A. A. PIFER & C. E. F. AHLM.
VARIABLE SPEED MOTOR.
APPLICATION FILED FEB. 14, 1906.

900,420. Patented Oct. 6, 1908.

2 SHEETS—SHEET 1.

Fig. 1.

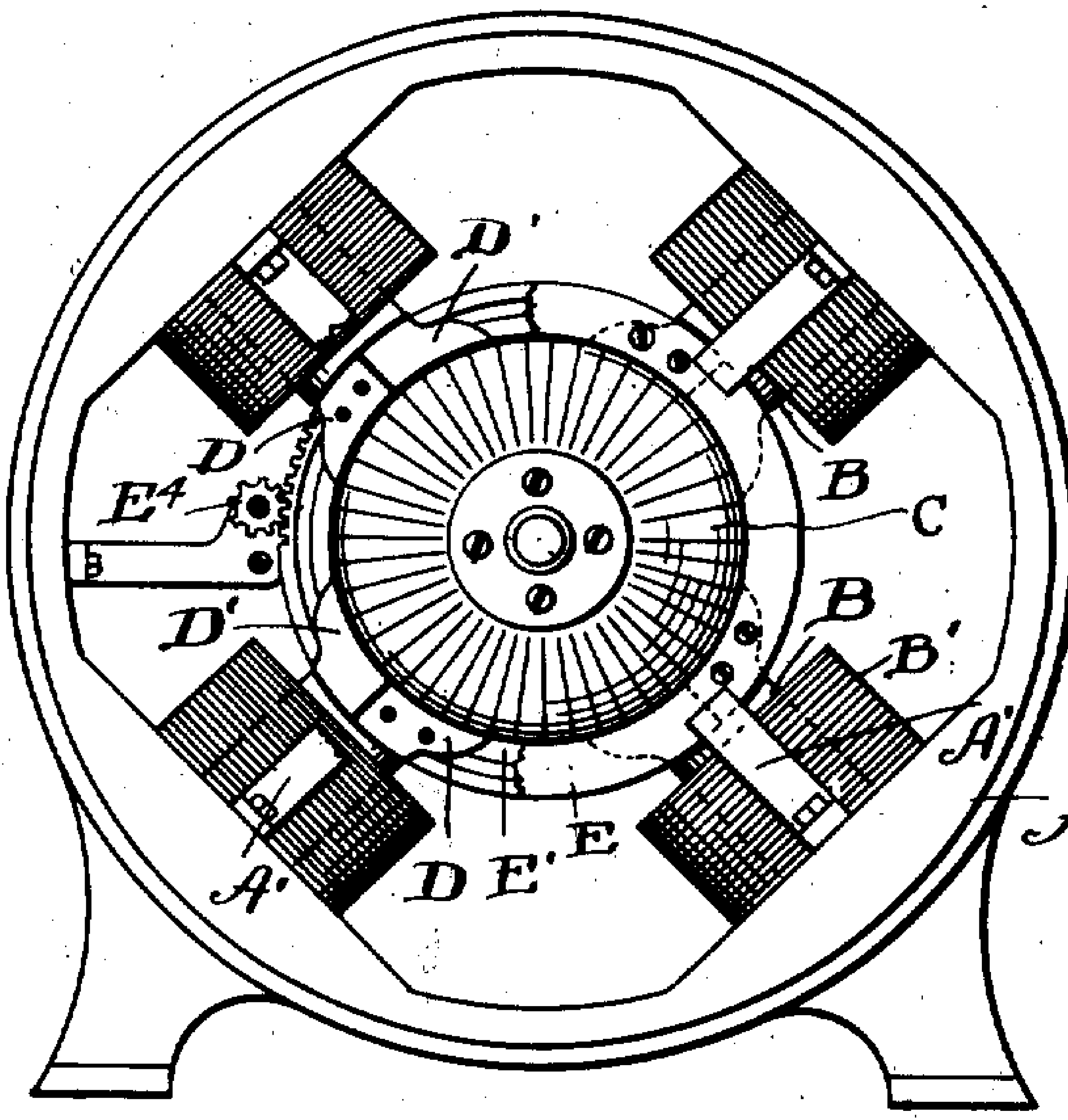
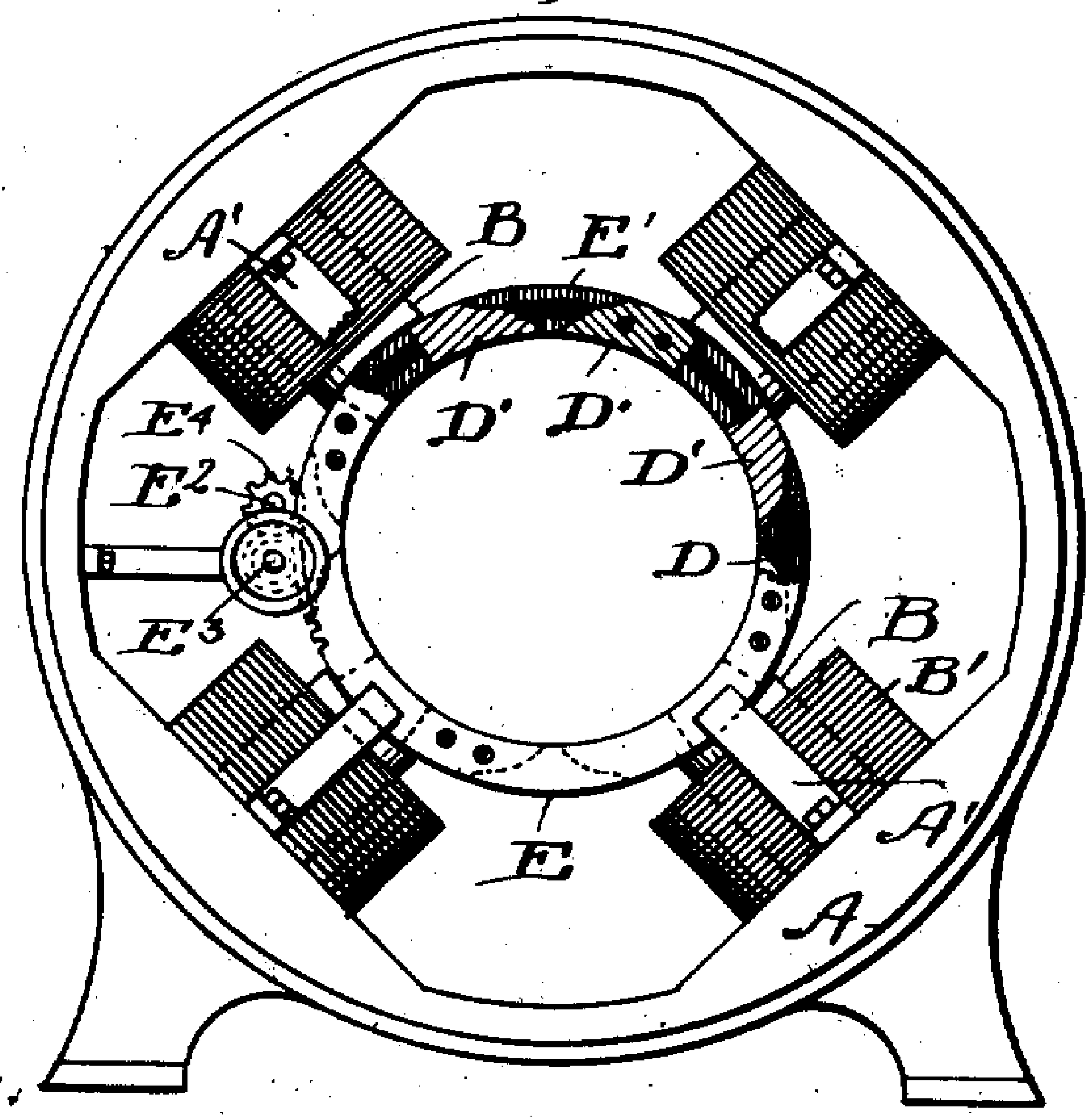


Fig. 2.



Witnesses.
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Fig. 3.

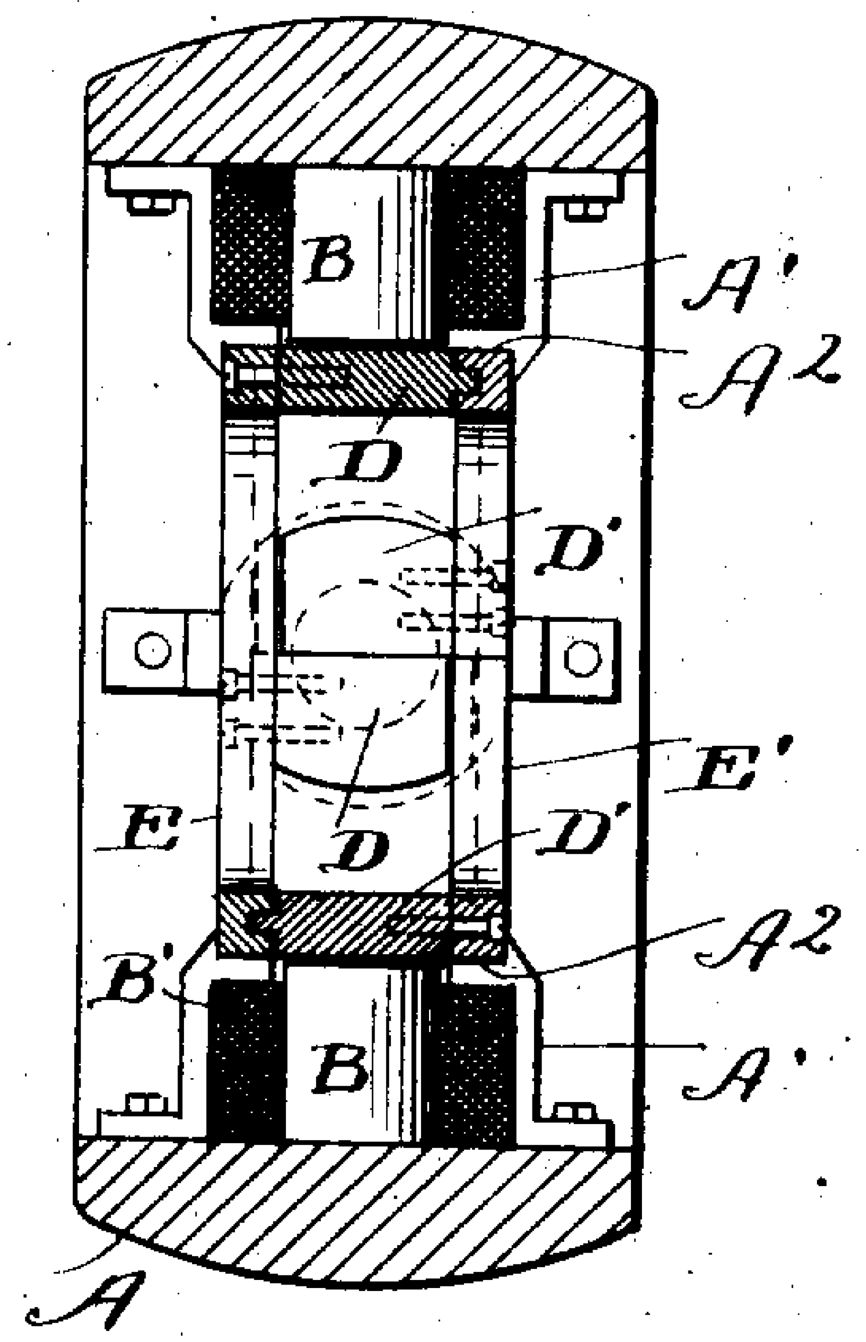
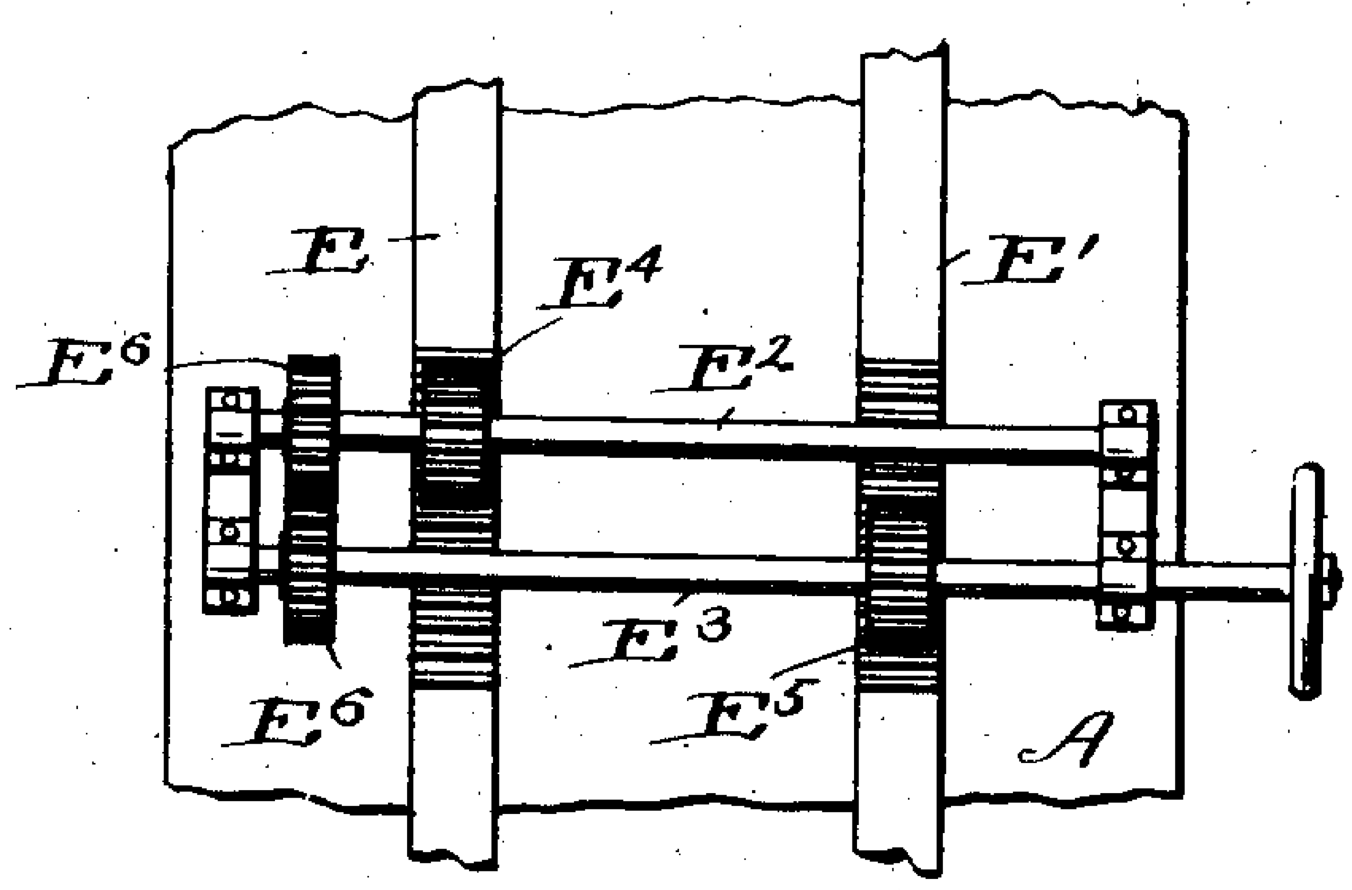


Fig. 4.



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UNITED STATES PATENT OFFICE.

ALVIN A. PIFER AND CHARLES E. F. AHLM, OF CLEVELAND, OHIO, ASSIGNORS, BY MESNE ASSIGNMENTS, TO F. B. WAGNER, OF CLEVELAND, OHIO.

VARIABLE-SPEED MOTOR.

No. 900,420. Specification of Letters Patent. Patented Oct. 6, 1908.

Application filed February 14, 1906. Serial No. 300,983.

To all whom it may concern:

Be it known that we, ALVIN A. PIFER and CHARLES E. F. AHLM, both citizens of the United States, and both residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Variable-Speed Motors, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

Our invention relates to dynamo electric machines, and its object is to provide means whereby the speed of the machine may be regulated as desired.

The regulation of the speed of a dynamo electric machine may be accomplished in several different ways, to all of which it is not here necessary to refer in detail; but, among the methods long known for accomplishing this purpose is that of employing a magnetic shunt and diverting some of the lines of force from their normal path through the armature. One of the specific adaptations of this principle has been the use of a single iron plate adapted to be moved between the armature and each pole of the field magnet, so as to fill the space between the pole piece and the armature. Such a plate serves as a deflector for the magnetic flux when moved to one side, and in this way operates under the general principle before noted. This specific structure is, however, open to objections which have prevented it coming into general use, and which have been the subject of attention on the part of subsequent inventors who have succeeded in overcoming certain of the disadvantages, but at the cost of complexity of structure. One of the chief disadvantages attending the use of this specific machine was the consequent shifting of the "neutral line", or theoretical diameter of commutation, in the magnetic field, which is normally midway between the adjacent pole pieces. This difficulty was eventually remedied to a degree by an arrangement of mechanism whereby the commutator brushes were shifted simultaneously and to the same degree with the shifting of the iron plate. Such shifting was secured by direct connection between the movable plate and the brushes with the result that the brushes were shifted through the same angle as the movable plate. But inasmuch as the angular dislocation of the neutral lines did not, in fact, advance to the same angular extent as the movable plates the shifting of the commutator brushes did not satisfactorily remedy the difficulty. The structure which we have devised overcomes the above noted defects and possesses advantages not hitherto obtainable.

Referring to the accompanying drawings, Figure 1 is an end elevation with parts broken away showing our construction of variable speed motor. Fig. 2 is an end elevation of our variable speed motor partly broken away and partly in section in order to better show the construction, and showing the pole-shoe sections moved so as to divert the magnetic flux. Fig. 3 is a transverse section on the lines 4—4 of Fig. 1. Fig. 4 is a detail.

In the form of machine illustrated, the frame A of the motor supports four pole pieces B, the coils, B′, for which are retained in position by brackets A′ secured to the frame. At the inner extremity of each pole piece, next to the armature C, we provide two pole-shoe sections D, D′, which are secured to and supported by rotatable diamagnetic rings E, E′. It will be noted that each shoe section is secured at one side to one ring, and guided by tongue and groove connection with the other ring.

The alternate shoe sections are screwed to the same ring and each is rotatably mounted in ways A^2 on the brackets A′ so that they can be shifted angularly and retained in proper position. The pole-shoe sections differ from the single plates hitherto used in the art in that, whereas the said single plates were constructed to be moved between the armature and the pole of the magnet, our pole shoe sections are constructed so that they cannot move but half-way between, a construction which has advantages as will be set forth below. It will be seen that movement of the rings and the pole-shoe sections is absolutely independent of the pole pieces, since the rings and sections are not supported from or connected with and do not engage the pole cores in any manner.

For the purpose of shifting the rings, we provide each of them with a short segmental rack on the periphery. Journaled in the frame in any suitable manner are two short shafts E^3 E^3 carrying pinions E^4 E^4 respectively, each in position to mesh with one of the racks on the rings E E'. At one end shafts are each provided with pinions E^6 which intermesh so that the rotation of one shaft in either direction will cause the other shaft to rotate in the opposite direction. Thus, as will be evident, a single hand wheel fitted to either shaft E^3 E^3 can be used for shifting all of the pole shoe sections.

Assuming the parts to be in the position shown in Fig. 1, the rotation of the shaft in the proper direction will cause the several shoe sections to gradually assume the position shown in Fig. 2. As this movement takes place the magnetic flux will be shunted so as to decrease the number of lines of force passing through the armature and an air gap will be formed at the center of each pole piece, thus increasing the magnetic reluctance at that point. The combined effect of the shifting of the shoe sections, so as to shunt the lines of force, and the creation of an air gap at the center of the pole-pieces is to cause a weakening of the magnetic field, the strength of which may obviously be regulated with any desired fineness and without loss of energy.

The increase of the magnetic reluctance about the center of the pole pieces will cause the crowding of the lines of force toward the edges of the pole pieces, and thus increase the density at the latter points so that the danger of sparking, which is present when the field is weakened at the edges, is eliminated. Further, it will be noted that as the several pole-shoe sections approach the adjacent shoe sections they do so in a uniform manner, and maintain the diameter of commutation in an absolutely constant position, regardless of any amount of angular change upon the part of the sections. The advantage of this construction will be obvious to those skilled in the art. While in the position shown in Fig. 3, the number of lines of force passing through the armature will be reduced to a minimum and the magnetic field weakened to the greatest extent desired, with the result that a motor will not race under a decreased load. This degree of control or speed regulation may be adjusted to any extent necessary by the mere turning of the shaft which carries the pinions meshing with the segmental racks upon the diamagnetic rings carrying the pole-shoes. Upon the shifting of the rings in the opposite direction to that just described, the divided sections of the pole-shoes will again come together and the air gap will be eliminated, thus restoring the full strength of the magnetic field.

Having thus described our invention, we claim:

1. A regulator for a dynamo electric machine comprising two pole-shoe sections adapted to be moved from and toward each other, the center of each section moving substantially in the plane passing through the axes of the pole pieces of the machine.

2. A regulator for a dynamo electric machine comprising two separate and independent pole-shoe sections adapted to be moved toward and from each other and circumferentially about the armature, the center of each section moving substantially in the plane passing through the axes of the pole pieces of the machine.

3. A regulator for dynamo electric machinery comprising two separate pole-shoe sections adapted to be moved toward and from each other, the center of each section moving substantially in the plane passing through the axes of the pole pieces of the machine and means for causing such movement to be simultaneous.

4. A regulator for dynamo electric machinery comprising two separate pole-shoe sections adapted to be moved toward and from each other, circumferentially about the armature, the center of each section moving substantially in the plane passing through the axes of the pole pieces of the machine and means for causing such movement to be simultaneous and of the same angular extent.

5. A regulator for dynamo electric machinery comprising two supports each carrying pole-shoe sections, and means for simultaneously moving said supports so that said sections may be made to approach or recede from each other, the center of each section moving substantially in the plane passing through the axes of the pole pieces of the machine.

6. In a dynamo electric machine, the combination of an armature, field magnet pole-pieces, bracket supports projecting from the machine frame, rings mounted on said brackets, and pole-shoe sections secured to said rings.

7. In a dynamo electric machine the combination of an armature, field magnet pole-pieces, bracket supports projecting from the machine frame, rings rotatably mounted on said brackets, and pole-shoe sections each secured to one of said rings, the alternate sections being secured to the same ring.

8. A dynamo electric machine comprising a plurality of field magnet pole pieces arranged circumferentially about the armature, a single series of pole-shoe sections, two rotatable supporting rings concentric with the armature, each alternate and only each alternate member of the series of shoe sections secured to the same ring.

9. A dynamo electric machine comprising a plurality of pole pieces disposed circumferentially about the armature, a series of pole-shoe sections, two rotatable supporting rings

one ring secured only to alternate sections of a series, the other ring secured to and only to the other section of the series, and means for displacing the rings angularly, simultaneously and to the same extent in opposite directions.

In testimony whereof, we hereunto affix our signatures in the presence of two witnesses.

ALVIN A. PIFER.
CHARLES E. F. AHLM.

Witnesses:
J. M. WOODWARD,
E. B. GILCHRIST.