fig. 7.

Fig. 8.

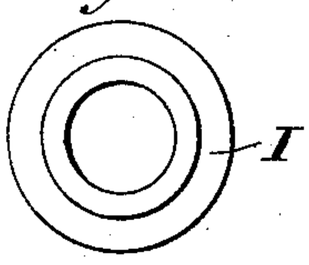
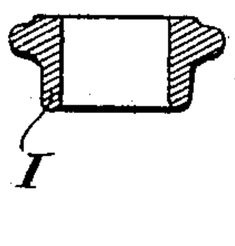


Fig. 9.



Witnesses.
Edward C. Davidson
Lloyd B. Wright.

Inventor:
Sebastian Ziani de Ferranti
by his attorneys
Baldwin, Davidson & Wright

(No Model.) 6 Sheets—Sheet 5.

S. Z. DE FERRANTI.

DYNAMO ELECTRIC MACHINE.

No. 408,403. Patented Aug. 6, 1889.

Fig. 11.

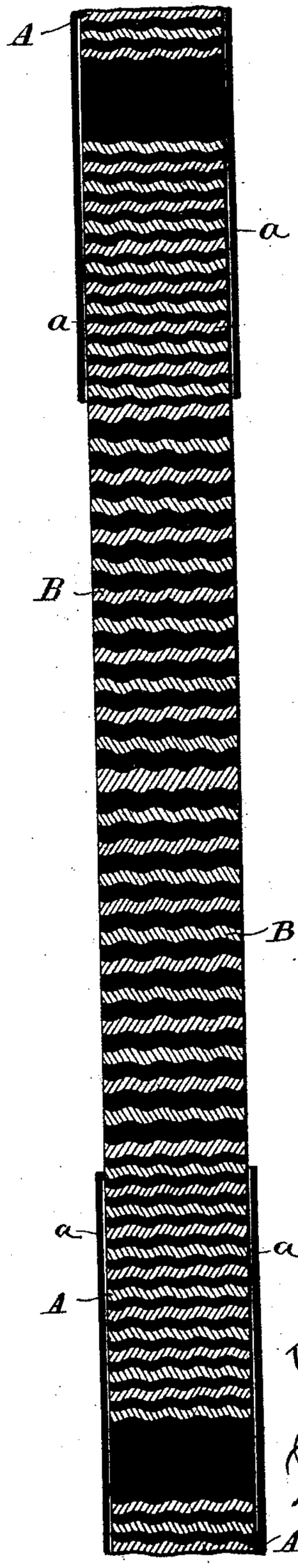


Fig. 10.

Witnesses.
Edward C. Davidson
Lloyd B. Wright

Inventor:
Sebastian Ziani de Ferranti
by his Attorneys
Baldwin, Davidson & Wright

(No Model.) 6 Sheets—Sheet 6.

S. Z. DE FERRANTI.

DYNAMO ELECTRIC MACHINE.

No. 408,403. Patented Aug. 6, 1889.

Fig. 12.

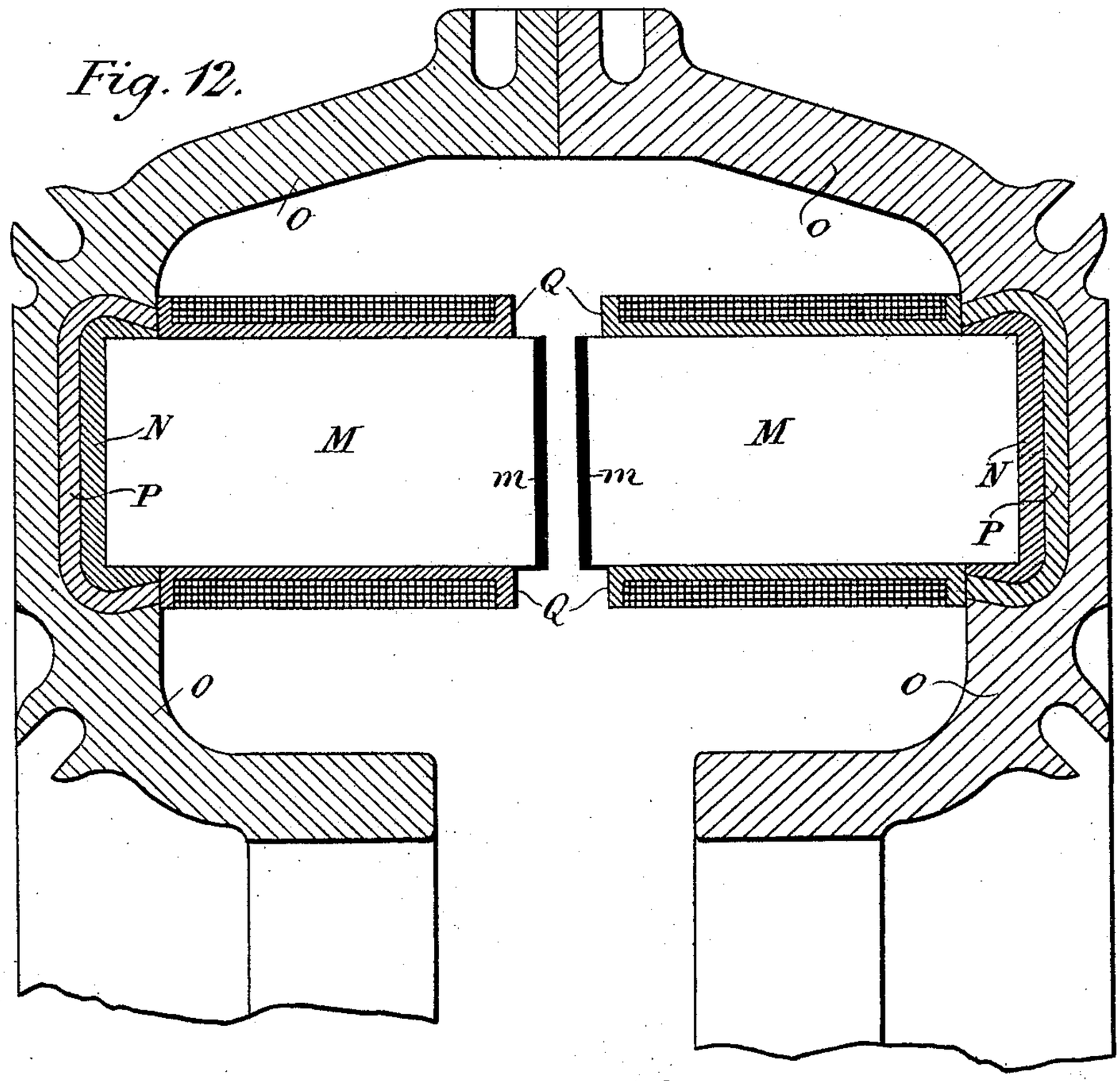
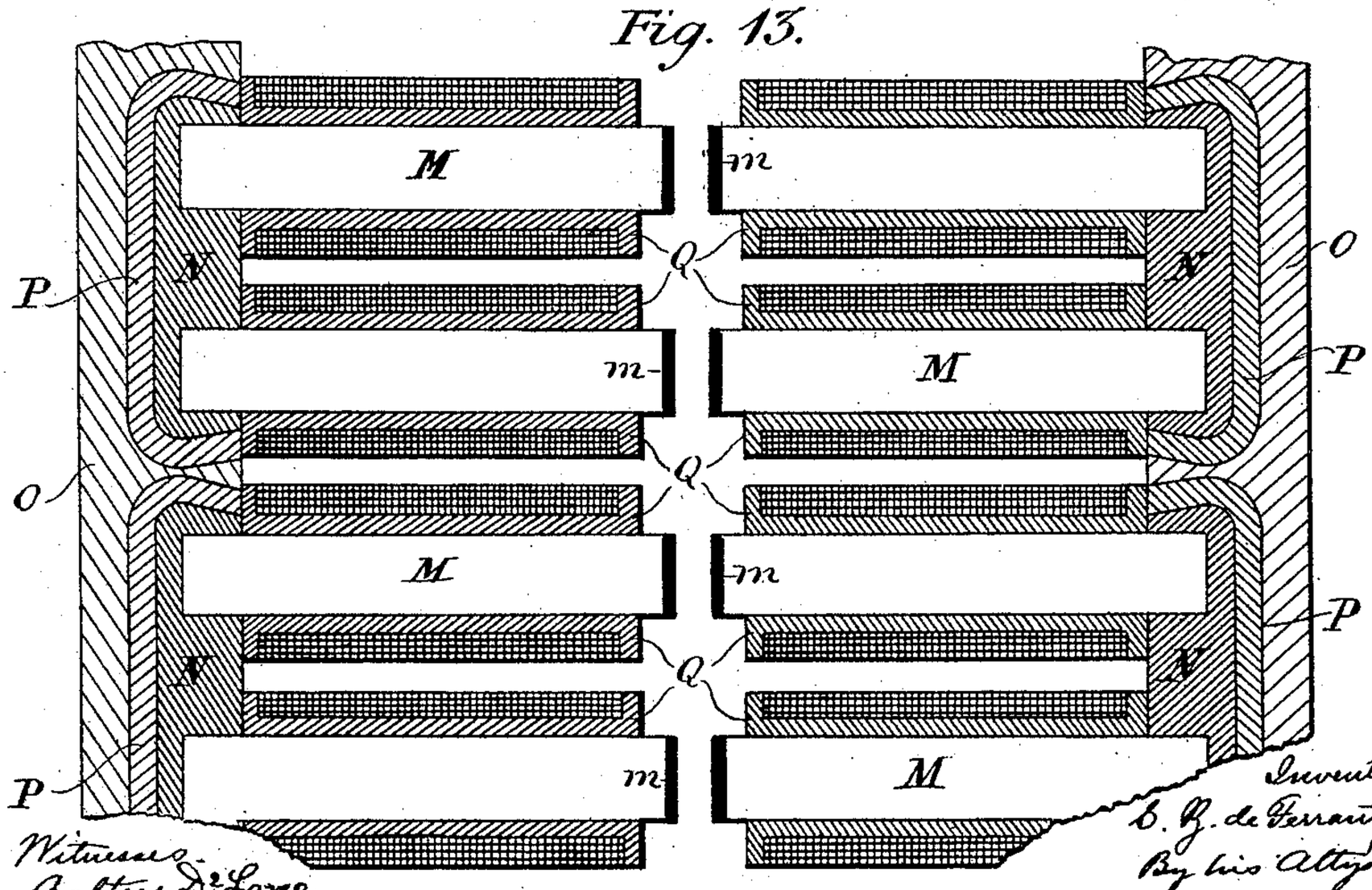


Fig. 13.



Witnesses.
Balties D. Lore
Lloyd B Wright.

Inventor.
S. Z. de Ferranti,
By his Attys.
Baldwin Davidson & Wright.

UNITED STATES PATENT OFFICE.

SEBASTIAN ZIANI DE FERRANTI, OF HAMPSTEAD, COUNTY OF MIDDLESEX, ENGLAND.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 408,403, dated August 6, 1889.

Application filed November 30, 1888. Serial No. 292,259. (No model.) Patented in England January 15, 1887, No. 702.

To all whom it may concern:

Be it known that I, SEBASTIAN ZIANI DE FERRANTI, electrician, a subject of the Queen of Great Britain, residing at 120 Fellowes Road, Hampstead, in the county of Middlesex, England, have invented certain new and useful Improvements in Dynamo-Electrical Machines, (for which I have received Letters Patent in Great Britain, No. 702, dated January 15, 1887,) of which the following is a specification.

The object of my invention is to improve the construction of the armatures and field-magnets of dynamo-electrical machines to enable currents of very high tension to be obtained.

The armature I make of a number of coils ranged around the circumference of a disk or wheel, each formed from a strip of metal, which is formed with interlocking projections or protuberances, and is preferably corrugated or ribbed, as shown, so that the coils overlap or interlock one with the other. In this way the overlying coils are not only kept from shifting sidewise, but in addition a much stronger coil is obtained, which will retain the form in which it is originally coiled, and will not alter its form when the dynamo is worked. The center of each coil I also fill in with a filling composed of strips of copper or bronze of the same section as the strip from which the coil is formed and separated one from the other by tapering strips of asbestus. The coils I hold in metal shoes, which I secure to the circumference of the rim of the wheel with thick insulation between the two, and this insulation being at a distance from the parts of the armature which come within the magnetic field very thick insulation may be used. To secure the shoes to the rim of the wheel, I, by preference, use sulphur, as hereinafter explained. When currents of very high tension are required, I also use in addition insulators of porcelain, stoneware, or glass placed between the shoes and the rim of the wheel. Preferably a pair of bobbins is held in each shoe, so that the bobbins can be coupled in series, in the manner hereinafter described.

In machines for producing current of very high tension I cover the magnet-faces with china or enamel, or ebonite, or like insulating material, and either with or without insulating the faces of the magnets I interpose sulphur cement or like insulating material between the rear ends of the magnet pole-pieces and the frame that carries them. The rear ends of the magnet pole-pieces may be coupled together in pairs to iron shoes and insulating material interposed between the shoes and frame.

My improvements are shown in the drawings hereunto annexed.

Figure 1 is a section of part of a dynamo-electric machine, showing an armature formed in the above manner and fixed on the end of a driving-axle. The section is taken parallel with the length of the axle. Fig. 2 is a similar section of a machine in which the armature is formed in the above manner and carried by the rim of a driving-wheel. Fig. 3 is an elevation, with some parts removed and some parts in section, of part of an armature formed as shown in Fig. 1. Fig. 4 is a side view, and Fig. 5 a cross-section, of one of the shoes in which the coils are held. Fig. 6 is a side view, and Fig. 7 a cross-section, of one of the filling-blocks which are placed into the shoes. Fig. 8 is an end view, and Fig. 9 a cross-section, of one of the porcelain insulators which are placed around the stems of the shoes. Fig. 10 is a cross-section, on a larger scale, of the strip from which I prefer to form the armature-coils; Fig. 11, a cross-section, on the same larger scale, of one of the coils and its central core, taken through the line *a b*, Fig. 3. Figs. 12 and 13 are sections taken through part of one of the frames which support the fixed field-magnets, showing how the magnet core-pieces are insulated from the frame.

A A are the coils, formed from strips of the section shown at Fig. 10, wound around a central core B, composed of an assemblage of strips of copper or bronze of the same section as the coils, with tapering strips of asbestus placed between, and the whole compressed together to bring it to the proper size and form. When compressed, a pair of clamping-pieces are placed across one face of the compressed block, and overlapping its side edges retain it in its compressed form. A strip of copper

of the section shown at Fig. 10, together with a strip of vulcanized fiber, is then wound around the compressed block, and a block of bronze B′ placed at its smaller end. I prefer to form the coils of strips of metal of the section shown; but the strips might be otherwise formed to interlock one with the other.

C C are metal shoes, in which the smaller ends of the coils are subsequently held by bolts D.

E E are metal filling-blocks placed in the shoes for the smaller ends of the coils to rest against. Each block is made to rest one half in one shoe and the other half in the adjoining shoe.

F F are pieces of insulating material placed between the two coils in each shoe.

G G are strips of insulating material interposed between the filling-blocks and the bottom of the shoes.

G′ are strips interposed between the sides of the filling-blocks and the sides of the shoes.

C′ are stems extending from each shoe toward the center of the armature-wheel H. These pass into radial holes H′ in the rim of the wheel.

H² are slots formed through the wheel from one side to the other. The radial holes H′ open into these slots.

I I are porcelain insulators placed around each stem C′, and secured to them by sulphur to come between the periphery of the wheel and the shoes.

J are nuts screwed onto the stems of the shoes.

J′ are pins by which the nuts are locked when they have been screwed up onto the stems.

K is a filling of sulphur poured into the space between the nuts J and the sides of the radial holes H′ and slots H². This filling of sulphur locks all the parts securely together, and affords very sound insulation between the shoes and wheel.

It will be noted that the insulation I K is of less thickness than the distance through the air or along the surface of the parts from any part of the shoe or stem to the wheel. By this construction surface-leakage is diminished.

The exterior of the winding of each of the two shoes held into each of the filling-blocks E are coupled together by being in contact with this block, while the inner ends of the two coils held in each shoe C are in contact with the bolts D, which hold them into the shoe, and are so coupled one with the other. In this way the coils are coupled in series. Current is conveyed away from two shoes C on opposite sides of the armature-wheel. Conductors L are led from the radial stems of these two shoes to metal studs L′, secured by sulphur cement to the hub of the wheel, and from these two studs current is conveyed by the radial arms *l* to the two collector-rings *l′* *l²*, with which they are connected, and which, therefore, revolve with the armature-wheel, and are concentric with it, and from these two rings current is conveyed away by rubbers *l³*, as described in an application for patent filed January 14, 1889, Serial No. 296,325.

l⁴ represents insulating material interposed between the spindle *l⁵*, which carries the ring *l²*, and the sleeve which carries the ring *l′*.

To secure effective insulation between the armature-coils and the faces of the field-magnets, I insulate the faces of the magnet pole-pieces by coating them with enamel or ebonite or like insulating material *m*. I also coat the sides of the armature-coils with insulating material. Preferably I do this by covering them with paper *a*, Figs. 3 and 11, made to adhere by a thick layer of shellac, the shellac being heated and the paper pressed down upon it; or the sides of the coils might be covered with vulcanite by covering them with a coating of india-rubber and sulphur, and subsequently submitting them to heat to effect vulcanization. I also interpose sulphur cement or like insulating material between the rear ends of the magnet pole-pieces and the frame that carries them. This I prefer to do in the manner shown at Figs. 12 and 13. In these figures M M are iron cores or pole-pieces of the magnets. These are connected in pairs to iron shoes N, which are themselves secured to the fixed frames O by sulphur filling P, cast between them. To secure insulation between the pole-pieces and the coils of insulated conductor by which they are surrounded, each pole-piece is surrounded by a thick layer Q of insulating material.

In applications Serial Nos. 296,325 and 296,326, filed January 14, 1889, I have shown machines similar in some respects to that herein shown, and any subject-matter herein shown but not claimed will be claimed in said cases.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. An armature for a dynamo-electrical machine, composed of a number of coils ranged around the circumference of a disk or wheel, and each formed from a corrugated or interlocking strip of metal, so that the several layers of the coil interlock with one another.

2. An armature for a dynamo-electric machine, having the center of each of its coils of insulated conductor filled in with a composite structure of non-magnetic metal and insulation so arranged as to be free from induced currents.

3. An armature for a dynamo-electrical machine, composed of a number of coils ranged around the circumference of a disk or wheel, and each formed from a corrugated or interlocking strip of metal, so that the several layers of the coil interlock with one another and with the center of the coil filled in with a filling of strips of metal separated by insulating material—such, for instance, as asbestus.

4. An armature for a dynamo-electrical machine, composed of a number of coils or bobbins of insulated conductor held in metal shoes, which are ranged around the circumference of a disk or wheel with insulating material interposed between the wheel and shoes.

5. An armature for a dynamo-electrical machine, composed of a number of coils or bobbins of insulated conductor held in metal shoes, which are ranged around the circumference of a disk or wheel, and which are formed with radial stems which pass into radial holes formed in the circumference of the wheel, and insulating material interposed between the wheel and shoes.

6. An armature for a dynamo-electrical machine, composed of a disk or wheel having holes formed radially into its circumference and other holes formed at the side, near the circumference, into which the radial holes enter, and of metal shoes carrying coils or bobbins and formed with stems to pass into the radial holes, and of nuts or collars contained in the side holes and screwed or secured onto the radial stems, and of a filling of insulating substance interposed between the sides of the holes and the stems and nuts or collars.

7. An armature for a dynamo-electrical machine, composed of a disk or wheel having metal shoes ranged around its circumference and separated from it by thickly-interposed insulating material, coils of insulated conductor held in pairs in the shoes, and filling-blocks placed between the coils and the bottom of the shoes, lying with one half in one shoe and the other half in the shoe next to it, and insulated from them both.

8. An armature for a dynamo-electrical machine, composed of a disk or wheel having holes formed radially into its circumference, other holes formed at the side, near the circumference, into which the radial holes enter, metal shoes formed with stems to pass into the radial holes, nuts or collars contained in the side holes and screwed or secured onto the radial stems, and a filling of insulating substance—such, for instance, as sulphur—interposed between the sides of the holes and the nuts or collars and stems, coils of insulated conductor held in pairs in the shoes, filling-blocks placed between the coils and the bottom of the shoe, lying with one half in one shoe and the other half in the adjacent shoe, and insulated from them both.

9. An armature for a dynamo-electrical machine, composed of a disk or wheel having metal shoes carrying coils or bobbins of insulated conductor ranged around its circumference, stems projecting from the shoes and secured to the disk or wheel, interposed insulating material, and insulators of porcelain or like material placed around the stems to come between the shoes and the disk or wheel.

10. An armature for a dynamo-electrical machine, composed of a disk or wheel having metal shoes carrying coils or bobbins of insulated conductor ranged around its circumference, stems projecting from the shoes, interposed insulating material interposed between the stems and wheels, and blocks I of insulating material placed around the stems to come between the shoes and the disk or wheel.

11. In the armature of a dynamo-electric machine, the combination of the insulated bobbins and their supports, the disk or wheel that carries them, and insulating material poured or cast between the wheel and bobbin supports.

12. In an armature for a dynamo-electric machine, the combination of the supporting disk, wheel, or body, the bobbins, and interposed insulation of less thickness between adjacent conducting parts than the distance over or along the surface of the insulation exposed to the air between the parts which it is desired to insulate, whereby surface-leakage is diminished.

13. An armature for a dynamo-electrical machine, composed of a disk or wheel having ranged around its circumference coils of flat conductor having insulating material between adjacent flat surfaces, and covered at their sides with separately-applied insulating material to come between them and the magnet pole-pieces.

14. A dynamo-electrical machine having the fixed field-magnets insulated from the frame of the machine.

15. A dynamo-electrical machine in which there is a circle of magnet pole-pieces of alternate polarity at the side of the revolving armature, coupled in pairs at their rear ends, and secured by insulating material to the frame of the machine.

SEBASTIAN ZIANI DE FERRANTI.

Witnesses:

HERBERT E. DALE,

ARTHUR R. SKERTEN,

Both of 17 *Gracechurch Street, London, E.C.*