No. 713,603. Patented Nov. 18, 1902.

A. CHURCHWARD.

DYNAMO ELECTRIC MACHINE.

(Application filed Jan. 2, 1900.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.

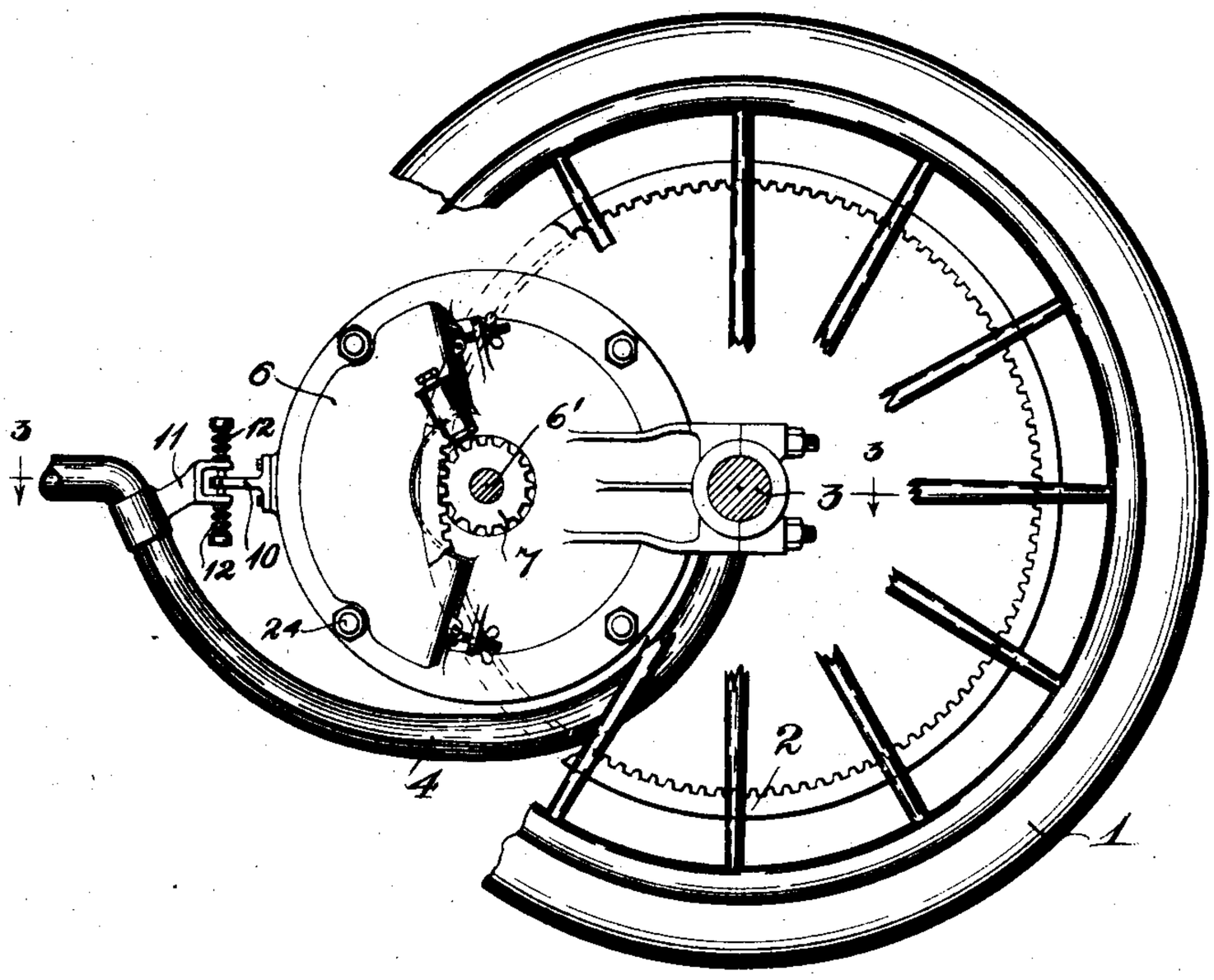
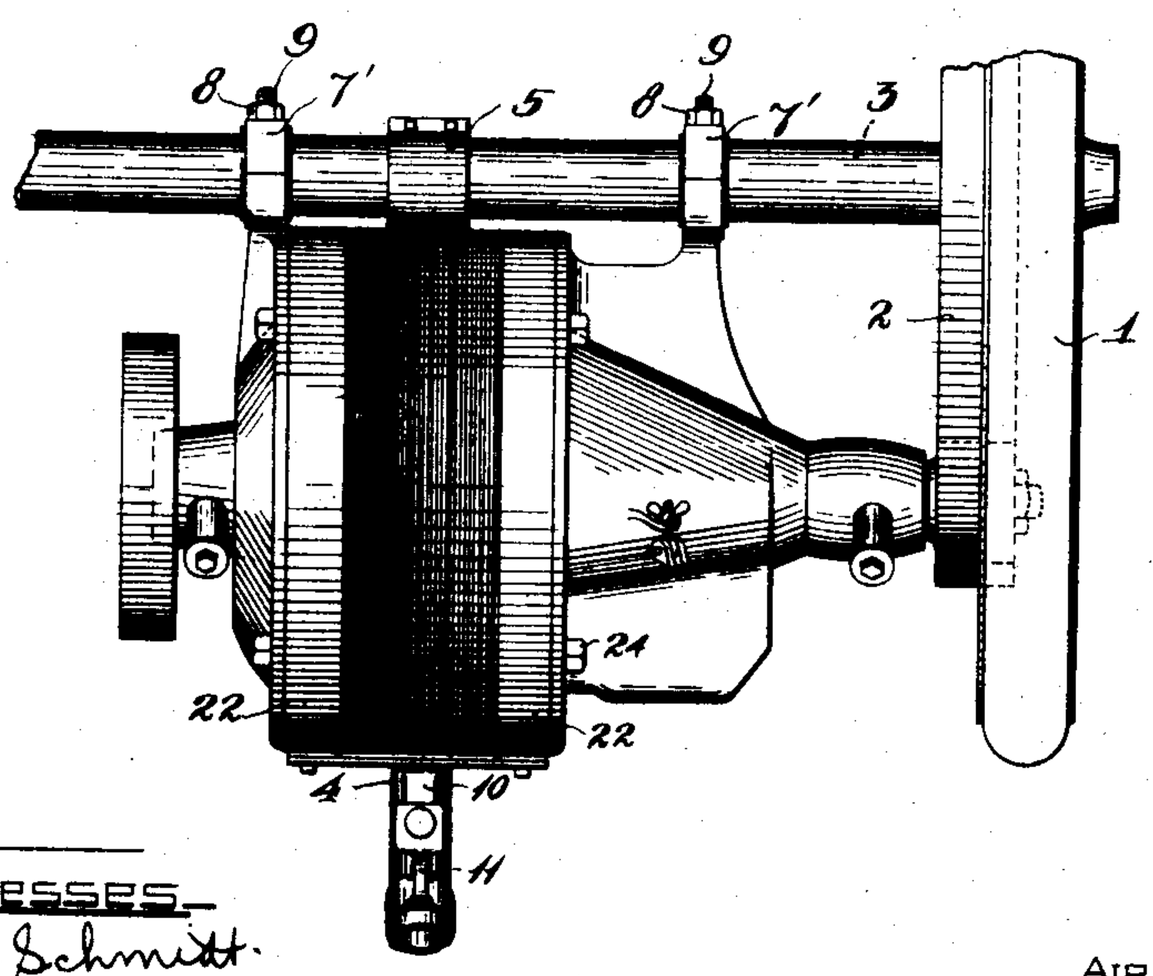


Fig. 2.



Witnesses.
C. J. Schmitt.
Max Laibel.

Inventor
Alexander Churchward
By Charles A. Brown & Cragg
Attorneys

No. 713,603. Patented Nov. 18, 1902.

A. CHURCHWARD.

DYNAMO ELECTRIC MACHINE.

(Application filed Jan. 2, 1900.)

(No Model.) 4 Sheets—Sheet 2.

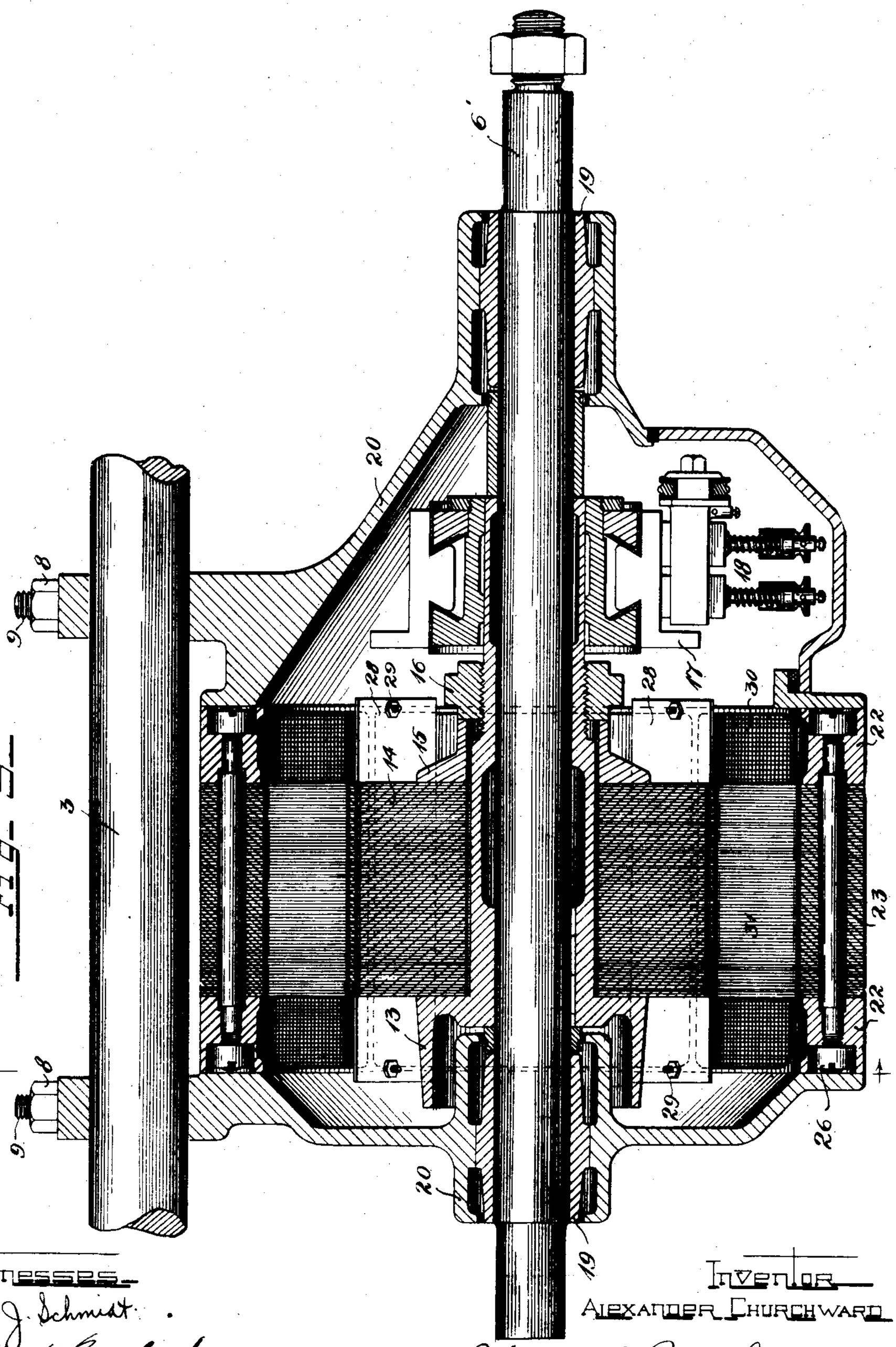


Fig 2.

Witnesses
C. J. Schmidt.
Max Zadek

Inventor
Alexander Churchward
By Charles A. Brown & Sons
Attorneys

No. 713,603. Patented Nov. 18, 1902.

A. CHURCHWARD.

DYNAMO ELECTRIC MACHINE.

(Application filed Jan. 2, 1900.)

(No Model.) 4 Sheets—Sheet 3.

Fig. 5.

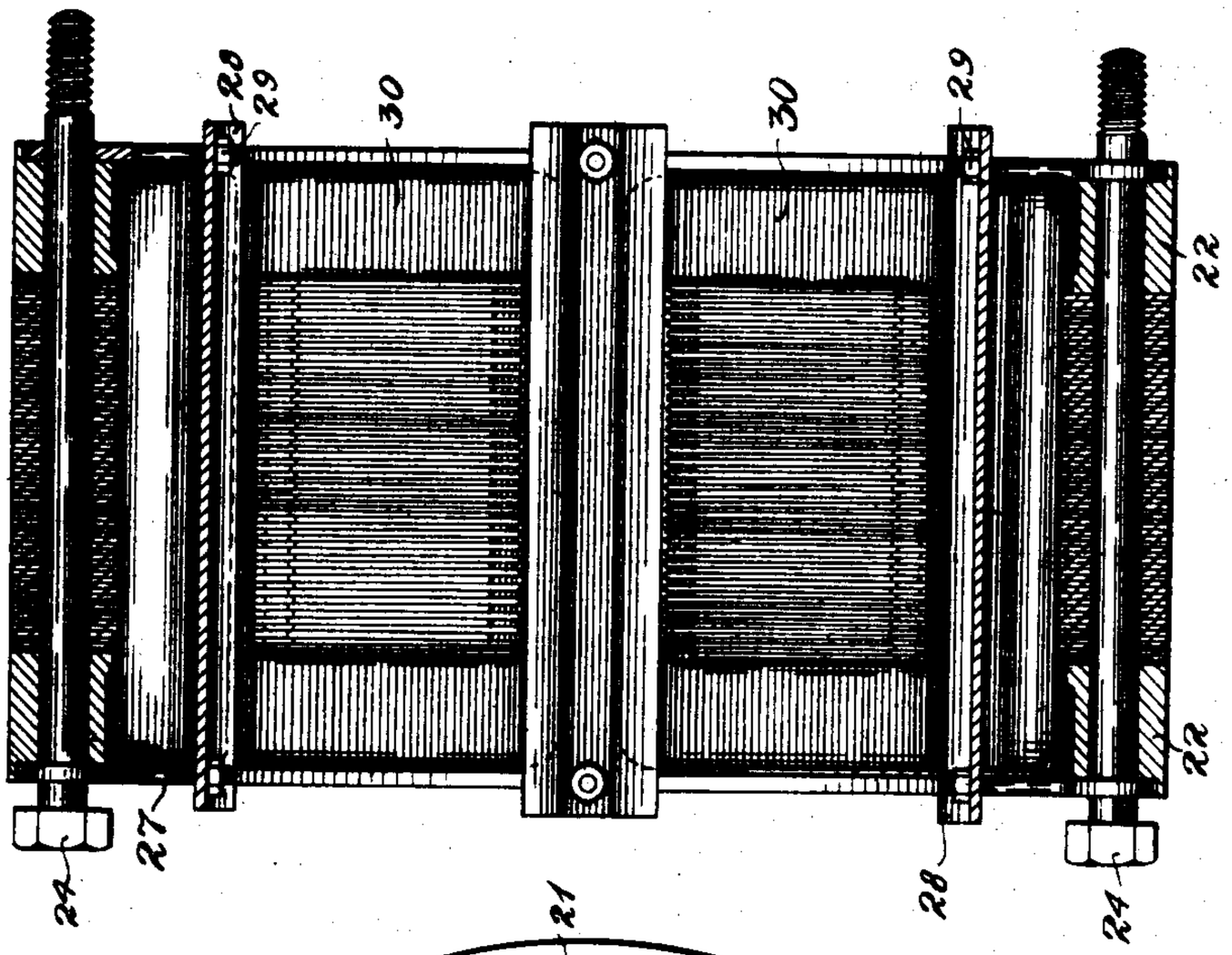
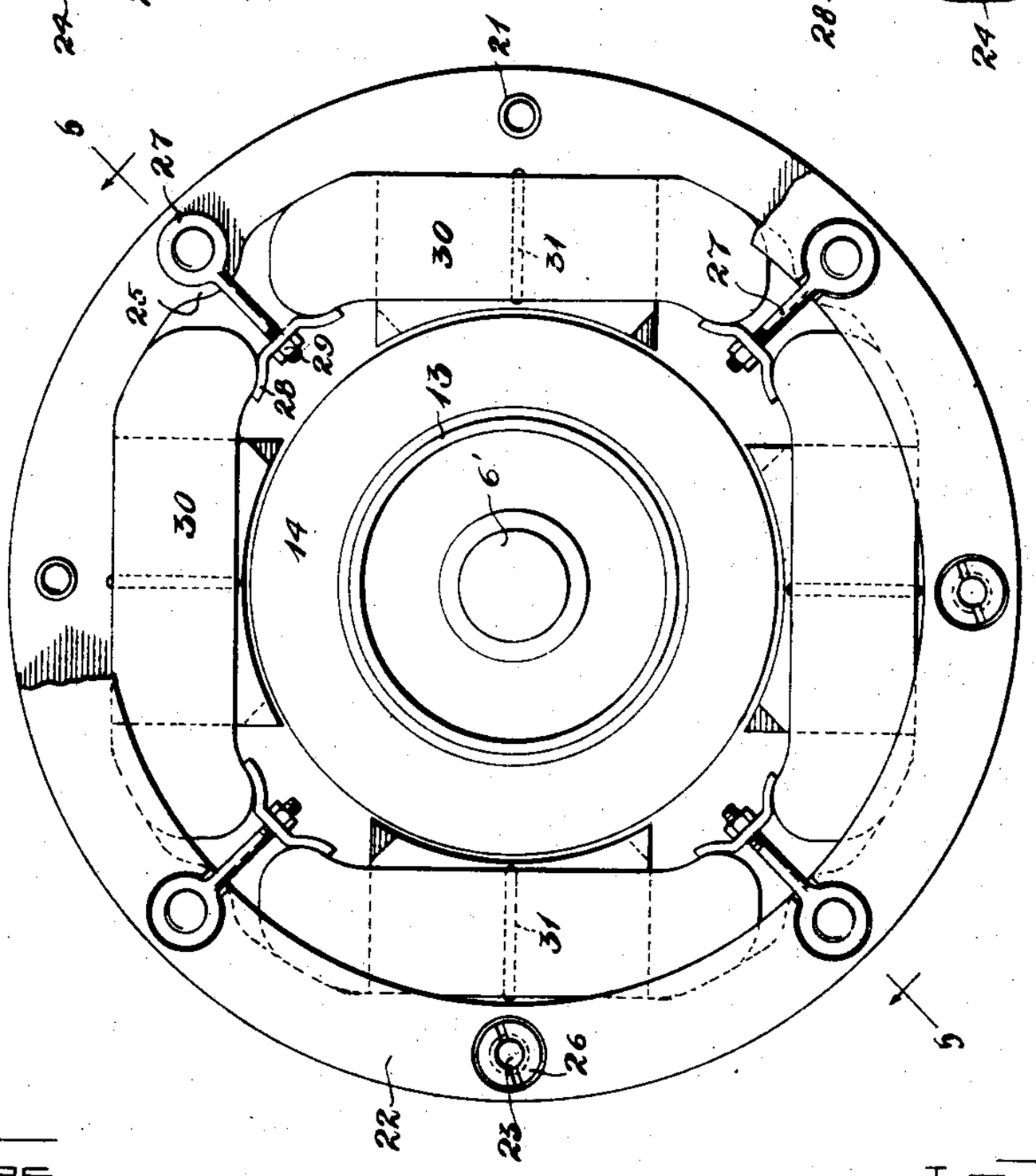


Fig. 4.



Witnesses—
C. J. Schmidt.
Max Zaled.

Inventor—
Alexander Churchward
By— Charles A. Brown & Cragg
Attorneys

No. 713,603. Patented Nov. 18, 1902.

A. CHURCHWARD.

DYNAMO ELECTRIC MACHINE.

(Application filed Jan. 2, 1900.)

(No Model.) 4 Sheets—Sheet 4.

Fig 6

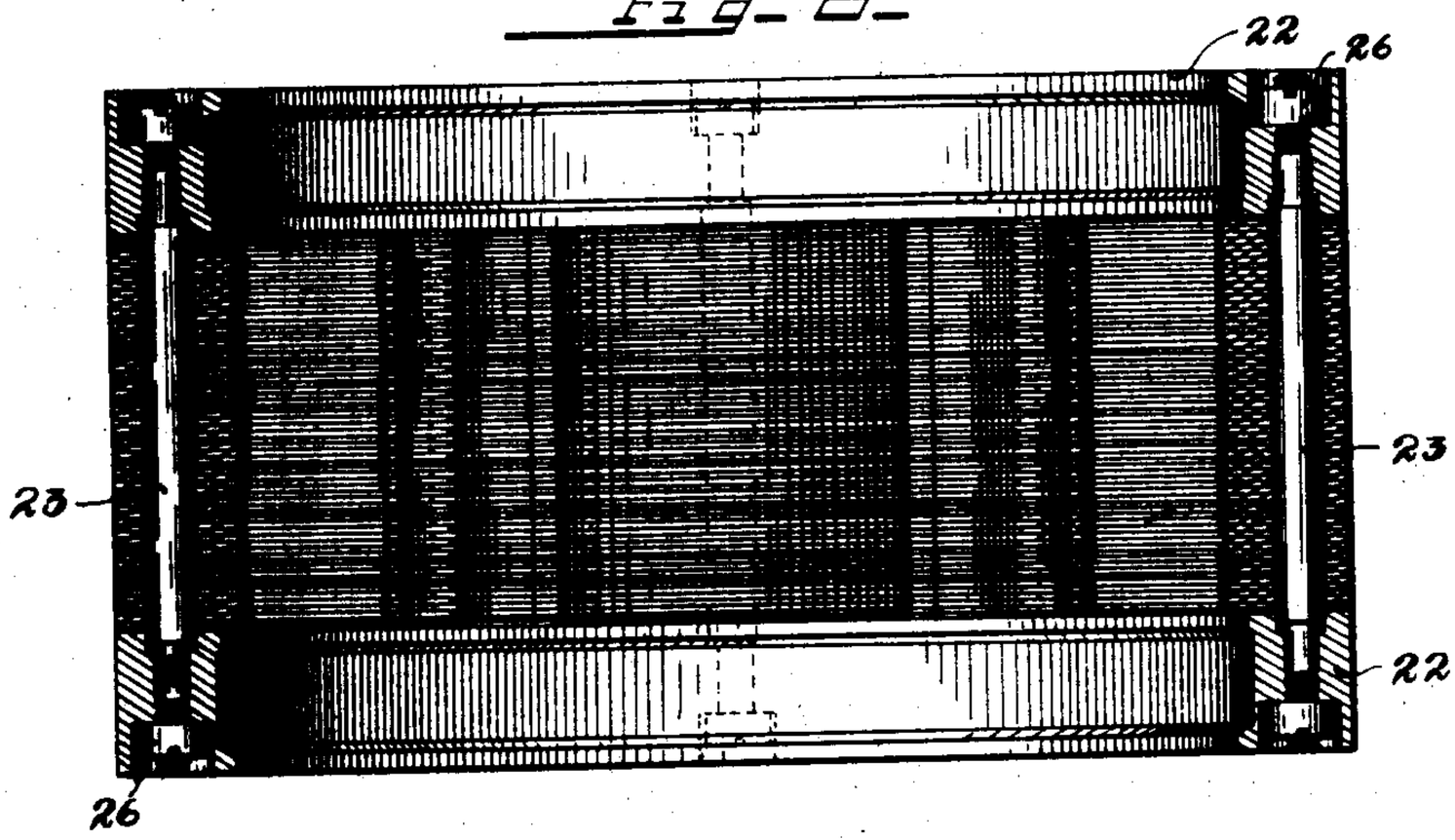
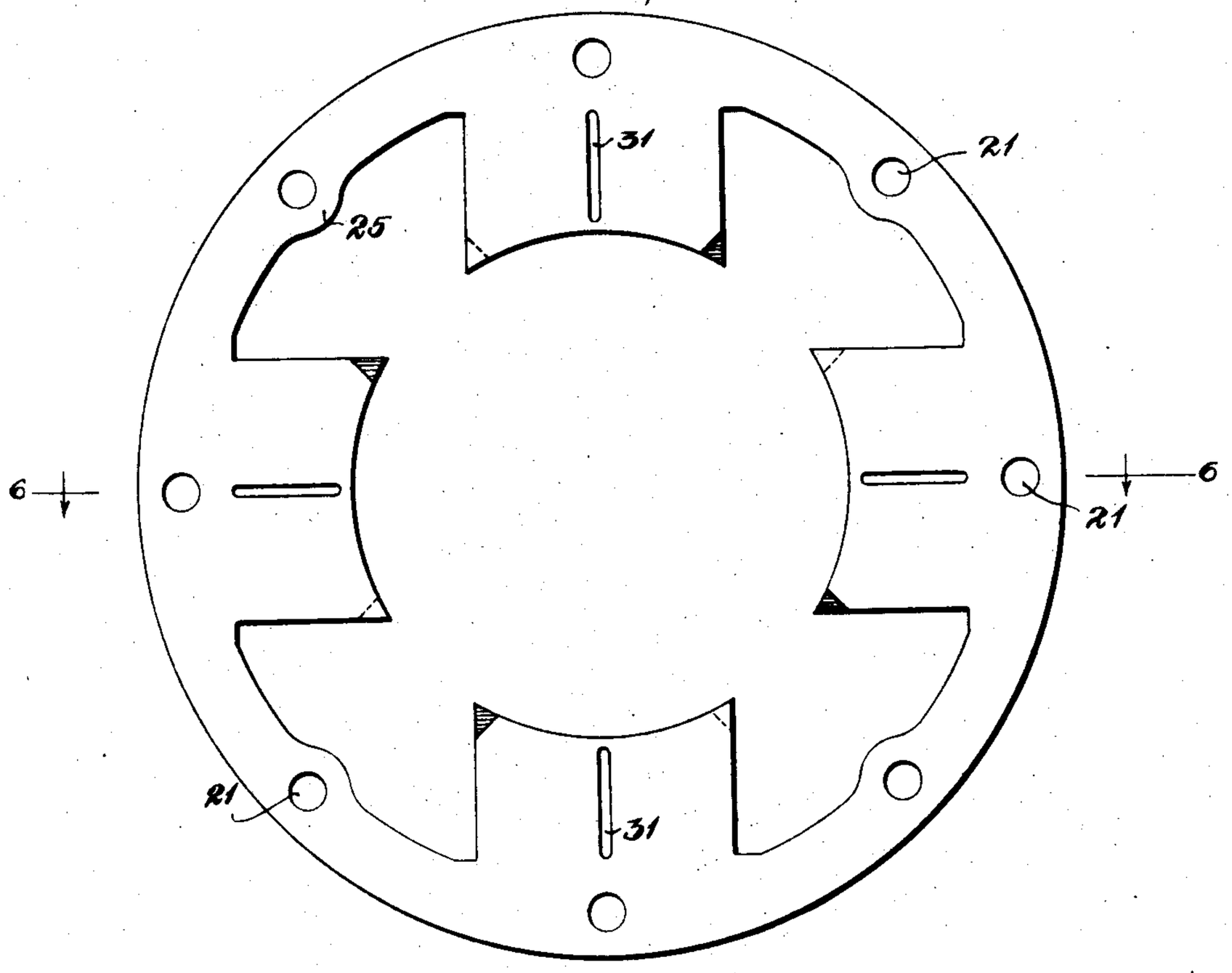


Fig 7



Witnesses—
C. J. Schmidt.
Max Zahn.

Inventor
Alexander Churchward
By— Charles A. Brown & Cragg
Attorneys

UNITED STATES PATENT OFFICE.

ALEXANDER CHURCHWARD, OF CHICAGO, ILLINOIS.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 713,603, dated November 18, 1902.

Application filed January 2, 1900. Serial No. 97. (No model.)

To all whom it may concern:

Be it known that I, ALEXANDER CHURCHWARD, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Dynamo-Electric Machines, (Case No. 294,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to dynamo-electric machines, and has for its object the provision of an improved construction thereof.

By means of my invention I am enabled to form the component parts of the dynamo separately and to readily assemble the same by simple mechanical means. I am further enabled to improve the efficiency of the dynamo by a novel construction of the poles, by which the armature reactions are reduced and sparking at the commutator counteracted.

My invention further consists in improved means for retaining the coils of the machine in position.

The dynamo of my invention is primarily designed and is particularly adapted for use in connection with motor-driven vehicles; but I do not wish to limit myself to the use to which the invention may be put, nor do I wish to be limited to the employment of all of my improvements in one machine, as a portion of the improvements alone may be useful when employed in other connections.

One feature of my invention consists in its preferred embodiment in forming a portion of the dynamo of laminated rings, which are assembled between retaining-rings and secured in place thereby. I preferably employ bolts, which pass through the laminæ longitudinally of the axis of rotation of the armature. A portion of these bolts serve only to secure the laminæ and retaining-rings together. Other bolts are employed, which not only act in a similar capacity, but which also serve to secure inclosing bonnets or caps in engagement with the retaining-rings. These assembled laminæ in the preferred embodiment of the invention constitute a field-core and are provided with polar projections which extend radially inward and about which the field-coils are disposed. The retaining-rings and the laminated rings also serve in the preferred construction to engage eyebolts which are secured to retaining clamps or plates engaging the field-coils, whereby the field-coils are firmly held in position. The retaining eyebolts and clamps serve to hold the field-coils firmly in engagement with the interior of the annular laminæ and prevent the field-coils from being dislodged.

That feature of my invention which has for its object the provision of improved means for overcoming the injurious effects of armature reactions is designed more particularly for use in connection with direct-current dynamo-electric machines, as the induction in alternators is not usually of so high a value, the disturbing influences being more effective in direct-current machines. The rotation of an armature in a field of lines of force is usually accompanied by the displacement of the lines of force and the distortion of the uniformity of induction, the lines of force tending to follow in the wake of the armature, thereby increasing the induction at the so-called "trailing pole-tips" with respect to the normal magnetization along the remainder of the surfaces of the pole-shoes opposed to the armature. This tendency of the lines of force to follow the armature occasions difficulties in the operation of dynamo-electric machines, among which may be mentioned an injurious increase of the armature reactions, the distortion of the field increasing with the load thereon. Magnetic leakage also takes place to an increased extent, thereby decreasing the general efficiency of the machine. The effect of this increased armature reaction is to cause sparking effects at the commutator, which in some instances makes it necessary to change the position of the brushes upon changes in load. This latter means for counteracting the injurious armature reactions is obviously difficult of attainment when the machines are used as motors upon motor-driven vehicles. Other means have been employed for overcoming these defects—such as lamination of the pole-shoes in a particular direction, provision of auxiliary magnets, or the like—many of which increase the cost of construction and maintenance considerably.

It is one of the prime objects of my present

invention to provide an improved means for eliminating these defects and to increase the inherent tendency of the machine to regulate itself automatically.

In practicing my invention I chamfer a portion of each of the pole-tips in order to distribute the flux which tends to concentrate at the entering pole-tips, the lines of force then emanating from a larger pole area and being more evenly distributed over the armature-surface, by which means the plane of commutation is displaced but slightly, and while it may not coincide with the neutral plane it may be so chosen that the conductors of the armature which are under commutation will then more readily permit of the reversal of current therethrough at any load.

Where the machine is designed to rotate in both directions, it is obvious that what at one time may be the trailing pole-tips are at another the entering pole-tips. I therefore chamfer, preferably, about one-half of each pole-tip, by which arrangement I am enabled to reduce the injurious effects of armature reactions and at the same time do not impair the effectiveness of the leading pole-tips, as a portion of each leading pole-tip remains intact, being thereby brought within effective range of the armature. To further increase the effectiveness of my construction, I provide slots in the polar projections which serve further to determine the flow of the magnetic flux.

I will describe my invention more particularly by reference to the accompanying drawings, in which—

Figure 1 is a side view of a motor constructed in accordance with my invention shown in coöperative relation with a vehicle driving-wheel. Fig. 2 is a longitudinal elevation of the motor shown in Fig. 1. Fig. 3 is a sectional view on line 3 3 of Fig. 1. Fig. 4 is a side elevation with one of the bonnets removed, a portion of the clamping-ring being also removed to reveal the construction more clearly. Fig. 5 is a view in cross-section on line 5 5 of Fig. 4. Fig. 6 is a sectional view on line 6 6 of Fig. 7, the clamping or retaining rings and the clamping-bolts being shown also. Fig. 7 is a side elevation of the laminated portion of the structure, the clamping bolts and rings being removed.

Like parts are indicated by similar characters of reference throughout the different figures.

Each driving-wheel 1 of the motor-vehicle may be provided with an annular gear 2. The shaft 3 of the wheel is shown as provided with a perch 4, secured by means of a split sleeve 5 to the shaft or axle 3 at one end. This perch is preferably curved downwardly, as shown in Fig. 1, to accommodate the motor 6. The motor-shaft 6′ is provided with a pinion 7, which engages the gear 2. This motor is provided with pivotal supports 7′, constructed in separable sections, which form split sleeves, nuts 8, engaging studs 9, serving to hold the said half-sleeves together about the driving-axle. The motor is so mounted, however, that it may swing about the axle as a center in the event of sudden jars, so that the pinion and the gear will not be brought into forcible engagement, which might result in the gear being stripped.

To permit the motor to swing about the driving-axle, I preferably secure a projection 10 upon the exterior of the motor to a buffer-rod. This buffer-rod is provided with enlargements at its ends. A U-shaped extension 11 is secured to the perch 4, springs 12 being located between the said extension and the enlargements upon the buffer-rod. As the motor sways these springs serve to yieldingly limit its bodily movement.

The machine shown in Figs. 1 and 2 is shown in detail in Figs. 3 to 7, inclusive; but although it is illustrated in the form of a motor I do not wish to be limited to this adaptation of the invention.

The motor-shaft 6′ is provided with a sleeve 13, keyed thereto, this sleeve being provided with a reduced portion for receiving the armature 14. A cap-sleeve 15 is brought into clamping engagement with the armature by means of a nut 16, surrounding a threaded extension of the sleeve 13. A commutator 17 is also preferably mounted upon the sleeve 13, one pair of commutator-brushes 18 being illustrated. The ends of the motor-shaft are mounted in bearings 19, provided in caps or bonnets 20, mechanically united with the field portion of the motor, as will be hereinafter set forth.

In accordance with my invention the laminæ of the field-core are preferably stamped with a circular outer periphery and with as many inward projections as there are to be field-poles. Each of these laminæ thus preferably partakes of the shape of a complete ring provided with inwardly-extending radial projections—in this instance four in number. These laminæ are assembled with the projections thereof located in alinement to form the field-poles. In order to readily assemble the laminæ with the projections arranged in proper alinement, I stamp in each of them holes 21, eight of such holes being in this instance shown—one in each space between the projections and one placed at the base of each projection. Clamping-rings 22 are provided for securing the laminæ together, four clamping-bolts 23 passing through the holes that are located at the polar projections, while four other clamping-bolts 24 are passed through the bonnets 20, the clamping-rings 22, and the laminæ composing the field-core. Thus the laminæ of the field-core are held together by means of eight bolts, four of which serve to hold the bonnets 20 in engagement with the clamping-rings. In order that the reluctance of the field-laminæ may not be increased by the holes passing through the same, I preferably provide enlargements 25 upon the interior of the laminæ to compensate for the loss

of metal at the holes between the polar projections. The retaining-bolts 23 are provided with reduced threaded extensions which receive clamping-nuts 26, the clamping-rings being preferably recessed to accommodate these nuts. The clamping-bolts 24 are each provided at one end with a fixed head and threaded at the other end to receive a clamping-nut. The clamping-bolts 24 are passed through the eyes of retaining-links or eyebolts 27, the threaded stems of these eyebolts passing through retaining clamps or plates 28, nuts 29 being employed to secure the clamping or retaining devices 28 in place. The plates 28 are provided with wedging-surfaces that engage the field-coils. By means of the clamping devices shown I am enabled to separately form the field-coils 30 and to slip the same in position over the poles, the retaining-links serving to secure the field-coils firmly in position, the degree of clamping action being regulated by the nuts 29. As stated heretofore, the pole-tips are chamfered to decrease the injurious effects of armature reactions, and as the particular type of machine herein shown is a motor adapted for use upon motor-driven vehicles a portion only of each of the angular pole-tips is chamfered away, so that each of the pole-tips may act both as entering and trailing pole-tips, according to the direction of rotation of the armature. By thus chamfering a portion only of each of the angular tips the effective area of the leading pole-tips is not harmfully decreased, while at the same time when the pole-tips are trailing the injurious effect of the armature reactions is counteracted. In chamfering the pole-tips the line of chamfer is preferably at an angle to the transverse edge of the tip and the segmental edge thereof which is opposed to the armature. Where a portion only of each tip is chamfered away, I preferably alternately chamfer the pole-tips of each lamina, the laminæ being assembled with the chamfered and unchamfered pole-tips alternately disposed, as shown, for example, most clearly in Figs. 5 and 6. In the embodiment of the invention shown one-half of each pole-tip is thus preferably cut away.

To more effectively control the direction of the magnetic flux and to properly divide the magnetic lines between the pole-tips, I preferably provide slots 31, which serve to prevent lines of force from passing from one side of the poles to the other. These slots preferably extend radially, but do not extend through to the segmental edges of the polar projections, in order not to impair the uniformity of the magnetic field.

I have thus devised a very efficient machine which in the embodiment of the invention shown is well adapted for use as a motor for propelling automobiles, and an important advantage is gained in that sparking at the commutator-brushes is prevented irrespective of the direction of rotation of the armature. By assembling the various parts as herein shown and particularly described the motors may readily be assembled and may readily be taken apart for the purpose of repair. The field-coils may be completely formed before being placed in position, the separable clamping means employed for retaining the same in place permitting them to be readily removed when impaired. While I have shown the laminæ of the field-core as being in the form of continuous rings, I do not wish to be limited to the construction wherein the rings are continuous and integral.

I have shown portions only of the pole-tips chamfered; but I do not wish to be limited to this construction in all embodiments of my invention.

While I have herein shown and particularly described the preferred embodiment of my invention and a particular adaptation thereof, I do not wish to be limited to the precise construction shown; but,

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

1. In a dynamo-electric machine, the combination with a plurality of laminæ in the form of rings provided with projections for constituting field-poles of the machine, of clamping-rings for securing the laminæ together, and clamping-bolts passing through the clamping-rings and laminæ to secure the laminæ upon the said rings, the said laminæ being provided with enlargements at holes through which bolts pass to compensate for the metal removed at the holes from the laminæ, substantially as described.

2. In a dynamo-electric machine, the combination with laminæ constructed in the form of rings provided with projections which form the pole-pieces, of clamping-rings for securing the laminæ together, bonnets for attachment to the clamping-rings, clamping-bolts passing through the bonnets, clamping-rings and laminæ, for securing these parts together, other bolts passing only through the laminæ and clamping-rings and serving only to secure these parts together, bearings for the armature-shaft supported by the bonnets, an armature, and a shaft therefor supported by said bearings, substantially as described.

3. In a dynamo-electric machine, the combination with a core formed of a plurality of laminæ, of clamping-bolts, means coacting with the clamping-bolts for securing the laminæ together, coils in place upon the core, and retaining-links engaged each at one end by a clamping-bolt, the said links being in mechanical engagement with the coils at the remaining ends, substantially as described.

4. In a dynamo-electric machine, the combination with a field-core constructed of a plurality of laminæ formed in the shape of rings and provided with inwardly-extending projections to form field-poles, of clamping-bolts, means coacting therewith for securing

the laminæ of the field-core together, retaining-links constructed in the form of eyebolts, the clamping-bolts extending through the eyes of the eyebolts, field-coils in place about the pole-pieces, clamping-plates interposed between the field-coils and directly engaging the same, the stems of the said retaining-eyebolts passing through the clamping-plates, and nuts in threaded engagement with the said stems serving to adjust the degree of clamping action between the clamping-plates and the field-coils, substantially as described.

5. In a dynamo-electric machine, the combination with a field-core constructed of a plurality of laminæ formed in the shape of rings and provided with inwardly-extending projections to form the field-poles, of clamping-bolts, means coacting therewith for securing the laminæ of the field-core together, retaining-links constructed in the form of eyebolts, the clamping-bolts extending through the eyes of the eyebolts, field-coils in place about the pole-pieces, clamping-plates directly engaging the field-coils, the stems of the said retaining-eyebolts passing through the clamping-plates, and nuts in threaded engagement with the said stems serving to adjust the degree of clamping action between the clamping-plates and the field-coils, substantially as described.

6. In a dynamo-electric machine, the combination with a plurality of laminæ provided with inwardly-extending projections for forming field-poles, of clamping-bolts passing through the laminæ, means coacting therewith for securing the laminæ together, field-coils passed about the field-poles, and links mechanically engaging the clamping-bolts and the field-coils for securing the latter in place, substantially as described.

7. In a dynamo-electric machine, the combination with a plurality of laminæ provided with inwardly-extending projections for forming field-poles, of clamping-bolts passing through the laminæ, means coacting therewith for securing the laminæ together, field-coils placed about the field-poles, and links in the form of eyebolts, the clamping-bolts passing through the eyes of the eyebolts, the remaining ends of the eyebolts having mechanical engagement with the field-coils for securing the same in place, substantially as described.

8. In a dynamo-electric machine, the combination with a field-core formed of a plurality of laminæ, of a clamping-bolt passing through the laminæ, means coacting therewith for securing the laminæ together, poles being provided upon the core, field-coils placed about the said poles, retaining-links in the form of eyebolts, the said clamping-bolt passing through the eyes of the eyebolts, the remaining ends of the eyebolts having mechanical engagement with the field-coils, substantially as described.

9. In a dynamo-electric machine, the combination with a field-core composed of laminated rings provided with projections for forming the field-poles, of clamping-rings upon each side of the laminated field-core, clamping-bolts passing through the laminæ and the clamping-rings, means coacting with the clamping-bolts for clamping the laminæ and the clamping-rings together, field-coils upon the field-poles, retaining-links in the form of eyebolts, the clamping-bolts passing through the eyes of the eyebolts, clamping-plates engaging adjacent field-coils, the stems of the eyebolts passing between the field-coils and through the clamping-plates, and nuts for securing the clamping-plates and eyebolts together, substantially as described.

10. In a dynamo-electric machine, the combination with a field-core composed of laminated rings provided with inwardly-extending projections for forming field-poles, of clamping-rings upon each side of the laminated field-core, an inclosing cap or bonnet for engagement with the clamping-rings, each provided with a bearing for the armature-shaft, clamping-bolts passing through said bonnets, the laminæ and the clamping-rings, means coacting with the clamping-bolts for clamping the bonnets, the clamping-rings and the laminæ together, field-coils upon the field-poles, retaining-rings in the form of eyebolts, the clamping-bolts passing through the eyes of the eyebolts, clamping-plates engaging adjacent field-coils, the stems of the eyebolts passing between the field-coils and through the clamping-plates, nuts for securing the clamping-plates and eyebolts together, an armature, and a shaft therefor, the shaft being disposed within the aforesaid bearings, substantially as described.

11. A field-core for a dynamo-electric machine composed of laminæ provided with polar projections, some of the tips whereof are chamfered, the laminæ being grouped with the chamfered polar projections distributed throughout the pole-piece and between unchamfered polar projections, said polar projections being provided with slots extending longitudinally of the field-core and located between the chamfered pole-tips, substantially as described.

12. A field-core for a dynamo-electric machine, composed of laminæ provided with polar projections, some of the leading and trailing tips whereof are chamfered, the laminæ being grouped with the chamfered polar projections distributed throughout the pole-piece and between unchamfered polar projections, said polar projections being provided with slots extending longitudinally of the field-core and located between the chamfered pole-tips, substantially as described.

13. A field-pole for a dynamo-electric machine, having a tip portion chamfered and a slot extending longitudinally of and between the tips of the pole, substantially as described.

14. A field-pole for a dynamo-electric machine, having portions of its leading and trailing pole-tips chamfered, and provided with a slot extending longitudinally of and between the pole-tips, substantially as described.

15. A field-pole for a dynamo-electric machine, having a tip portion chamfered and a slot extending longitudinally of and between the tips of the pole, said slot also extending substantially radially with respect to the axis of rotation of the armature, substantially as described.

16. A field-pole for a dynamo-electric machine, having portions of its leading and trailing pole-tips chamfered, and provided with a slot extending longitudinally of and between the pole-tips, said slot also extending substantially radially with respect to the axis of rotation of the armature, substantially as described.

17. A field-core for dynamo-electric machines having a polar projection for receiving a field-coil, a slot being provided in the said polar projection extending longitudinally of the machine, substantially as described.

18. A field-core for dynamo-electric machines having a polar projection provided with a slot extending longitudinally of the machine and having a chamfered pole-tip, substantially as described.

19. A field-core for dynamo-electric machines having inwardly-extending radial polar projections, each provided with a slot extending logitudinally of the machine, substantially as described.

20. A field-core for dynamo-electric machines having a polar projection for receiving a field-coil, a radial slot being provided in the said polar projection extending longitudinally of the machine, substantially as described.

21. A field-core for dynamo-electric machines having a polar projection provided with a radial slot extending longitudinally of the machine and having a chamfered pole-tip, substantially as described.

22. A field-core for dynamo-electric machines having inwardly-extending radial polar projections, each provided with a radial slot extending longitudinally of the machine, substantially as described.

In witness whereof I hereunto subscribe my name this 21st day of December, A. D. 1899.

ALEXANDER CHURCHWARD.

Witnesses:

H. C. ZAHISKIE,

FRED. J. HARTMAN.