D. HALL.

DYNAMO ELECTRIC MACHINE.

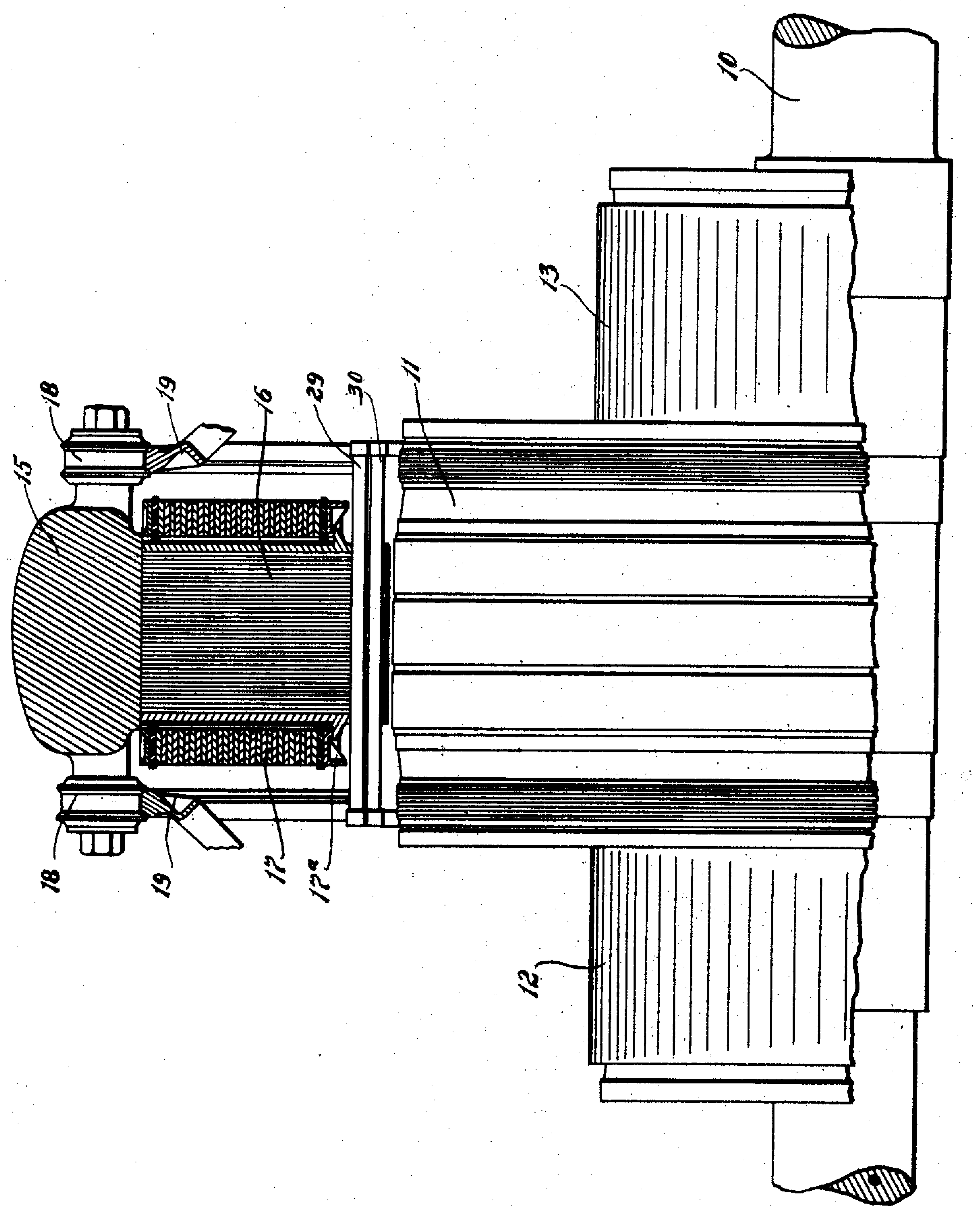
APPLICATION FILED JAN. 15, 1906.

982,813.

Patented Jan. 31, 1911.

3 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

George J. Schwartz

Fred J. Kinsey

INVENTOR:

David Hall.

BY

Chas. E. Lord

ATTORNEY.

D. HALL.

DYNAMO ELECTRIC MACHINE.

APPLICATION FILED JAN. 15, 1906.

982,813. Patented Jan. 31, 1911.

3 SHEETS—SHEET 2.

Fig. 2.

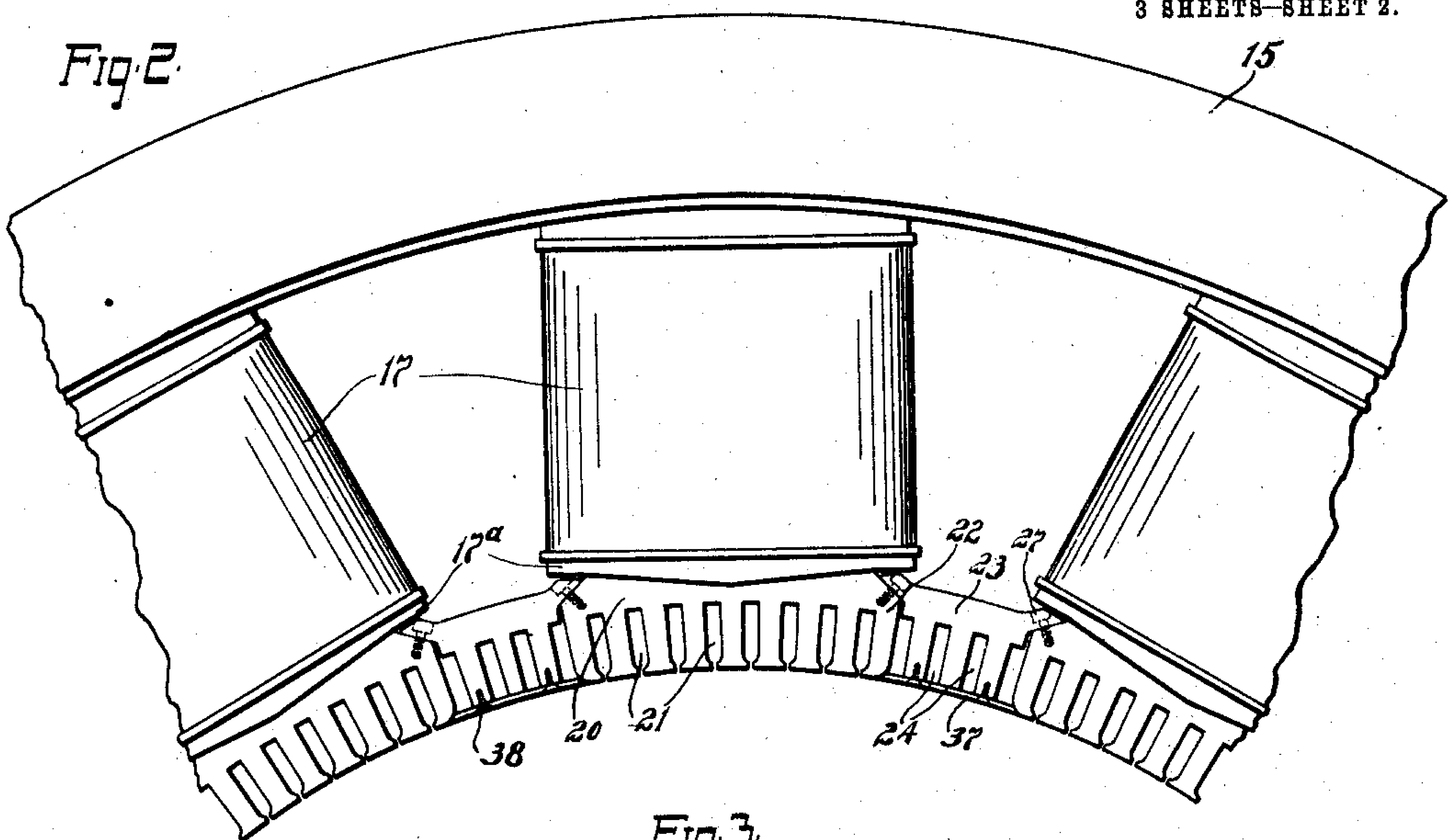


Fig. 3.

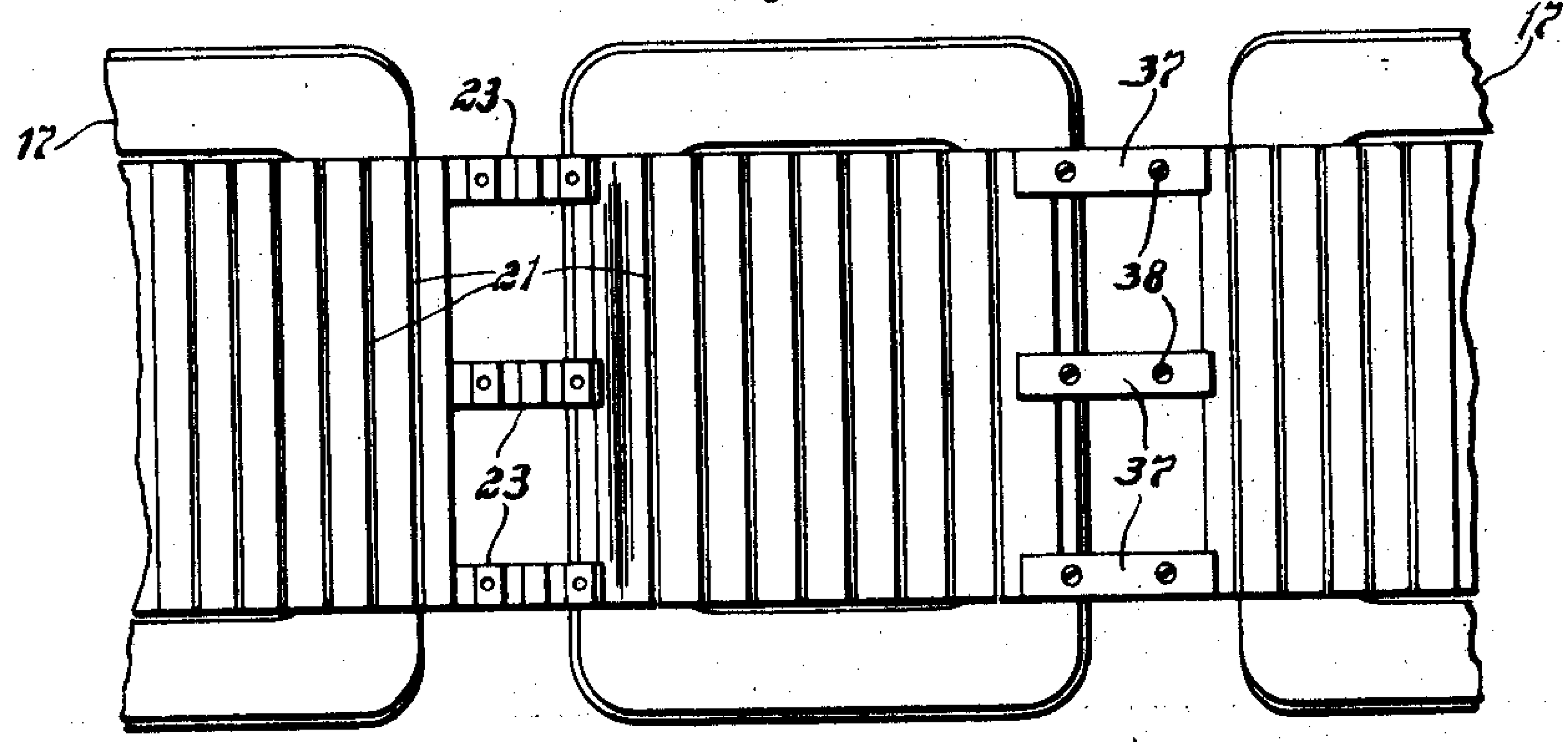


Fig. 4.

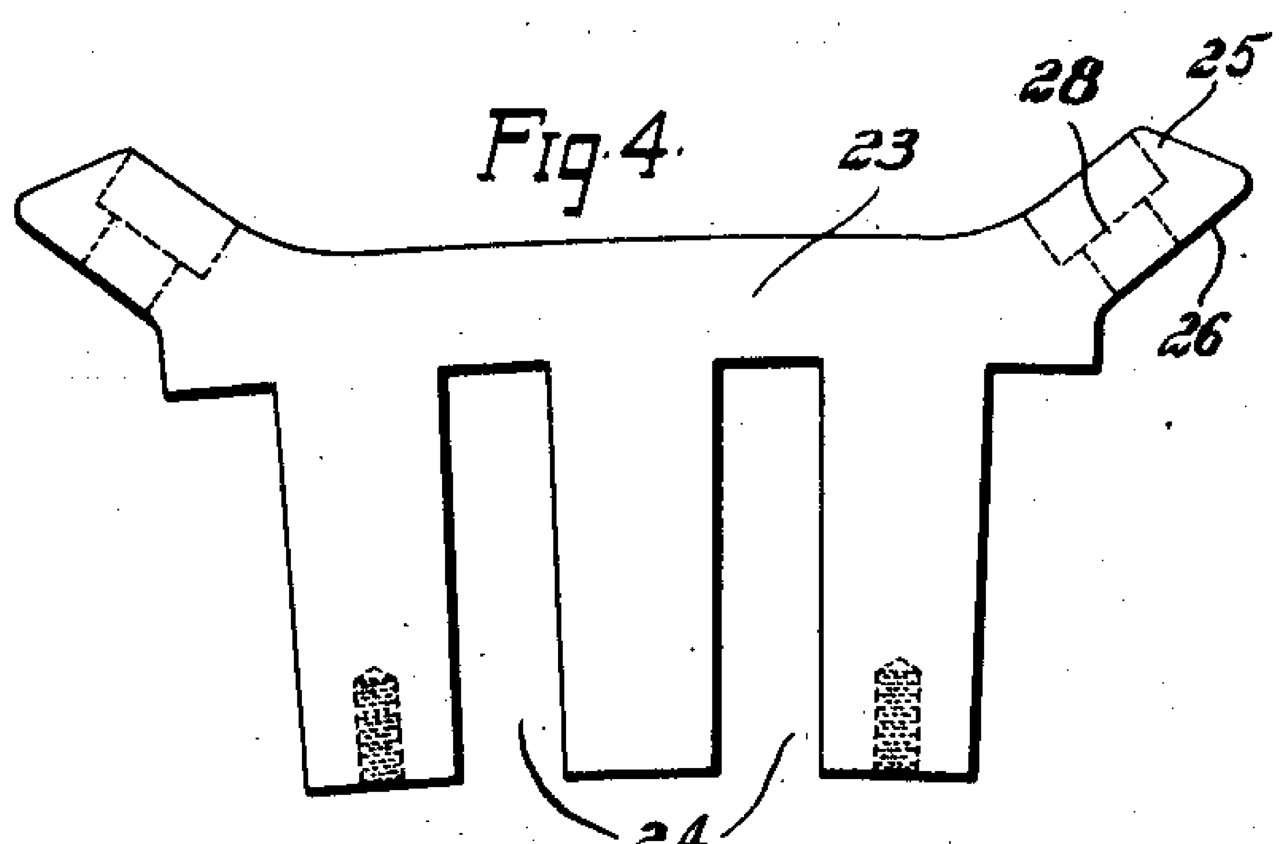


Fig. 5.

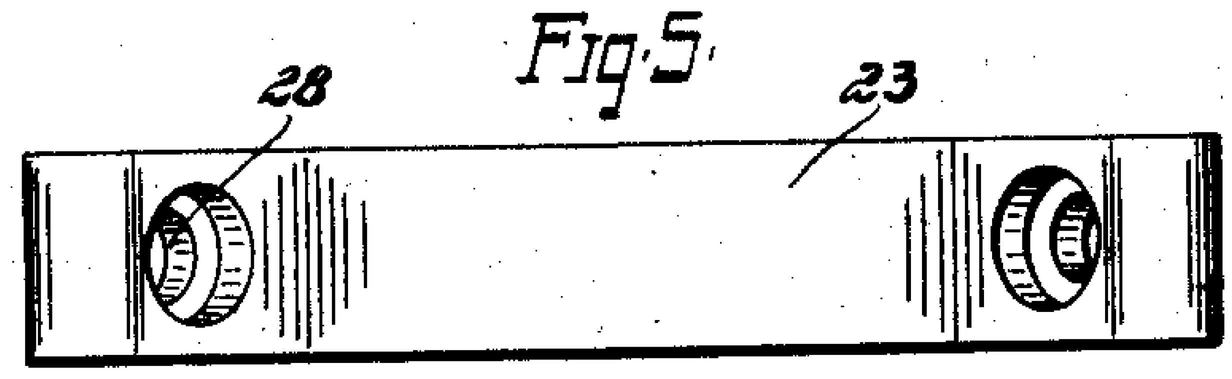
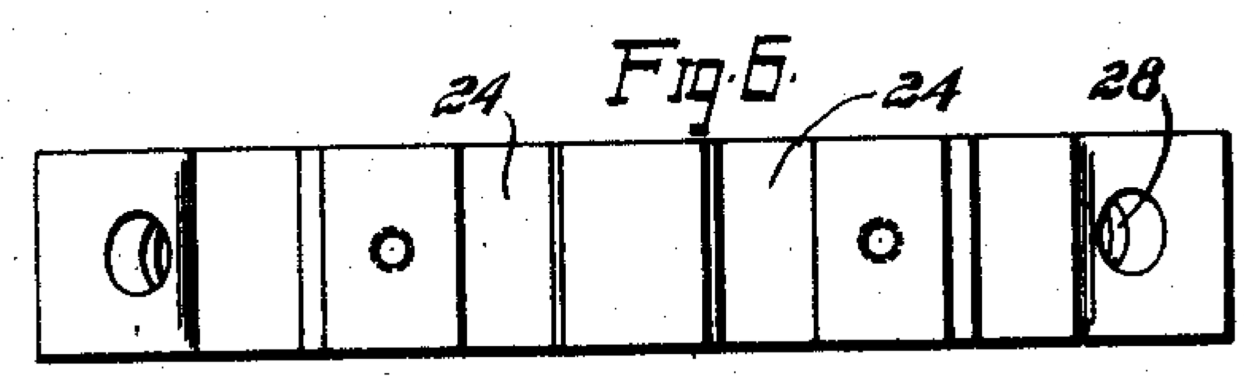


Fig. 6.



WITNESSES:

George J. Schwartz

Fred J. Kinsey

INVENTOR:

David Hall.

BY

Chas. E. Lord

ATTORNEY.

D. HALL.
DYNAMO ELECTRIC MACHINE.
APPLICATION FILED JAN. 15, 1906.

982,813. Patented Jan. 31, 1911.

3 SHEETS—SHEET 3.

Fig. 7.

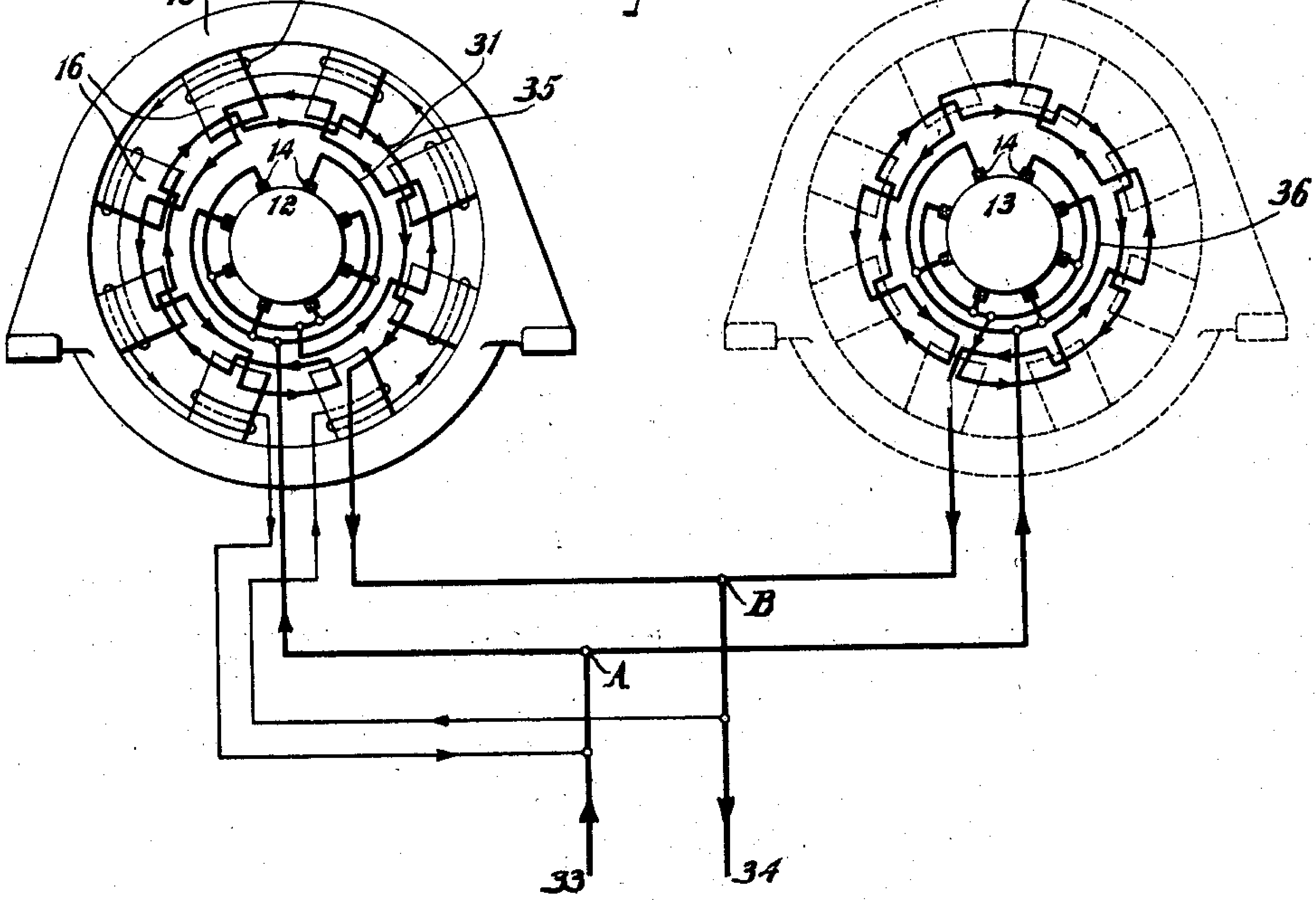
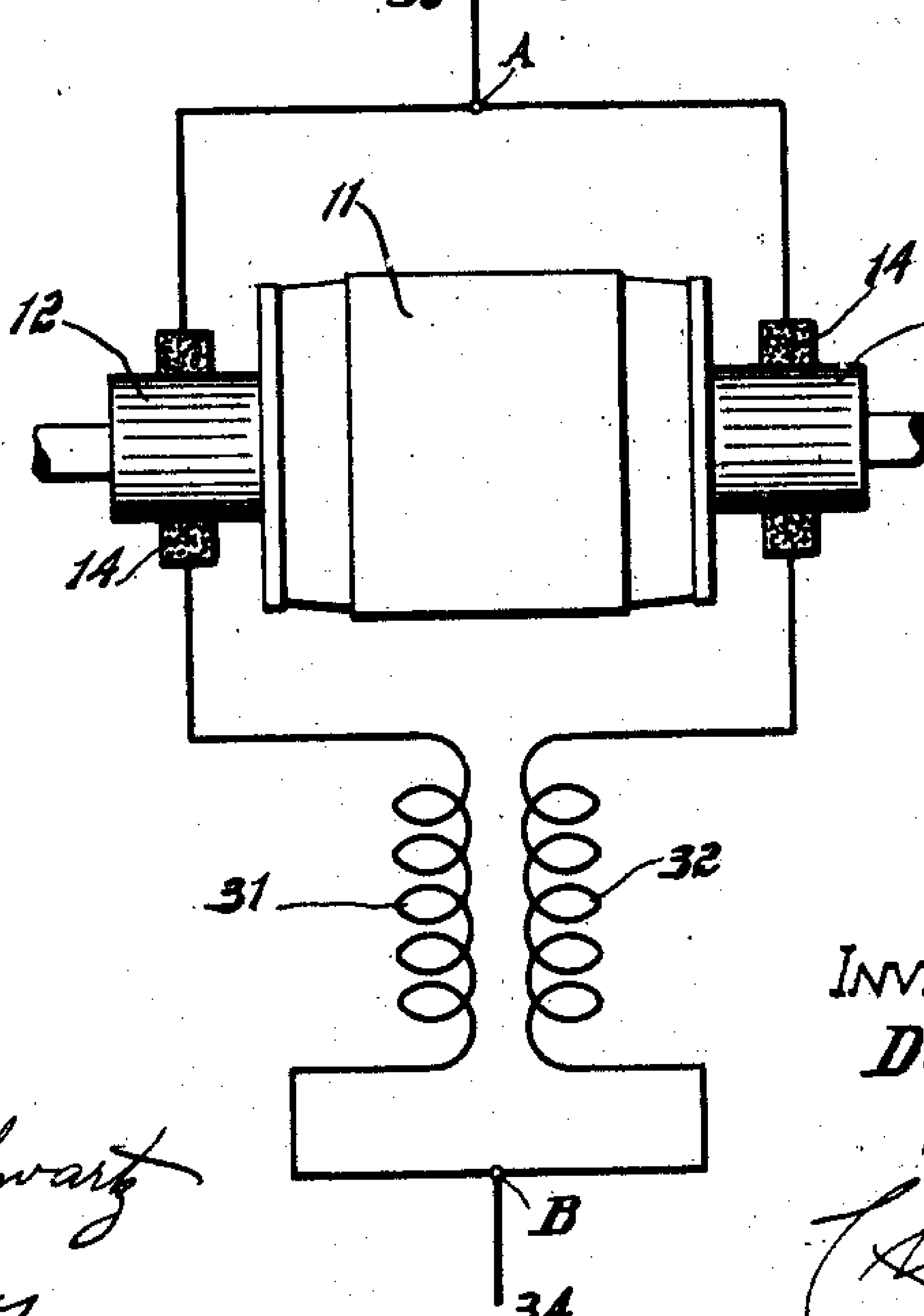


Fig. 8.



WITNESSES:
George J. Schwartz
Fred J. Kinsey

INVENTOR:
David Hall.
BY
Chas. E. Lord
ATTORNEY.

UNITED STATES PATENT OFFICE.

DAVID HALL, OF NORWOOD, OHIO, ASSIGNOR TO THE BULLOCK ELECTRIC MANUFACTURING COMPANY, A CORPORATION OF OHIO.

DYNAMO-ELECTRIC MACHINE.

982,813. Specification of Letters Patent. Patented Jan. 31, 1911.

Application filed January 15, 1906. Serial No. 296,041.

To all whom it may concern:

Be it known that I, DAVID HALL, a citizen of the United States, residing at Norwood, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Dynamo-Electric Machines, of which the following is a full, clear, and exact specification.

My invention relates to improvements in dynamo-electric machines and especially to machines of the double commutator type having a "balancing" winding for neutralizing the armature reaction.

In operating double commutator generators, considerable difficulty has been experienced due to an unbalancing of the load on the machine; that is, due to an unsymmetrical distribution of the current between the commutators of the generator armature. This is especially true of multipolar machines employing a large number of carbon brushes or collectors. In such machines there is a tendency for certain of the brushes on the machine, or all of the brushes on a single commutator, to "grab" the load, as it is called. This so called "grabbing" of the load takes place as follows:—As the result of some local disturbance, such for instance as dirt or dust between the commutator and brushes, or a brush of peculiar composition, or due to a relatively low resistance feeder connection, or for some other reason, the path for the current from the armature winding through certain of the brushes is at first of slightly lower resistance than is the path through certain other brushes. This condition causes the first mentioned brushes to at first take a little more current than is taken by the other brushes. As is well known, a carbon brush has less resistance when hot than when cool, and as the resistance of said brush drops very rapidly as the current density and consequently the heat increases, it will be seen that the first mentioned brushes offer less and less resistance to the passage of current than do the other brushes. As a result said first mentioned brushes heat up quite rapidly, and as they heat up, they take more and more of the current until, as sometimes happens, the brushes on a single commutator are carrying the entire current of the machine, leaving the other commutator and brushes practically currentless. Under these conditions, the commutator, brushes, and brush holders on one side of the machine are greatly overloaded, since they are designed to carry one-half of the current of the machine and not the whole current. This unbalanced condition may produce considerable sparking and it may happen that the brushes, brush holders, and commutators are entirely destroyed as the result of the sparking and excessive heating. To prevent this unequal division of current between the two commutators, it has been proposed to increase the resistance of each side of the machine by placing in series with the brushes of the commutators equal ohmic resistances. This method, while it maintains a substantially equal distribution of current between the commutators, results in considerable loss in energy.

In large machines intended to operate under different conditions of load, it is customary to employ an auxiliary field winding, the conductors of which are usually located in slots in the faces of the field poles. This winding is in series with the armature winding or windings and is so arranged that the magnetic field produced by the current carried thereby will neutralize or balance the armature reaction, or the field distorting action of the armature, and is therefore called a "balancing" winding.

The object of my invention is to so arrange the auxiliary field or balancing winding or windings on a double commutator machine that it or they tend to maintain an equal division of current between the commutators.

A further object is to provide improved bridging members between the ends of the pole pieces, having slots for the reception of conductors of the balancing winding. By means of these slotted bridging members and the slots in the faces of the pole pieces the winding can be equally distributed around the armature.

In carrying out one part of my invention, I provide a double commutator dynamo-electric machine with auxiliary field coils for reducing sparking at the brushes which field coils are so arranged as to maintain an equal division of current between the commutators.

My invention further consists in a dynamo-electric machine having two commutators connected to the armature winding or windings and field poles having tips which are bridged by non-magnetic members, which pole tips and bridging members are slotted to receive two distributed balancing windings, one of which is connected in series with the brushes of one commutator and the other of which is connected in series with the brushes of the other commutator, whereby they will not only balance the armature reaction and reduce sparking at the brushes, but will also serve to maintain an equal division of current between the two commutators.

My invention still further consists in the details of construction, and combinations of elements, described in the specification and set forth in the appended claims.

For a better understanding of my invention, reference is had to the accompanying drawings forming a part of this specification, in which—

Figure 1 is a sectional elevation of a portion of a dynamo-electric machine embodying my invention; Fig. 2 is an elevation of a portion of the field member of the machine showing the slotted pole tips and slotted bridging members between the pole tips; Fig. 3 is a view of the same looking toward the inner faces of the pole pieces, parts being removed for the sake of clearness; Fig. 4 is an elevation of one of the non-magnetic bridging members; Fig. 5 is a top view of the same; Fig. 6 is a bottom view of the same; Fig. 7 is a diagrammatic view showing the two balancing windings and their connections; and Fig. 8 is still another diagrammatic view showing the arrangement of the balancing windings.

Referring to the figures of the drawing, I have shown at 10 a shaft of the machine to which is attached the armature 11, and commutators 12 and 13 located at each side of the armature. The segments of the two commutators are connected to the armature winding or windings in the well known manner. Brushes 14 shown in Figs. 7 and 8 bear on the commutators. The field frame 15 which surrounds the armature, has connected thereto in any desired manner, a number of radial, inwardly projecting, laminated pole pieces 16. There may be any desired number of poles, eight being shown in Fig. 7. Each pole piece has a main field coil 17, which is supported on the seat 17^a. Mounted on bolts which extend laterally from the field frame are rollers 18 which support brush rings or yokes 19 in the usual manner.

Each of the laminated pole pieces has a pole tip 20 which extends beyond the field coils. Each pole tip is provided with a plurality of equally spaced, partially closed slots 21. These slots are preferably punched in the sheet metal laminations of the pole piece by dies. Each pole tip has at each side a projection 22 which has an inwardly inclined portion for supporting the non-magnetic bridging members 23. Each bridging member, shown in detail in Figs. 4, 5 and 6, is provided with open slots 24, of the same width and spaced the same as are the slots 21 in the pole tips. These slots 24 are preferably milled in the bridging member. As shown in Fig. 3, between each adjacent pair of pole tips there are three spaced bridging members. The bridging members may, if desired, be cut in any desired widths from a section which has been provided with the milled slots 24. Each bridging member is provided with two oppositely extending lugs or projections 25 having inclined faces 26 which fit snugly on the inclined faces of the projecting portions 22 of the pole tips. Screws 27 pass through holes or openings 28 in the lugs or projections and into tapped holes in the hole tips. By this means the bridging members are held securely in place. As is clearly shown in Fig. 2, the slots in the pole tips and bridging members are closely arranged and the slotted pole tips and bridging members completely envelop the armature. The purpose of these slots is to receive the auxiliary distributed field winding or balancing windings which are commonly employed to neutralize or balance the armature reaction and prevent the distortion of the field. As previously stated the currents on the two sides of the double commutator machine may become unequal unless some means is provided for maintaining an equal division of the current.

Reference is now had to Figs. 7 and 8. It has been proposed to add between the points A and B on each side of the machine or in series with the brushes on each commutator, a certain predetermined ohmic resistance. The ohmic resistances maintain practically an equal division of current between the commutators for the following reason: If there are no such ohmic resistances, any inequality, however slight and from whatever cause, in the division of the current between the two commutators tends to increase, because the brushes on the more heavily loaded commutator are heated by the passage of current more than those on the more lightly loaded commutator, and, the resistance of carbon decreasing with its temperature, the hotter brushes take more and more of the current and continue to rise in temperature until they carry practically the entire current. Because of this unstable balance of parts of the current, the commutator and brushes which take the greater share of the current are greatly overloaded, for they are designed to carry only one half of the current and not all of it. By inserting ohmic resistances in each branch of the circuit before the two branches are re-united outside of the armature, the balance between the two parts of the current is rendered more stable, for a decrease in the resistance of one set of brushes will decrease the total resistance of that branch but slightly in comparison to the resistance of the whole branch, and by making the ohmic resistances of material having a positive temperature co-efficient of resistance as would commonly be done, even this slight decrease may be compensated for by the increased resistance of such ohmic resistances. Instead of employing for this purpose mere ohmic resistances in series with the brushes of each commutator, which, as is understood, causes a useless waste of energy, I employ in this case two auxiliary field windings, and so arrange and connect them that they will not only balance the armature reaction, but will also serve to maintain an equal division of current between the brushes of the two commutators. I employ for this purpose two separate balancing windings which are equally distributed about the armature, both windings being placed in the same slots. I connect one of these balancing windings in series with the brushes of one commutator, and the other balancing winding in series with the brushes of the other commutator. By this arrangement of the two windings an equal division of current is maintained without the unnecessary waste of energy incident to the use of ordinary ohmic resistances. Two conductors of the balancing windings located in the same slot are shown respectively in Fig. 1 at 29 and 30. The balancing windings, however, are shown more clearly in Figs. 7 and 8 at 31 and 32. In Fig. 7, two different views of the field frame are shown in full and dotted lines for the sake of clearness. The full and dotted lines represent respectively the front and rear ends of the machine. The main terminals are shown at 33 and 34. The paths of the current through the machine are as follows: Current enters at the negative terminal 33 and at the point A divides and passes equally (if the machine is properly balanced) to the cross connector 35, joining the negative brushes on the commutator 12, and to the cross connector 36, joining the negative brushes of the commutator 13. The current then passes through the armature to the positive brushes and equally through the two balancing windings 31 and 32, shown clearly in Figs. 7 and 8, and then to the positive terminal 34. In Fig. 7 the main field coils 17 are shown in shunt to the terminals 33 and 34.

The balancing windings may be inserted through the narrow openings leading to the slots in the pole tips, and will be retained therein by the overhanging portions of the iron teeth. As is shown in Fig. 4, the bridging members are provided with open slots. It is customary to retain conductors in open slots by wedges which engage grooves in the sides of the teeth. Since the milling of the grooves which hold the retaining wedges in place is expensive, I prefer to retain the conductors in the slots of the bridging members by strips or plates 37 of non-magnetic material, which strips are preferably secured to the inner faces of the teeth by screws 38. In Fig. 3 the strips have been omitted from three of the bridging members.

I aim in my claims to cover all modifications which do not involve a departure from the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent is:—

1. In a dynamo-electric machine, an armature, a plurality of commutators, brushes bearing on said commutators, main field coils, and auxiliary field coils for preventing sparking at the brushes, said auxiliary field coils being connected in parallel paths which extend through the respective commutators.

2. In a dynamo-electric machine, an armature, a plurality of commutators, brushes bearing on said commutators, a main field winding, and auxiliary field windings for neutralizing the armature reaction, said latter windings being connected in parallel paths which extend through the respective commutators.

3. In a double-commutator dynamo-electric machine, balancing coils for neutralizing the armature reaction, one portion of said coils being in series with the brushes of one commutator and another portion being in series with the brushes of the other commutator.

4. In a dynamo-electric machine, an armature, two commutators connected to the armature winding, a field member having main field coils, stationary balancing conductors adjacent to the armautre and parallel to the conductors thereof, a portion of said stationary conductors being in series with the brushes on one commutator, and another portion being in series with the brushes on the other commutator.

5. In a dynamo-electric machine, an armature, two commutators therefor, brushes bearing on said commutators, and stationary conductors equally distributed about the armature and adjacent thereto, one half of said stationary conductors being in series with the brushes of one commutator, and the other half being in series with the brushes of the other commutator.

6. In a dynamo-electric machine, an armature, two commutators, brushes bearing on said commutators, a main field winding, and two auxiliary field windings for balancing the armature reaction, one of said auxiliary windings being in series with the brushes of one commutator and the other auxiliary winding being in series with the brushes of the other commutator.

7. In a dynamo-electric machine, an armature, a plurality of commutators, brushes bearing on said commutators, main field coils, and auxiliary field coils equally distributed about the armature for balancing the armature reaction, said latter coils being divided into equal groups, each of which is in series with the brushes of one of said commutators.

8. In a dynamo-electric machine, an armature, two commutators, brushes bearing thereon, a main field winding, and two auxiliary field windings distributed in slots about the armature for balancing the armature reaction, each of said auxiliary windings being in series with the brushes of one of said commutators.

9. In a double-commutator dynamo-electric machine, an armature, two commutators, field poles, bridging members between the ends of the field poles, said field poles and bridging members having equally distributed slots, and two auxiliary field windings for balancing the armature reaction, said windings being located in said slots and respectively connected in series with the brushes of said commutators.

10. In a dynamo-electric machine, an armature, a plurality of commutators, brushes bearing on said commutators, a main field winding, and auxiliary field windings connected in parallel paths which include brushes bearing on the respective commutators.

11. In a dynamo-electric machine, an armature, a plurality of commutators, brushes bearing on said commutators, main field coils, and auxiliary field coils, said latter coils being divided into equal groups, each of which is in series with the brushes of one of said commutators.

12. In a dynamo-electric machine, an armature, two commutators, brushes bearing thereon, a main field winding, and two auxiliary field windings, each of said auxiliary windings being in series with the brushes of one of said commutators.

13. A dynamo-electric machine, comprising an armature provided with a plurality of commutators, brushes for the commutators, and field windings in series respectively with brushes on the different commutators, said field windings being arranged in such a manner as to maintain the proper division of current between such brushes.

14. A dynamo-electric machine having a single armature winding, two commutators connected to said winding, and a separate field winding in series with each commutator.

15. In a dynamo-electric machine, an armature, two commutators therefor, a main field winding, and two distributed compensating or balancing windings, one of said compensating windings being in series with each commutator.

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

DAVID HALL.

Witnesses:

Arthur F. Kwis,
Fred J. Kinsey.