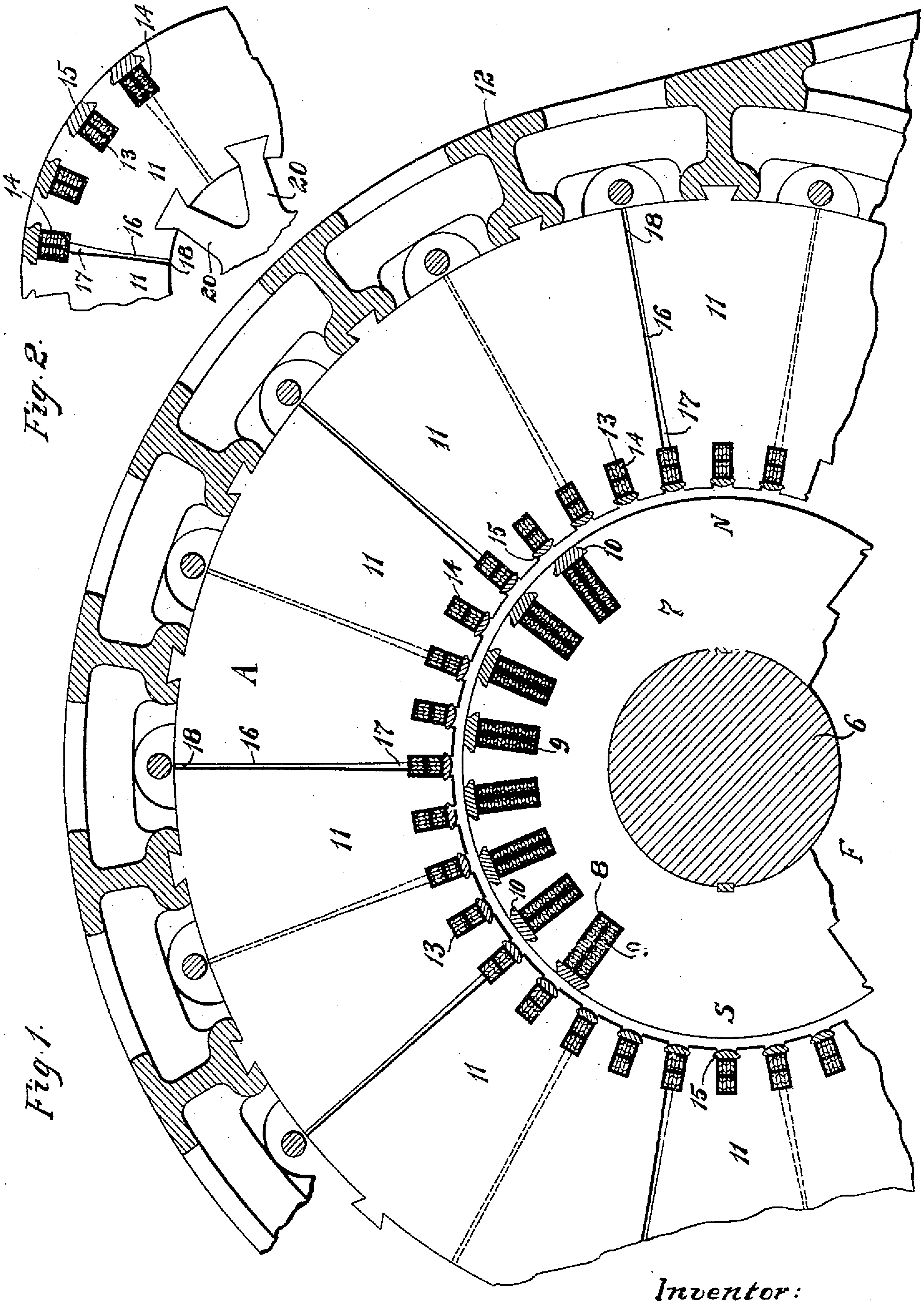
B. A. BEHREND.

ARMATURE CONSTRUCTION.

APPLICATION FILED SEPT. 19, 1904.

923,614. Patented June 1, 1909.

2 SHEETS—SHEET 1.



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2 SHEETS—SHEET 2.

Fig. 3.

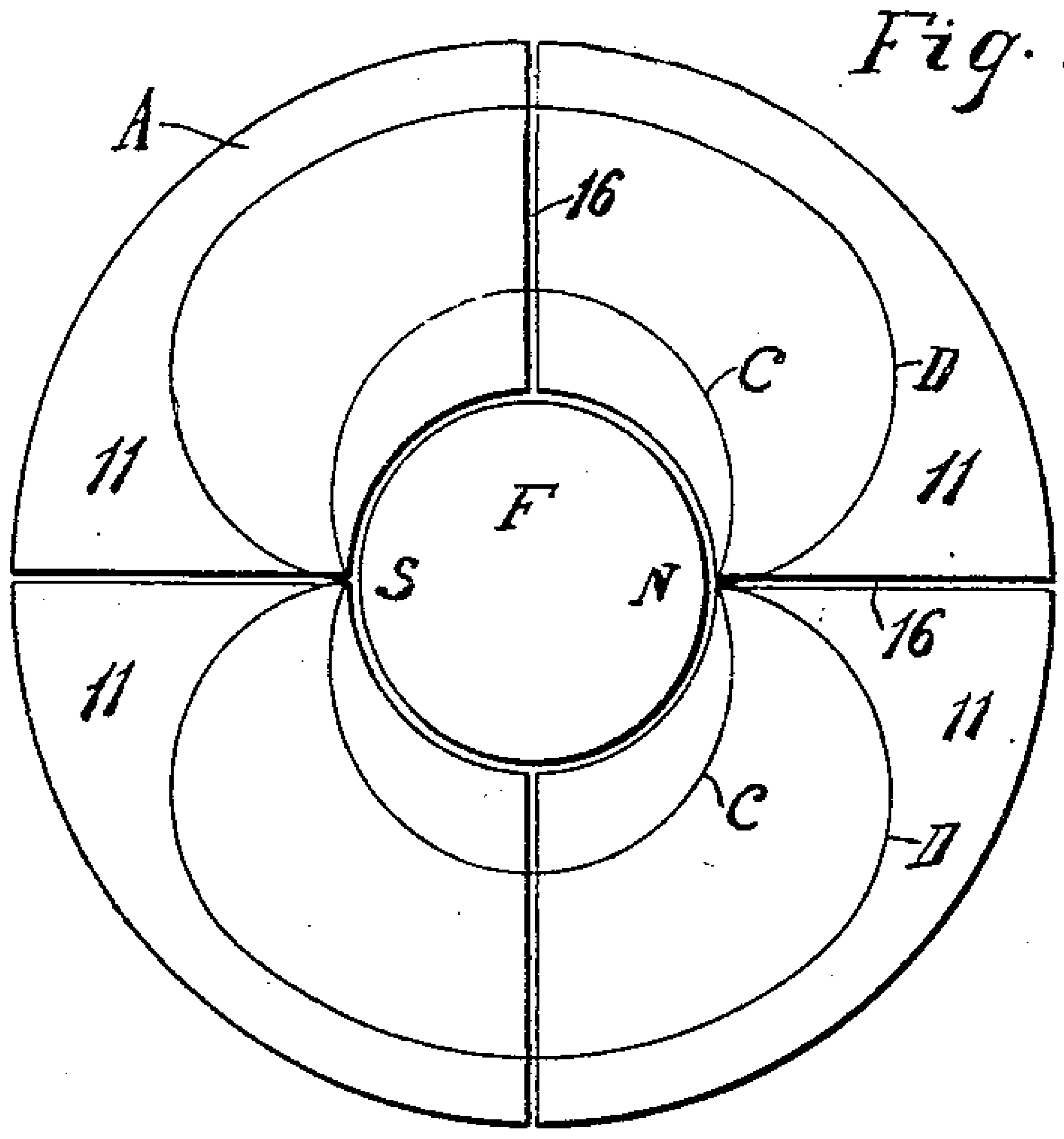


Fig. 4

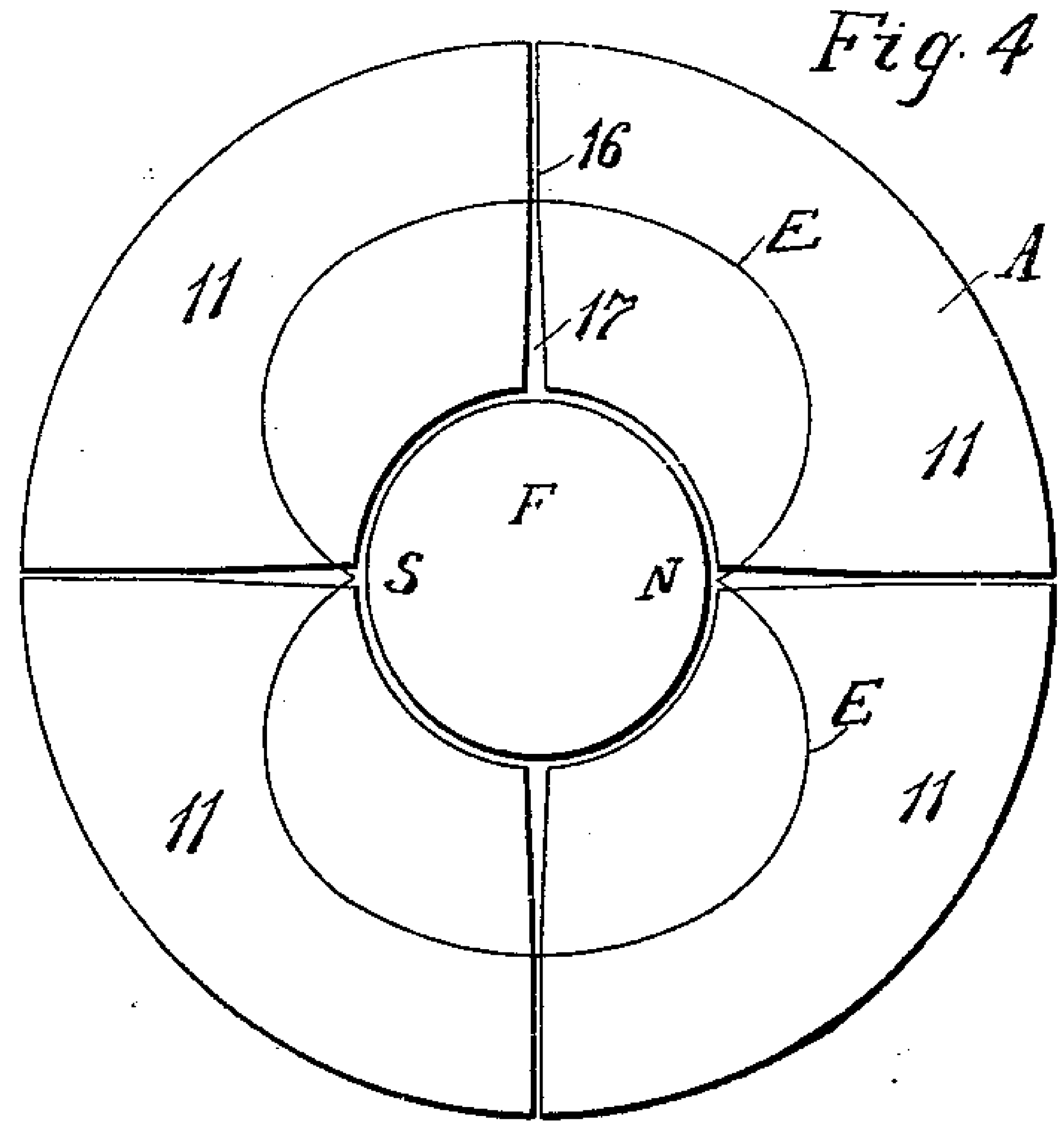
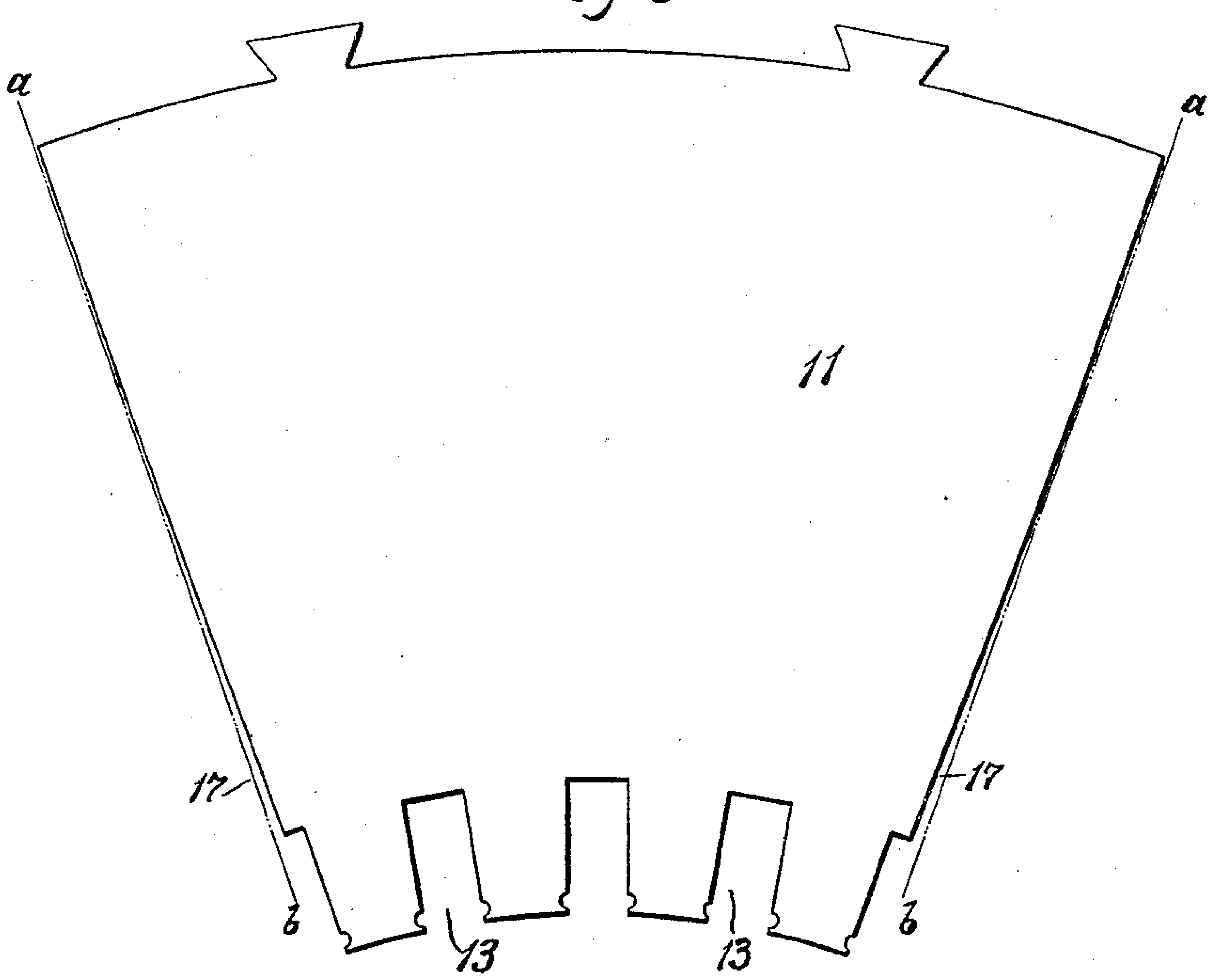


Fig. 5.



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UNITED STATES PATENT OFFICE.

BERNARD ARTHUR BEHREND, OF NORWOOD, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE BULLOCK ELECTRIC MANUFACTURING COMPANY, A CORPORATION OF OHIO, AND ALLIS-CHALMERS COMPANY, A CORPORATION OF NEW JERSEY.

ARMATURE CONSTRUCTION.

No. 923,614. Specification of Letters Patent. Patented June 1, 1909.

Application filed September 19, 1904. Serial No. 225,071.

To all whom it may concern:

Be it known that I, BERNARD ARTHUR BEHREND, 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 Armature Construction, of which the following is a full, clear, and exact specification.

My invention relates to dynamo-electric machines, and more particularly to the construction and arrangement of the armatures of such machines.

It has been customary in constructing armatures of dynamo-electric machines, especially the armatures of large alternators, to build the core of segmental laminæ, fastened to a fixed frame if a rotating field is used, or fastened to a shaft or spider if a rotating armature is employed. These laminæ are arranged with the adjacent edges of the segments of each layer either in contact or separated a short distance, the opening or joint between adjacent segments in a single layer being of uniform width throughout its length. The laminæ in adjacent layers are shifted or staggered so as to increase the rigidity of the armature structure and break the joint between the armature segments. In such a construction as just described especially in high speed machines, or turbo-alternators in which a small number of poles are employed on the field magnet, there is a lack of uniformity in the density of the magnetic flux through the armature core. In fact, it may be said that the magnetic flux in passing through the armature core between the field magnet poles, follows two paths, one being short and of high density, and the other being long and of relatively low density. The former path is of relatively low reluctance and is close to the armature winding while the latter is of high reluctance and remote from said winding. The magnetic material of the armature core tends toward saturation near the armature winding while the parts away from said winding are far from saturation. This condition is undesirable as it augments the core loss due to hysteresis and eddy currents in the armature, thus reducing the efficiency of the machine.

The object of my invention is to increase the efficiency of a dynamo-electric machine by overcoming the objectionable features above enumerated. To this end, I employ means for increasing the reluctance of the magnetic path through the iron of the armature near the periphery of the field magnet in such a manner as to permit substantially a uniform density of magnetic flux between the field poles through the iron of said armature.

More specifically considered, my invention consists of an armature of a dynamo-electric machine having its core built up of segmental laminæ in which the space or break between adjacent segments in the same layer is wider near the periphery of the field magnet than it is at a distance from said periphery.

In another aspect my invention consists of an armature segment having formed along one edge slots or openings adapted to receive a winding, and having cut-away portions in its sides and adjacent to the slotted edge so that when two adjacent segments are placed in position in the machine, the space or break between said segments will be wider at a point near said slotted edge than at a point remote therefrom.

In the accompanying drawings which illustrate the preferred embodiments of my invention, Figure 1 represents a vertical section through a dynamo-electric machine having a rotating field magnet and a stationary armature; Fig. 2 represents a vertical section of part of a rotatable member of a dynamo-electric machine illustrating how my invention may be applied to a rotating armature; Fig. 3 is a diagrammatic view illustrating the customary construction of segmental armatures; Fig. 4 is a diagrammatic view of my improved armature construction; Fig. 5 is a face view of a stationary armature segment punched in accordance with my invention.

Referring to the drawings, 6 represents the shaft of a rotating field magnet F. The laminæ 7 mounted upon said shaft are slotted at 8 to receive the windings 9, which are held in the slots by the wedges 10. The windings are preferably so connected that a north pole is produced at N and a south pole at S. The core of the armature A is built up of the segmental laminæ 11, fastened to the supporting frame 12 in any desired manner, here shown as dove-tailed. The segments in adjacent layers are staggered, the dotted lines indicating the segments in the next layer below segments 11. The segments 11 are slotted at 13 to receive the windings 14, which are held in position in the slots by means of wedges 15. The segments 11 are preferably so punched that when assembled in a single layer in the frame 12, the space or break 16 between adjacent segments is greater or wider at 17 near the periphery of the field magnet F, or near the slots 13 containing the armature 14, than at 18 a point at a distance from the periphery of the field magnet F, or remote from the slotted edge of the armature segment.

In Figs. 3 and 4, I have illustrated diagrammatically a two-pole rotatable field magnet F, having poles N and S, and a stationary armature A built up of laminæ, each lamina or layer being divided into four segments 11. Fig. 3 represents the customary construction in which the segments in a single layer are spaced apart a slight distance, the space or joint between adjacent segments being of constant width throughout its length. In such a construction it may be assumed that the magnetic flux between the poles of the field magnet F follows two paths through the iron of the armature on either side of the field magnet axis, one path indicated diagrammatically by line C, being short, of small reluctance and high density, the other path indicated by line D being long, of great reluctance and low density. It will thus be seen that the iron of the armature A near the periphery of the field magnet F and along the path C tends toward saturation, while the iron along path D is far from saturation. Furthermore the mass of iron composing the armature core is not being efficiently employed. In Fig. 4 I have shown a similar machine with the armature constructed in accordance with my invention. To produce a path of substantially uniform reluctance and permit a substantially uniform flux density between poles I increase the reluctance of the path C in any desired manner preferably by so designing the break, or gap 16 between adjacent segments that it is wider at 17 near the periphery of the field magnet F and diminishes in width gradually along the line of said break or gap in a direction away from said periphery. The path of uniform reluctance thus produced is indicated diagrammatically by line E. This construction reduces the tendency toward saturation near the field magnet periphery, reduces the core loss due to hysteresis and eddy currents in the armature, and increases the efficiency of the machine. By permitting the iron of the armature to be worked more effectively, the machine may be built with less iron in the armature for a given capacity than with the construction shown in Fig. 3.

In Fig. 5 I have illustrated on an enlarged scale one of the armature segments 11 of the machine shown in Fig. 1. The broken lines *a*—*b* represent radial lines from the center of the rotating field F. It will be clearly seen that the edges of said segment are not parallel to the radial lines throughout their length, but make an appreciable angle with said radial lines adjacent to the slotted edge of the segment.

Although this invention is here shown as applied to machines which have approximately radial joints or gaps between adjacent segments, it must be understood that it is equally applicable to machines of other types and constructions and the magnetic reluctance of the path of the flux through the armature core may be increased in any desirable practical manner. My invention is also equally applicable to machines having fixed field magnets and rotating armatures as may be readily seen from Fig. 2, in which the armature segments 11 are shown as mounted on the arms of a spider 20. The armature coils are indicated as before by 14, and are shown held in the slots 13 by means of the wedges 15.

I aim in the appended claims to cover all modifications of my invention which do not depart from its spirit and scope.

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

1. In a dynamo-electric machine, a field magnet, an armature, said armature providing for the flux passing through the armature between any two field poles, paths of different lengths but of equal reluctances so that a substantially uniform flux density in the armature is obtained.

2. In a dynamo-electric machine, a field magnet, an armature having its core built up of laminæ, said core providing for the flux passing through the armature between any two field poles, paths of different lengths and having spaces which equalize the reluctances of said paths and cause a substantially uniform flux density.

3. In a dynamo-electric machine, a field magnet, and an armature, having its core built up of segmental laminæ having portions of the adjacent edges of the segments of a single layer cut-away in such a manner that the magnetic path for the flux between the field magnet poles has substantially uniform reluctance through the armature core.

4. In a dynamo-electric machine, a field magnet, and an armature having its core built up of segmental laminæ and in which the space or break between adjacent segments in the same layer is of gradually decreasing width from the periphery of the field magnet inward.

5. In a dynamo-electric machine, a field magnet, an armature having its core built of laminæ and providing for the flux passing

through the armature between any two field poles, paths which are of different lengths and extend into the armature different distances remote from the periphery of the field magnet but are of equal reluctances, so that the flux density in the armature at different distances remote from the field magnet is substantially the same as adjacent the field magnet.

6. In a dynamo-electric machine, a field magnet, an armature having its core built of laminæ, said armature providing for the flux passing through the armature between any two field poles, paths which extend into the armature different distances remote from the periphery of the field magnet, and having slots which equalize the reluctances of said paths so that the flux density in the armature at different distances remote from the field magnet is substantially the same as adjacent the field magnet.

7. As an article of manufacture, a punched armature segment having two edges forming arcs of concentric circles, one of which is provided with slots forming teeth, and one of said arcs subtending a smaller angle than the other.

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

BERNARD ARTHUR BEHREND.

Witnesses:

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