No. 606,863. **Patented July 5, 1898.**

L. GUTMANN.

ALTERNATING CURRENT DYNAMO.

(Application filed Dec. 4, 1897.)

(No Model.) 2 Sheets—Sheet I.

Fig. 1.

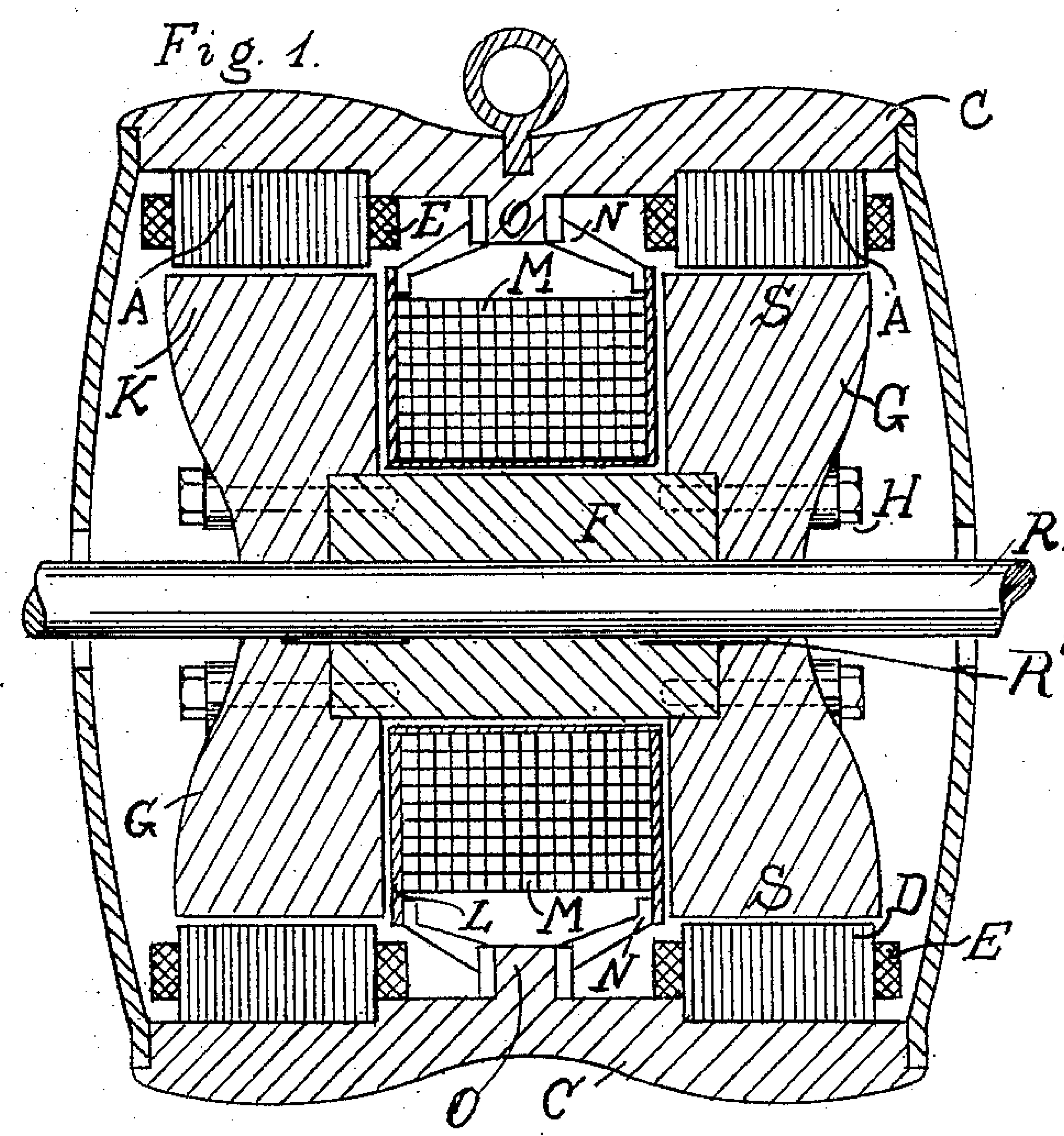


Fig. 3.

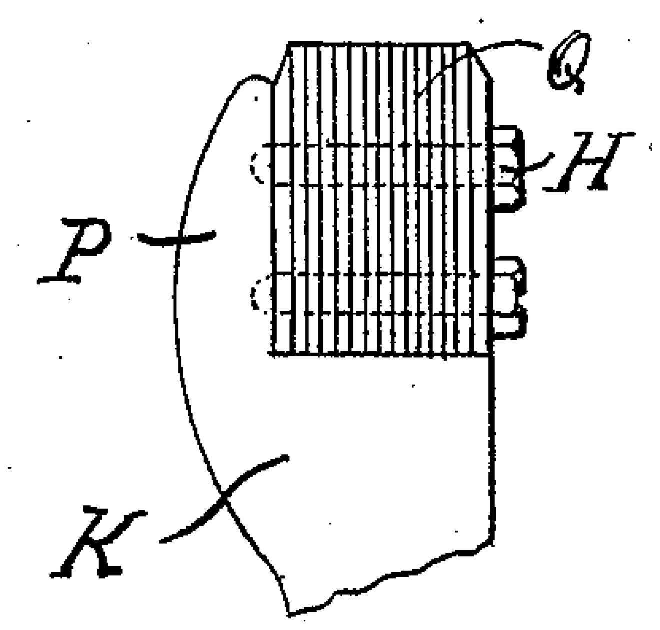


Fig. 4.

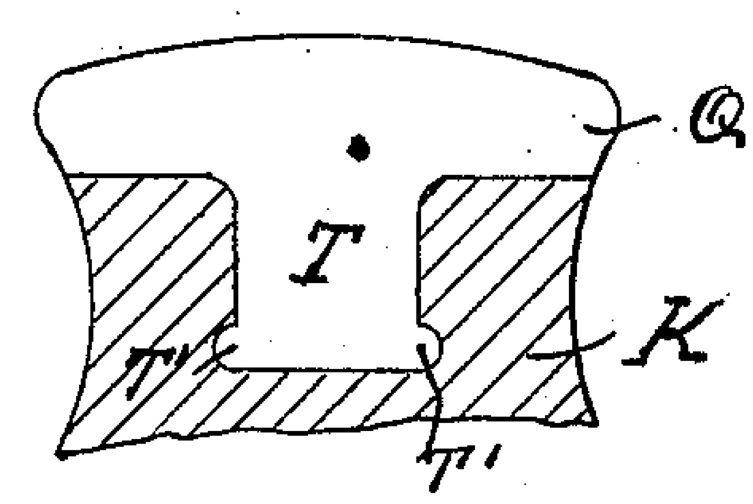


Fig. 2.

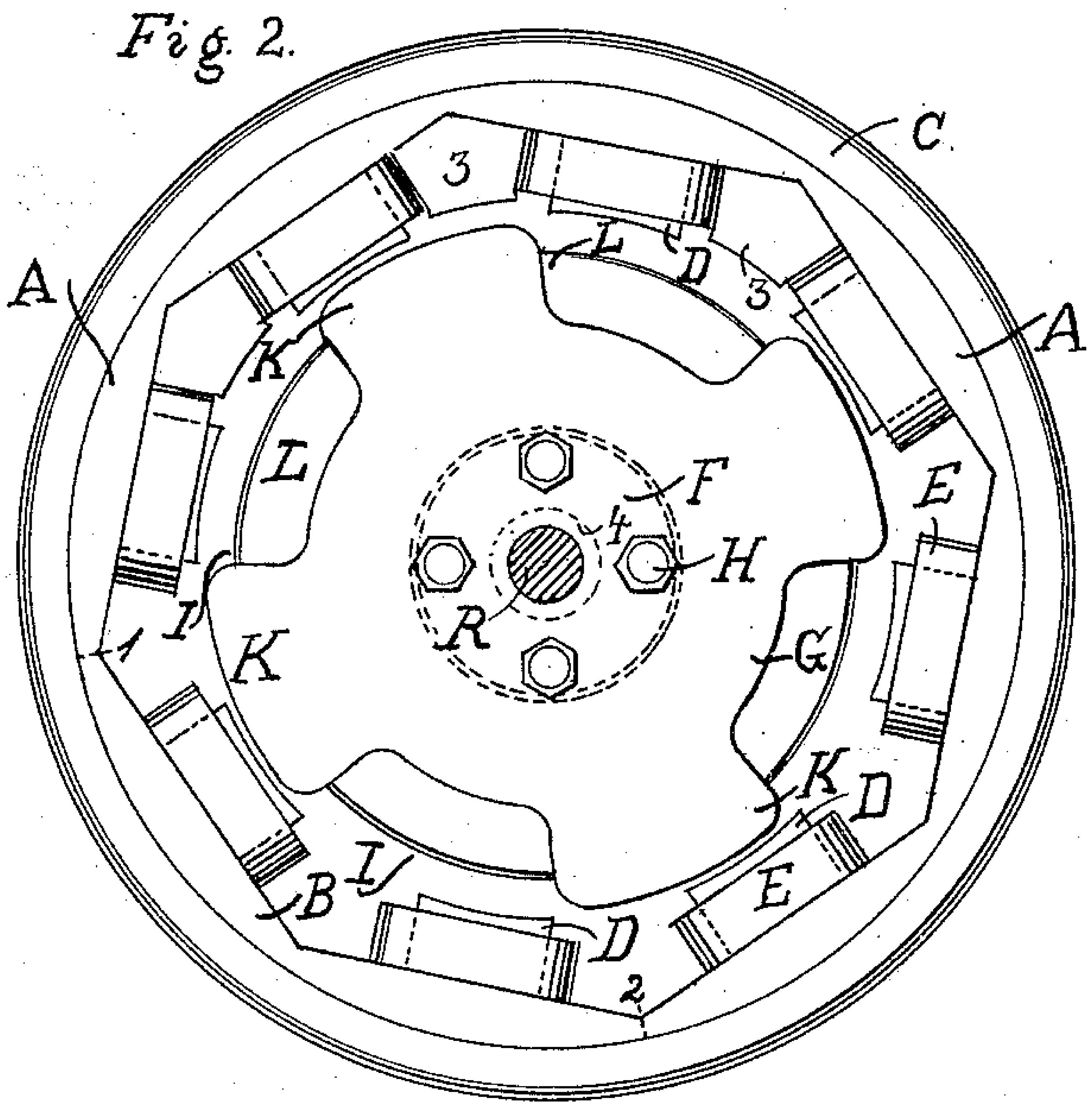
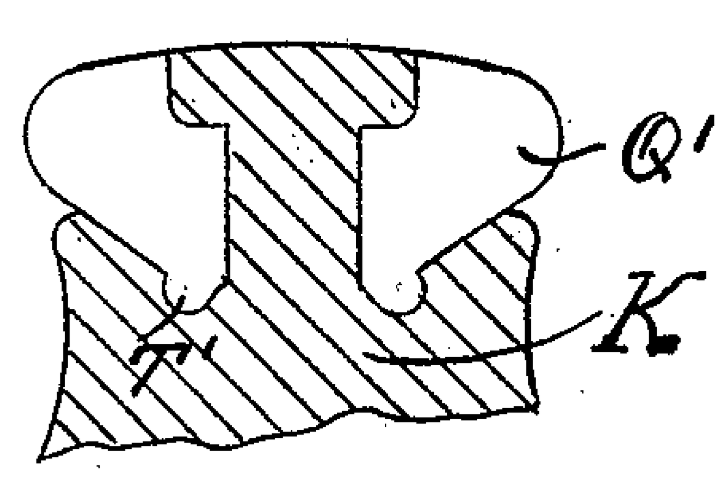


Fig. 5.



Witnesses:
Harry T. Hays.
Robert Graber

Inventor:
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(No Model.) **2 Sheets—Sheet 2.**

Fig. 6.

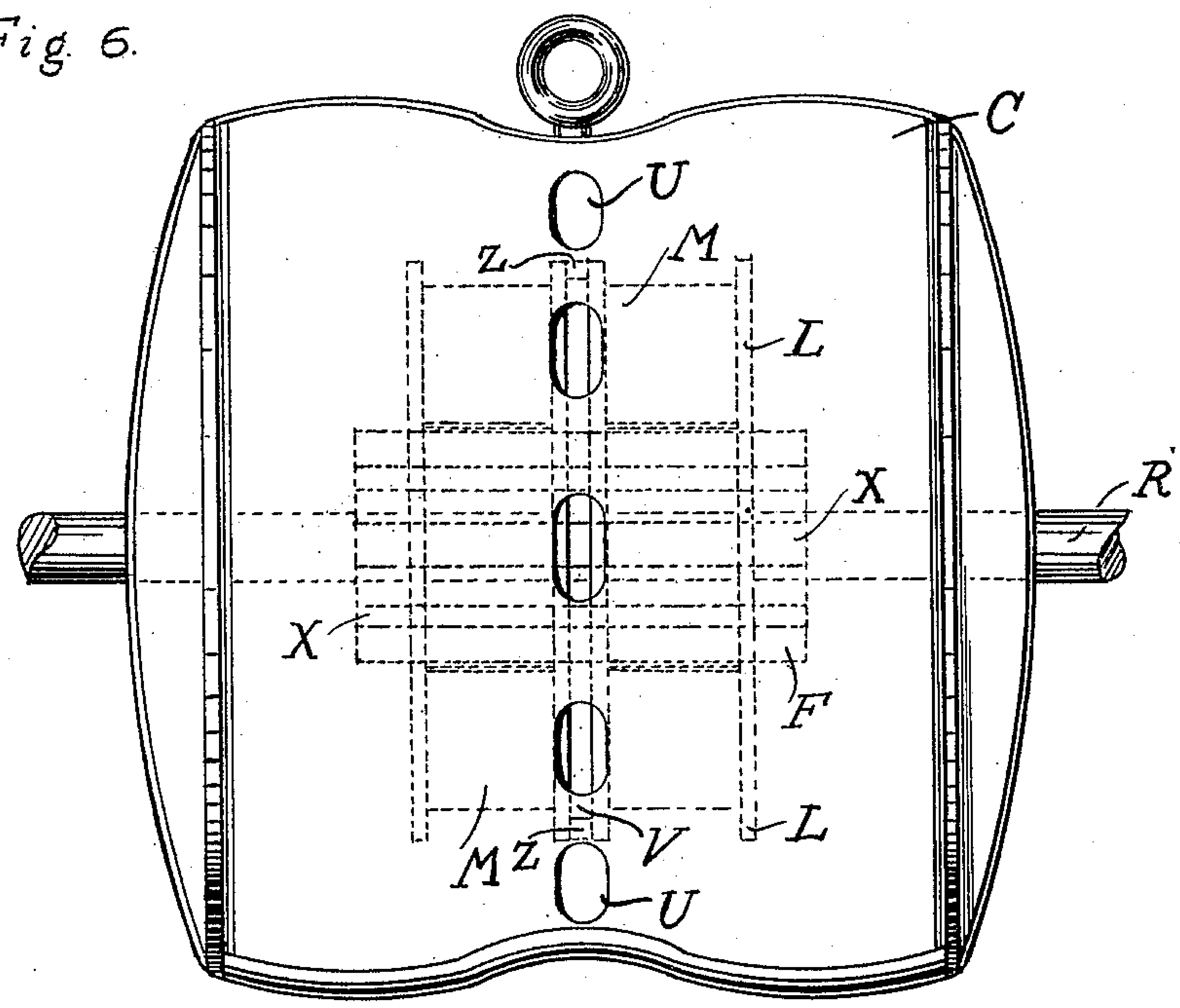


Fig. 7.

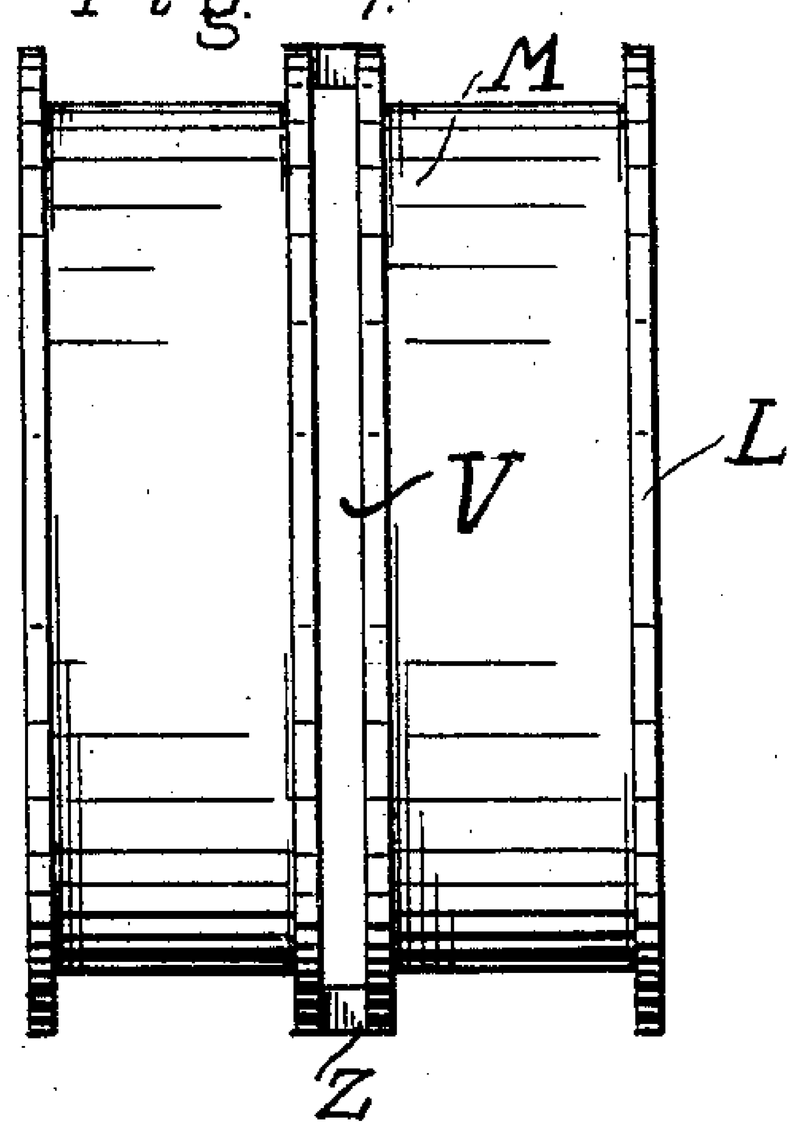
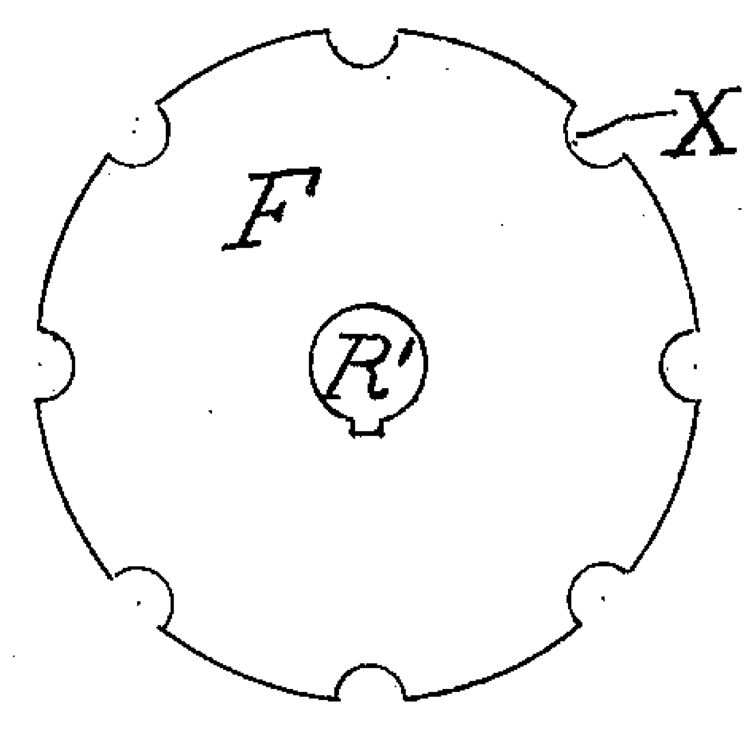


Fig. 8.



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Robert Graber

Inventor:
Ludwig Gutmann.

UNITED STATES PATENT OFFICE.

LUDWIG GUTMANN, OF PEORIA, ILLINOIS.

ALTERNATING-CURRENT DYNAMO.

SPECIFICATION forming part of Letters Patent No. 606,863, dated July 5, 1898.

Application filed December 4, 1897. Serial No. 660,768. (No model.)

To all whom it may concern:

Be it known that I, LUDWIG GUTMANN, a citizen of the United States, and a resident of the city of Peoria, county of Peoria and State of Illinois, have invented new and useful Improvements in Alternating-Current Dynamos, (Case No. 90,) of which the following is a specification.

My invention relates to dynamo-electric machines, and especially to the class of alternators in which both the field-winding and the armature-coils remain stationary.

In some inductor dynamos up to the present there exists, owing to their construction, a heavy magnetic leakage. In others this defect is reduced at the expense of increased cost by making the field-magnet core identical with that of the armature-core and rotating in front of it a piece of iron for varying the magnetic flux. This latter construction, while it leaves nothing to be desired from the standpoint of operation, has the great drawback that machines made on this plan are complicated, expensive to build, and necessarily their first cost price is high. This is evident when the size of a turn, as well as the total weight of the exciting-coil, is considered, especially for machines of large capacities. Besides, the parts become the more inaccessible the larger the cacapity of the machine.

The object of this invention is to provide a mode of construction which shall be favorable not only from the standpoint of the operator, but also for the manufacturer and purchaser, by changing the construction in such a manner as to reduce the dimensions of the machine over all for the same capacity and at the same time reduce leakage and overcome the other objections named. I accomplish this purpose, first, by making the field-electromagnet an independent structure; secondly, by giving the energizing-spool the smallest possible dimensions, and, thirdly, by providing means for ready access to all the parts subject to wear.

To explain more fully the nature of my invention, reference may be had to the accompanying drawings, in which—

Figure 1 shows a sectional view in elevation of my invention, the base and bearings being omitted. Fig. 2 is an end view in elevation of Fig. 1. Figs. 3, 4, and 5 are detailed constructions of field-magnet poles used in connection with my invention. Fig. 6 is a view in elevation of the frame of the machine, the bearings and base being omitted. Fig. 7 is a modified field-magnet-spool construction, and Fig. 8 is a modified field-magnet core.

Like letters and figures refer to similar parts in all the drawings.

Referring in particular to Figs. 1 and 2, A A are two cylindrical armature-cores of laminated iron, which may be composed of a number of superposed rings, each forming a complete circle, or else each ring or laminæ may consist of several sections, the sections built up into an annular core by superposing and assembling them in a manner well understood in the art. One such section B is indicated in Fig. 2 and located between lines 1 2. These ring-cores are provided with radial projections extending inwardly, and may be held in the casting C, of which they form the projecting ends, either by bolts or screws, or else the annular cores may be cast into this iron shell.

On the projections D of the laminated core are mounted the armature-coils E. The coils may be held in position by wooden or porcelain wedges 3. Centrally between this armature structure is located the field-magnet, of which F is the main core, of wrought-iron, cast-steel, or any other highly magnetic material. It is removably mounted on a shaft R, to which it may be keyed, as shown in Fig. 1 at R^2.

G G are iron or cast-steel pole-pieces, which are rigidly attached to core F by means of a nut 4, screwed on shaft R, (see Fig. 2,) or screw H. These pole-pieces are provided with recesses I, so as to form the projecting teeth or pole extensions K. The number of these teeth is one-half of that of the armature-teeth D and are placed an equal distance apart from one another, so that the pole projections cover alternate teeth on the armature facing them. The field-core F (whose diameter is chosen as small as consistent with proper and efficient designing of magnetic density for the capacity of the machine and for which the most permeable magnetic material is selected, so as to give the smallest possible diameter to this core) is surrounded by the field-magnet spool L, carrying the field-exciting winding or coil M. To reduce magnetic leakage, the spool is made of non-magnetic material, such as brass or copper. The flanges may be made of brass, while the cylindrical part surrounding the core F may be made of sheet-iron, but preferably of sheet-copper. This spool may be supported in any convenient way—for instance, by means of arms N to the core C at the projecting lugs O O. This mode of construction enables me to make the magnetic circuit as small as possible by leaving only enough room for the field-coil M between the poles and again making the field-coil and each individual turn as small as possible by bringing it as near the center as is possible. The whole space being filled up with active material, contrary to most inductor-dynamos, whose inductors are connected to the shaft by arms of comparatively great length, it stands to reason that with the proper utilization of the space near the shaft the size of the machine, its total weight, and cost can be reduced for the same output.

The magnetic circuit is completed as follows: As soon as an energizing-current is sent through the field-magnet coil M from any suitable source—for instance, from a battery or exciter—the core F and the pole-pieces become magnetized. All the projections on one pole—for instance, the left one—have north polarity, while the projections K on the right-hand pole-piece have south polarity. The magnetic field extends from the north poles through the laminated armature-teeth in front of the pole extensions K, through the body C, the second laminated structure A, the second field-pole, exhibiting south polarity, field-core F, and back to the first pole-piece.

Depending on the width of the armature-teeth and those of the field, the magnetic flux may be kept constant in all positions, and internal waste due to variation of flux may be avoided.

The current induced in the armature-coils is effected by commuting the flux from one set of coils covered by the field-pole projections to those next to them, which are not in the magnetic field at that instance, as well understood in the art.

An important part in my invention is the subdivision of the field-magnet structure. In most modern iron-clad inductor-alternators accessibility of parts is generally neglected, and to have access to a single coil or connection it is required to lift up the upper half of the dynamo, and should the defect be in the lower half the inductor and exciter-spool have to be removed. In other constructions complicated contrivances are added to be able to separate the parts in a vertical plane, requiring in addition the opening of connections on the armature and an increased floor-space. I have overcome this weakness by making the field-magnet core independent and small as possible and by dividing it into three parts, each consisting of a solid block of iron or steel. All three parts are removably fastened to the shaft R. The core F is located at a place where inspection is not required. To each side, however, are located the armature-coils. Experience has shown that these coils can easily be constructed to stand the work for years, and inspection is more desired for the sake of cleanliness than for necessity. Nevertheless accessibility is well appreciated if, for instance, due to lightning or similar unforseen causes, a coil or its insulation becomes defective. To handle the smallest parts and for having access to the armature-coils, the division has been made in line with the armature-coils. These end plates or pole-pieces are secured to the core F by means of screws H. If for any cause it is desired to examine the coils on one side, it is but necessary to remove the screws securing the pole-piece facing these coils, while the remaining core parts and the connections remain undisturbed. Evidently the field-core could be made in two parts by making the division in the middle of core F. However, the weight to be removed and lifted would be considerably greater, and this is unnecessary and less desirable.

Fig. 3 shows one pole extension K in side elevation. The pole-piece itself is of solid iron or steel, but the extreme end may preferably be laminated. For this purpose an extension or flange P is cast on the extreme end of K, to which a laminated block Q of the desired shape is secured by means of screws H. This block preferably projects over the extension P.

Fig. 4 shows a modified pole extension. The T-shaped laminated block Q is cast into the pole-piece K. The body part T is shown with parallel sides, and to prevent it from being thrown out by centrifugal force the projecting lugs T' are provided, which extend into the casting K. Instead of having the sides of body T parallel they may be made tapering, with the narrow end near the periphery, so as to wedge itself tighter the greater the centrifugal force.

Fig. 5 shows a further modification, which consists in subdividing only the pole-corners. It is well known in the art that heating takes place only at these points, and therefore only these places need be subdivided. In Fig. 5 the pole K extends to the periphery. The laminated corners Q' form, together with the part K, a uniform tooth. The casting has itself a T-shape projection and prevents the blocks Q' from moving outwardly. The inner part of the block Q' is provided with extensions T'', which firmly lock the laminated structures into the casting.

Figs. 6, 7, and 8 show some modified construction over Fig. 1. Fig. 6 shows the external shell-like casting C of the stationary armature, which may be provided all around with holes U. These holes penetrate through the thickness of the casting, and their object is to provide favorable means of ventilating the field-coil as well as the armature-coils. To keep this compact machine as cool as possible, I provide further means for circulation of air. Experience has shown that the rotating poles cause some circulation of air, by which the armature-coils are mostly benefited. To effectively ventilate the field-spool, I have split it into two parts, as shown in Fig. 7 and indicated in dotted lines in Fig. 6. By this means the radiating-surface of the field-coils is greatly increased. The field-magnet winding M is wound on two spools L, which are kept apart by the distance-blocks Z, thereby creating the opening V. This channel is located centrally below the holes U, and therefore the air has access to the center of the machine from all sides. Experiments have demonstrated that the revolving pole-pieces cause air to circulate through these holes and prevent the accumulation of of any warm air. To still further encourage air, circulation the core F may be provided with grooves X, as shown in Fig. 8 and indicated by dotted lines in Fig. 6.

Fig. 8 shows an end view of the core F. The central hole R′ is provided for the reception of shaft R. The channels establish a connection between the various air-spaces which exist between the rotary pole-pieces to either side of the stationary field-magnet coil and between core F and field-magnet spools L, resulting in a very efficient ventilation.

This type of dynamo is susceptible to a number of modifications, some of which have already been mentioned, and another is to make the core F stationary, while the pole-pieces G only revolve. The core F would have to be supported by spool L and would have to clear the shaft R as well as the pole-pieces. These modifications are evident and are fully within the scope of my invention, and I do not wish to limit it to the exact construction shown; but

What I desire to secure by Letters Patent is—

1. In an iron-clad inductor-alternator the combination with one or more stationary annular armature-cores and windings for the same, of a stationary field-winding, a field-core for said winding, in three solid and separable structures, and a removable shaft for said field-magnet core, as and for the purpose described.

2. In an inductor-alternator the combination of an annular armature-core having two sets of laminated structures with radially inwardly projecting poles, coils mounted on said poles, a field-energizing coil, means for securing said coil to the armature-frame, a field-magnet core adapted to rotate within the pole projections of said armature, an independent shaft for supporting said field-magnet core, and means for removing said magnet-core in parts, as and for the purpose described.

3. In an alternator the combination with a stationary iron-clad armature, of a field-magnet core for said alternator consisting of three solid structures, a shaft for said field-magnet core adapted to rotate, and means for temporarily removing said pieces from said shaft, as and for the purpose described.

4. In an alternating-current generator the combination of a rotary field-magnet core of solid magnetic material, having outwardly-projecting poles; an energizing-coil securely held between said polar projections; a stationary magnetic annulus having inwardly-extending polar projections, alternate ones corresponding with those of said field-magnet; stationary induced coils mounted on said inwardly-extending projections; and means for removing parts of the field-magnet core, as and for the purpose described.

5. In an inductor-alternator the combination with an iron-clad armature-core and winding, of a rotary field-magnet core located within said armature-core, temporarily detachable in parts.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 1st day of December, A. D. 1897.

LUDWIG GUTMANN.

Witnesses:
DAVID ROSS,
G. G. LUTHY.