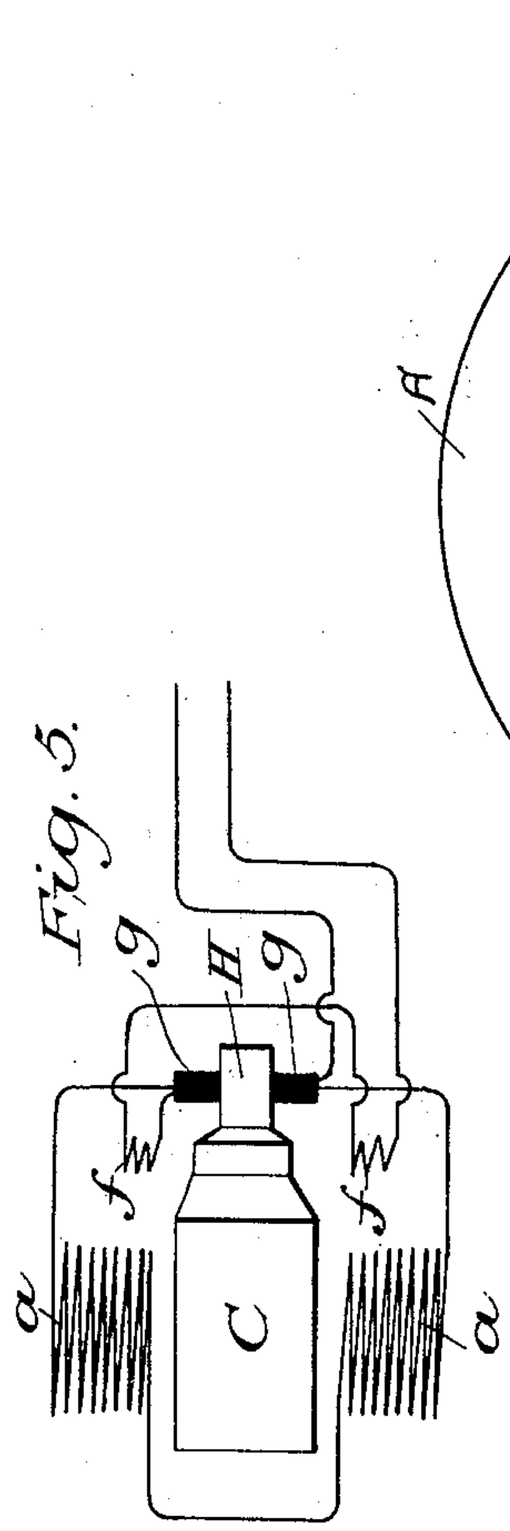
No. 760,408. PATENTED MAY 17, 1904.

L. WILSON.

DYNAMO ELECTRIC MACHINE.

APPLICATION FILED JUNE 1, 1903.

NO MODEL. 2 SHEETS—SHEET 1.



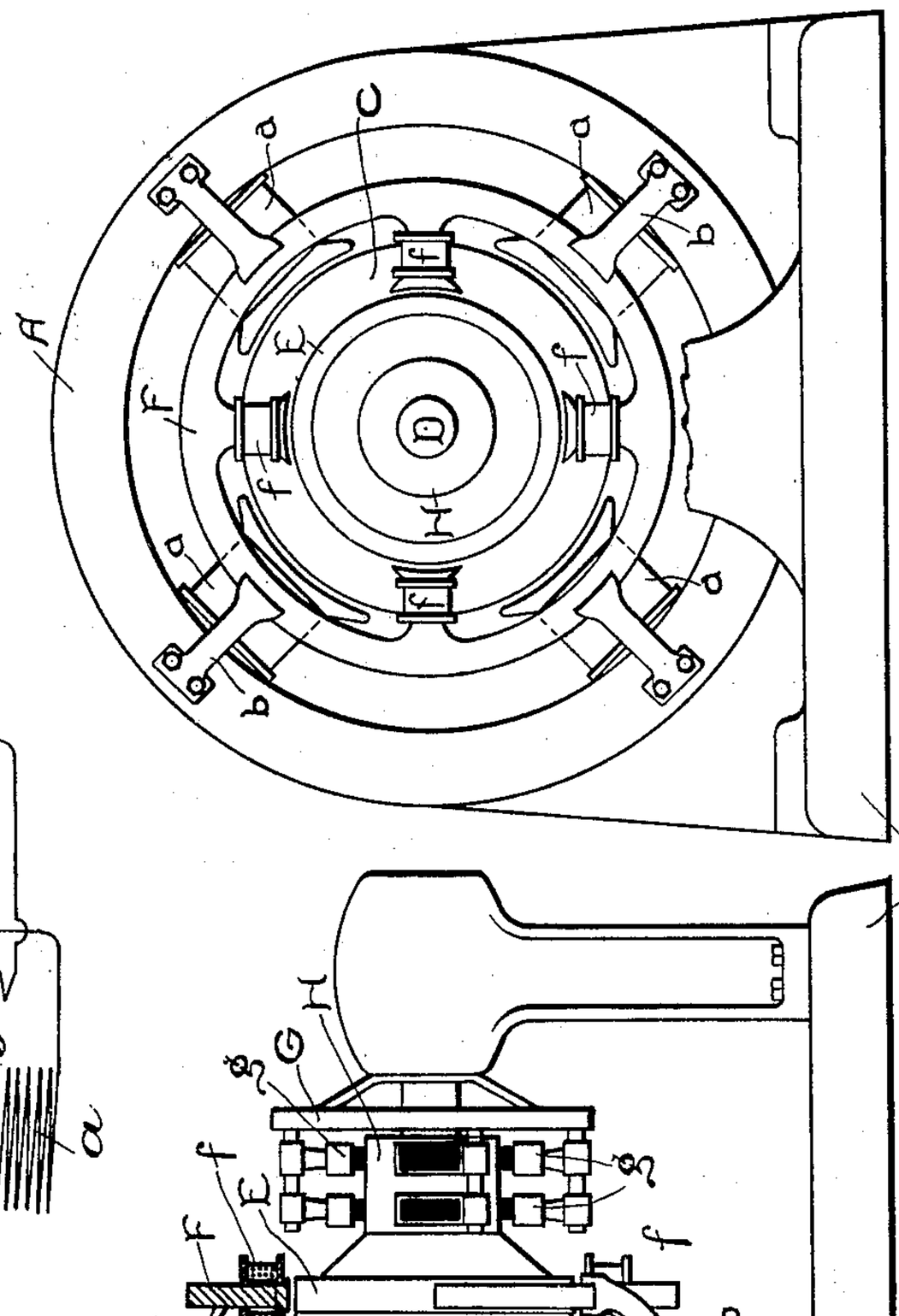


Fig. 2.

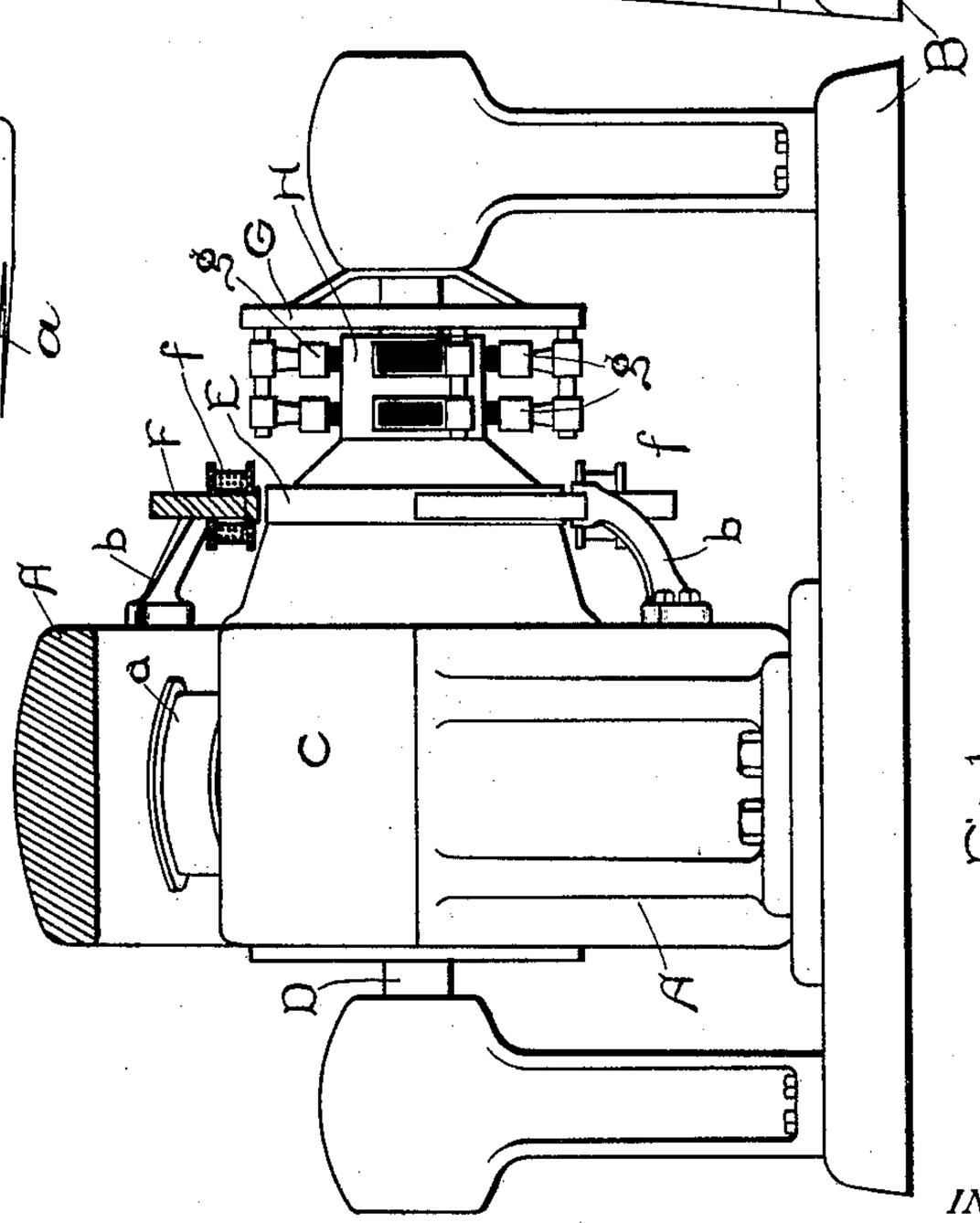


Fig. 1.

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NO MODEL. 2 SHEETS—SHEET 2.

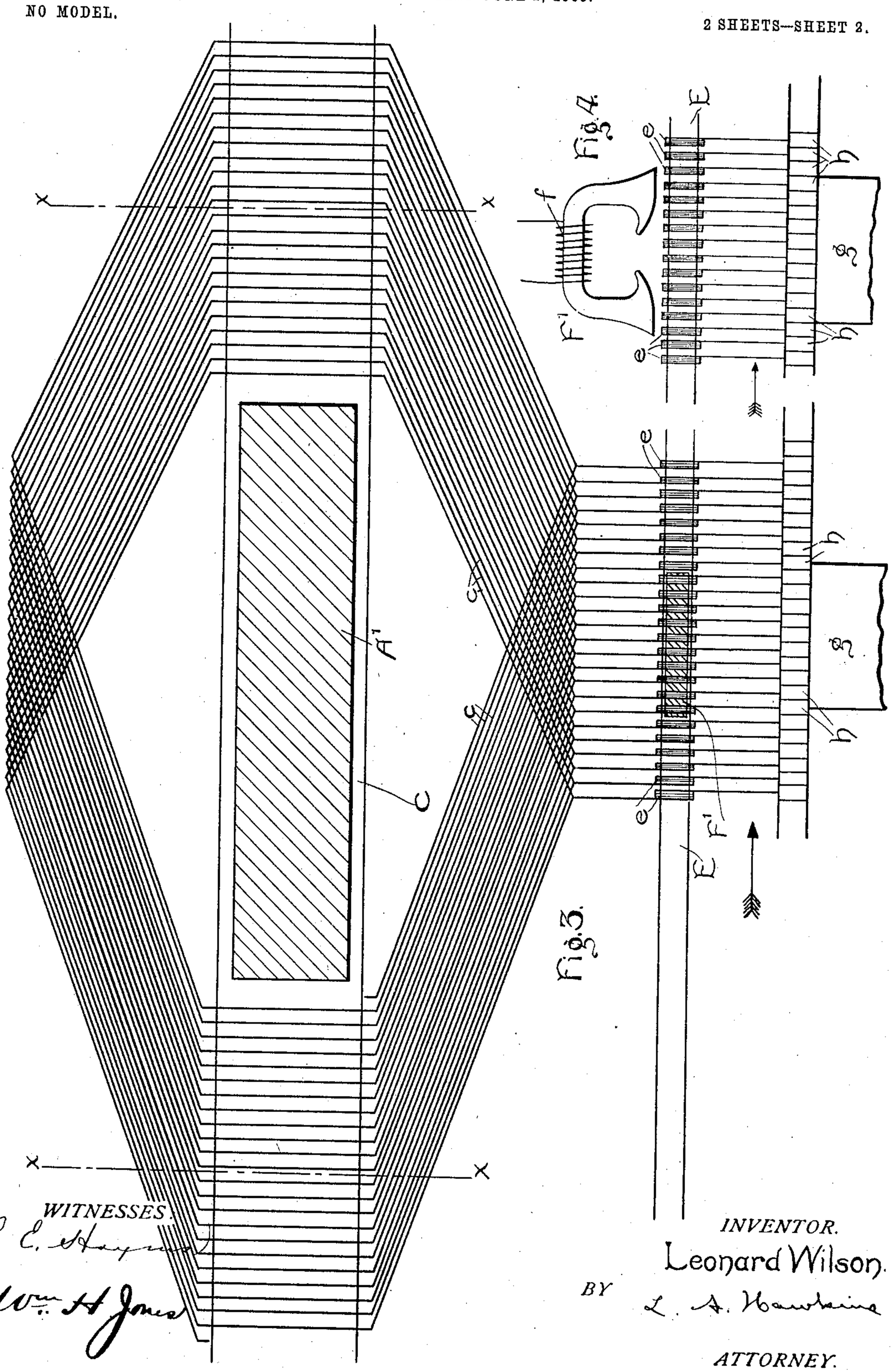

Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE.

LEONARD WILSON, OF PITTSFIELD, MASSACHUSETTS, ASSIGNOR TO STANLEY ELECTRIC MANUFACTURING COMPANY, OF PITTSFIELD, MASSACHUSETTS, A CORPORATION OF NEW JERSEY.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 760,408, dated May 17, 1904.

Application filed June 1, 1903. Serial No. 159,537. (No model.)

To all whom it may concern:

Be it known that I, LEONARD WILSON, a subject of the King of England, and a resident of Pittsfield, Massachusetts, have invented certain new and useful Improvements in Dynamo-Electric Machines, of which the following is a specification.

My invention relates to dynamo-electric machines of the direct-current type, and especially to those designed to operate at a high speed. In high-speed machines as at present built great difficulty is found in securing proper commutation. Since the frequency, and consequently the inductive effects, are very high, the voltages generated in the coils at any instant on each side of the neutral line are comparatively high, and if a wide brush is used, covering several commutator-segments, and thus short-circuiting several coils, large currents will flow, heating the coils, commutator, and brush and producing sparking. This evil is increased by the inequalities in the voltages in the coils short-circuited by the brush, which produce an uneven current distribution through those coils and through the commutator and brush, and thus augment the heating and the sparking. To avoid this difficulty, it has been customary to use very narrow brushes on high-speed machines, covering only one or two commutator-segments at a time; but this practice introduces another difficulty. The time for current reversal in each coil as it passes the brush is at best of small duration in high-speed machines, and the use of a narrow brush reduces this to a mininum. The time is thus much too short for satisfactory reversal and good commutation, and this deficiency results in highly-objectionable sparking. This evil is increased by the high-current density in commutator bars and brushes, which is rendered necessary by the narrow brush and which produces undue heating at the brush-contacts.

The object of my invention is to provide a structure which shall avoid these evils.

By my invention a wide brush may be used on high-speed machines, thus obtaining low-current densities and providing ample time for proper reversal and yet wholly avoiding local excess or uneven distribution of current.

Referring to the drawings, Figure 1 shows a side view of a structure embodying my invention, the upper part of the field being shown in cross-section. Fig. 2 shows an end view of such a structure with one bearing and the brush-holder removed. Fig. 3 shows a partial development of the winding of such a machine, and Fig. 4 shows a detail of a modification. Fig. 5 is a diagram of connections.

Referring first to Figs. 1 and 2, A represents the main field-magnet mounted on base B and carrying the field-coils *a a*. These coils may be shunt, series, or compound wound, as in the ordinary dynamo-electric machine. These coils are shown as shunt-coils in diagram of connections, Fig. 5. C is the main armature, shown as of the usual drum type, carried on shaft D. Also carried on shaft D is the small auxiliary armature E. This armature may be of any well-known type; but for convenience of winding I prefer the ring type. The winding of this armature will be described later. F is the auxiliary field, carrying the field-coils *f f* and supported from the main field by brackets *b b*. Field F is mounted in brackets *b b* in a manner similar to the usual construction for the brush-holder ring in dynamo-electric machines as ordinarily constructed, so that it may be rotated in its own plane for purposes that will be evident later. Coils *f f* are connected in series with the armature like ordinary series field-coils, as shown in Fig. 5. G is the brush-holder ring carrying the broad brushes *g g*, bearing on the commutator H.

Referring now to Fig. 3, C represents the main armature, with some of the coils *c c* at and on each side of the neutral lines *x x* developed. A′ represents a pole of the main field. The winding of coils *c c* is of a well-known type and needs no description. *g* represents one of the brushes bearing on several commutator-segments *h h*. E represents the auxiliary armature between the main armature and the commutator. Each lead from the coils *c c* before passing to its commutator-

segment makes a few turns around the auxiliary armature E, forming the armature-coils *e e*. F′ represents a pole of the auxiliary field. The direction of rotation of the armature is shown by the arrow.

The coils *e e* of the auxiliary armature are of comparatively high resistance. It is therefore obvious that their insertion in the commutator-leads from the main armature will prevent the flow of heavy currents in the coils short-circuited by the brush and also will prevent uneven distribution of current-flow due to small differences in voltage in the coils connected to the brush. Thus the excessive heating and sparking that result from these two causes in ordinary machines if it is attempted to use a broad brush are eliminated from this structure.

The purposes of the auxiliary field-pole F′ are two. In the first place by its use I am able to compensate for the voltage drop that would otherwise take place due to the high resistance of coils *e e*. By winding the auxiliary field with series coils and by keeping the magnetic density low I am able to generate in the coils *e e*, which are in circuit—*i. e.*, connected at any time to the brush—an electromotive force equal on all loads to the voltage drop in these coils due to their resistance. This resistance drop is thus perfectly compensated for, and the voltage regulation of the machine is in no wise impaired.

The second purpose of the auxiliary field is to assist in the proper reversal of current in the main armature-coils that are passing through the neutral space. It will be seen in Fig. 3 that pole F′ is slightly in advance of brush *g* with respect to the armature. It is to secure this adjustment that the auxiliary field is made movable in its supports, as has been heretofore described, whereby the auxiliary field may be adjusted exactly as the position of the brushes is adjusted in machines as ordinarily built. The object of this advance is as follows: It will be seen from the drawings that before a coil *e* reaches the brush *g* it will have passed under the pole F′ and will thus have an electromotive force generated in it which will oppose the reactive voltage produced by the flow of current when its commutator-segment reaches the brush. After the segment reaches the brush and current is flowing through the auxiliary coil pole F′ furnishes the necessary electromotive force to compensate for the resistance drop, as has been heretofore described; but before the coil leaves the brush it passes out from the influence of the pole. The coil thus acts as so much dead resistance, and the current is shunted from it through the following coils. Thus as the coil and its segmant leave the brush there is almost no current flowing through them. There is consequently little current to break, and the segment leaves the brush without a spark.

Fig. 4 shows a modification in the auxiliary field. In this arrangement two poles are used at each brush instead of one. By this means the electromotive force in the auxiliary coil is reversed before leaving the brush. This has the advantage that the current flowing through the segment that is leaving the brush can be reduced to zero, thus completely destroying the possibility of the smallest sparking. This arrangement has the disadvantage, however, that the perfectly even distribution of current in the coils under the brush obtained in the arrangement of Fig. 3 is no longer possible, and the compensation for resistance drop must be obtained by extra turns on the main field; but with the size of brush made possible by my invention unevenness of current distribution is not the serious disadvantage that it is with ordinary structures where the brush is narrow and the current density is high at best, while the few turns necessary for compensation may be placed with equal facility on the main or auxiliary field. The choice between one or two poles per brush for the auxiliary field is therefore open to the designer, who may select the arrangement best suited to meet the particular conditions of operation in the machine.

Since the auxiliary coils carry only a small portion of the current in the main armature-coils (one-fifth in the case illustrated in Fig. 3) and carrying it only when passing the brush, it is evident that they may be made of small cross-section, so that the necessary resistance can be obtained with little expense in the winding.

It is obvious that by my invention I avoid the difficulties of heavy short-circuit currents and of uneven current distribution, with consequent excessive heating and sparking, which are the necessary concomitants of a broad brush in high-speed machines of ordinary structure, while, on the other hand, I avoid the disadvantages of high-current densities and inadequate current reversal which follow the use of a narrow brush.

I do not desire to limit myself to the particular construction and arrangement of parts here shown, since changes therein which do not depart from the spirit of my invention and which are within the scope of the appended claims will be obvious to those skilled in the art.

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

1. In a dynamo-electric machine, armature-coils, a commutator, leads from said armature-coils to said commutator, brushes bearing on said commutator and short-circuiting a plurality of said armature-coils, resistances inserted in said leads, and means for compensating for the voltage drop in the leads excepting those leads that are leaving said brushes.

2. In a dynamo-electric machine, main ar-

mature-coils, a main field, a commutator, leads from said main armature-coils to said commutator, brushes bearing on said commutator and short-circuiting a plurality of said main armature-coils, auxiliary armature-coils of high resistance inserted in said leads, and an auxiliary field adapted to compensate for the voltage drop in said auxiliary coils.

3. In a dynamo-electric machine, main armature-coils, a commutator, leads from said coils to said commutator, brushes bearing on said commutator and short-circuiting a plurality of said coils, resistances inserted in said leads and means for compensating for the voltage drop in said resistances.

4. In a dynamo-electric machine, main armature-coils, commutator-segments, leads from said coils to said segments, brushes bearing on said segments and short-circuiting a plurality of said coils, and means adapted to produce an electromotive force in said leads tending to assist the current-flow in the leads whose armature-segments are arriving at the brushes and to oppose the current-flow in the leads whose commutator-segments are leaving the brushes.

5. In a dynamo-electric machine, main commutator-coils, commutator-segments, leads from said coils to said segments, brushes bearing on said segments and short-circuiting a plurality of said coils, resistances inserted in said leads, and means adapted to produce an electromotive force tending to assist the current-flow in the leads whose commutator-segments are arriving at the brushes.

6. In a dynamo-electric machine, main commutator-coils, commutator-segments, leads from said coils to said segments, brushes bearing on said segments and short-circuiting a plurality of said coils, auxiliary coils of high resistance inserted in said leads, and a magnetic field adapted to produce an electromotive force in said auxiliary coils tending to assist the current-flow in said leads, except in those of said leads whose commutator-segments are leaving the brushes and to compensate for the resistance drop of voltage in said auxiliary coils.

Signed at Pittsfield, Massachusetts, this 26th day of May, 1903.

LEONARD WILSON.

Witnesses:

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R. E. HAYNES.