No. 647,585. Patented Apr. 17, 1900.

S. H. SHORT.

MEANS FOR BALANCING MULTIPOLAR ELECTRIC MACHINES.

(Application filed Nov. 2, 1898.)

(No Model.)

Fig. 1

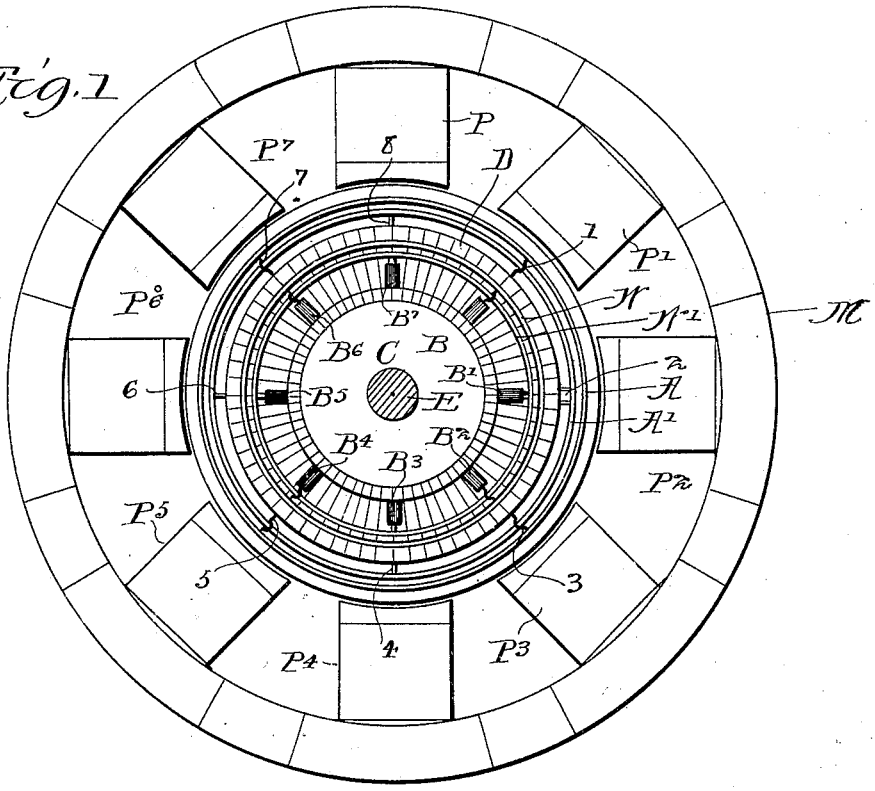
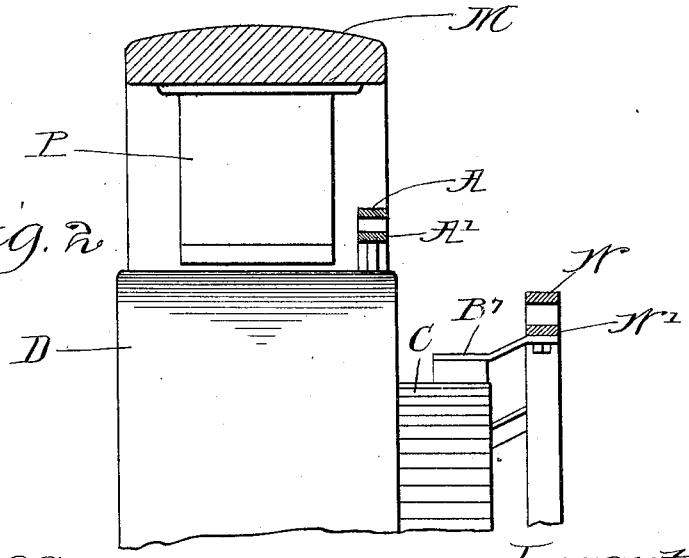


Fig. 2



Witnesses

H. C. Bamett

Wm. M. Rheem.

Inventor

Sidney H. Short

by Brown & Darby

Attys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

SIDNEY H. SHORT, OF CLEVELAND, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, OF PITTSBURG, PENNSYLVANIA.

MEANS FOR BALANCING MULTIPOLAR ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 647,585, dated April 17, 1900.

Application filed November 2, 1898. Serial No. 695,288. (No model.)

To all whom it may concern:

Be it known that I, SIDNEY H. SHORT, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a new and useful Means for Balancing Multipolar Electric Machines, of which the following is a specification.

This invention relates to means for balancing multipolar electric machines.

The object of the invention is to provide means whereby the electromotive force or electric pressure of a multipolar machine is equalized and balanced throughout the machine, thus preventing the development of a higher electromotive force at one point than at one or more other points of the machine on the same frame, and hence preventing the tendency at the point of lower electromotive force to create a "motoring" effect.

The invention consists, substantially, in the construction, combination, location, and arrangement, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally specifically pointed out in the appended claims.

Referring to the accompanying drawings and to the various views and reference-signs appearing thereon, Figure 1 is a transverse sectional view of a multipolar generator embodying my invention. Fig. 2 is a broken side view of the same, parts in section, taken longitudinally of the same.

Formerly it was the practice in the manufacture of armatures to wind the armature wires or inductors upon the exterior surface of the armature-core, the core not having projections of iron between the windings and presented toward the field-magnets. This construction resulted in leaving considerable space or air-gap between the iron of the core and the face of the field pole-pieces, resulting in the development of great reluctance or resistance to the lines of force in the magnetic circuit of the machine. In order to overcome this difficulty, it was necessary to increase the amount of wire wound on the field-magnets. The next step in the development of the art was the construction of armature-cores with teeth and notches on their peripheral surface, the armature windings or inductors being placed in the notches and between the teeth. This practice resulted in reducing the air-gap or space between the surface of the iron-core and the faces of the field-magnet pole-pieces, thus reducing the resistance or reluctance in the magnetic circuit, and hence also reducing the amount of winding required for the field-magnets, and by producing a larger magnetic flux through the magnetic circuit the number of armature windings or inductors was also reduced. With this type of machine, however, another difficulty was encountered. The iron or steel forming the magnet-cores and pole-pieces is not absolutely homogeneous. The material varies in hardness as well as magnetic properties. It sometimes happens, therefore, that some one or more of the field-magnets develops a higher electromotive force than some one or more of the others. This may be due, in part at least, to the fact that by reason of the variations in magnetic properties of the several magnets when the excitation of the field ceases the magnet-cores retain a residual magnetism differing in intensity according to the variation in the magnetic properties of the various magnets. One pole or pair of poles may have a considerable permanent magnetism, while the next pole or pair may have practically or relatively none. This condition results in the development in one or more of the field-magnets of a higher electromotive force than is developed in other magnets on the same frame, thereby producing a flow of current through the cross-connecting bars of the brush-holders from one generator into another generator on the same frame of the multipolar machine, the current flowing around through the armature out through the commutator to the brush, and around the cross-connecting bar or brush-ring to the next or some other brush, and back through it and its commutator-bar to the armature-coil beneath the other field-magnet pole. The effect of this current is to "motor" the generator at the point of lower electromotive force—that is, magnetic lines are induced beneath the pole-piece having the lower electromotive

force, which magnetic lines are in the wrong direction and which therefore tend to turn the armature in the direction of its rotation, thus converting the generator at this point into a motor. On the other hand, the magnets of greater electromotive force induce lines of force in the opposite direction to those above referred to, and which tend to hold the armature back or keep it from rotating in the direction in which it is driven. Thus the magnetic flux is decreased at one point and is increased at another point in the same machine. The result of this unbalanced condition of the various generators is an objectionable sparking at the brushes and in aggravated cases bad flashing at the commutator. If the difference of electromotive force of the various magnets is but slight and is intermittent during the revolution of the armature, the sparking or flashing may not manifest itself, but may simply burn the commutator-bars slightly at each revolution, causing black spots to form upon the commutator-surface at different points in its circumference, rendering the commutator in time so rough at these places as to cause sparking and rapid deterioration.

It is the special purpose of the present invention to provide means for preventing the alternating and varying flux in the pole-pieces of the different generators by equalizing the potential of the various generators on the multipolar frame, thus preventing the interchange of generator and motor due, as above explained, to such unequal potentials.

Referring to the accompanying drawings, illustrating a construction and arrangement embodying the principles of my invention, reference-sign M designates a magnetic ring or frame of a multipolar machine and having its pole-pieces P P′ P^2 P^3 P^4 P^5 P^6 P^7 presenting their faces to an ordinary multipolar armature D, carried upon its driving-shaft E in the usual way. The armature is provided with a commutator, around which are arranged the brushes B B′ B^2 B^3 B^4 B^5 B^6 B^7. Every alternate brush B B^2 B^4 B^6 is connected to the stationary cross-connecting bar or brush-ring W, which forms one terminal or pole of the generator, and similarly the brushes B′ B^3 B^5 B^7, alternating, respectively, with brushes B B^2 B^4 B^6, are connected to the stationary cross-connecting bar or brush-ring W′, which forms the other terminal or pole of the generator, the brushes, as well as the cross-connecting bars or rings, remaining stationary, while the commutator revolves with the armature.

From the foregoing description it will be understood that if the poles P′ and P^2 have a less reluctance through the magnet-frame M and their coöperating portions of the armature than the poles P^3 P^4 have through the magnet-frame M and their coöperating portions of the armature then the electromotive force delivered to brushes B and B′ will be greater than that delivered by the other poles mentioned to brushes B^2 and B^3. The result will be that a current will be set up through that portion of the cross-connecting conductors or brush-rings W W′ which leads to brushes B^2 B^3, and hence a motoring effect of the generators P^3 P^4 will take place. To prevent this result, I equalize the pressure between those portions of the armature-windings which are under poles P′ and P^2 with respect to those under poles P^3 and P^4. This result is accomplished by providing one or more cross-connecting conducting bars or rings A A′, suitably mounted to revolve with the armature, and I electrically connect these rings A A′ alternately with the armature-windings, as shown at 1 2 3 4 5 6 7 8. For instance, the copper or conductor ring A is connected with the armature-windings or commutator-leads, as at 1. The next connection to connecting conductor or ring A must be to a winding on the armature which is of the same potential as at the connection 1. This position would be, in the form of multipolar generator shown, under the pole-piece P^3 or opposite brush B^2—that is, at the point marked 3 on the drawings. The connecting conductor or ring A is in the form of a heavy low-resistance copper bar, and hence from the arrangement above described it will be seen that if the pressure tends to rise under pole-pieces P′ P^2 above the pressure under pole-pieces P^3 P^4 the current will flow through conductor-ring A instead of the brush-rings W W′, and hence will equalize the pressure.

I have found in practice that if the variations in the electromotive force of the various generators of a multipolar machine are slight only one of the cross-connecting conductors or rings A A′ will be sufficient to prevent material differences in pressure between the various generators upon the machine, it being understood that said connecting conductor or ring is coupled up electrically in the manner above indicated to the armature-windings or commutator-leads all the way around the armature—that is, at the points of similar potential. For instance, in the case shown of a multipolar machine employing eight poles this connection is made at the points 1, 3, 5, and 7 at equal distances apart. If, however, the difficulty is serious, it is better to employ one or more additional conductor-rings A′, having similar connection with the armature-windings at points midway between the connections of ring A—that is, in the form shown, at the points 2 4 6 8. This arrangement will tend to further equalize the pressure at the various generators of the machine. It is obvious, therefore, that as many of these connecting conductors or rings as may be desired may be employed, thus splitting up the armature more and more, and hence equalizing the pressure more and more throughout the machine and resulting in less and less disturbance throughout the machine through unbalanced circuits. In the drawings I have shown my invention applied to an eight-pole

machine. In this case it will be observed that the ring A is connected to armature-coils at four points equally spaced apart around the periphery of the armature. In case of a six-pole machine there should be three such connections spaced equal distances apart. In case of a ten-pole machine at five equal distances, and so on, and where two or more conductor-rings are employed the connections of the one ring should alternate with those of the others and all spaced equal distances apart, thus dividing up the armature into as many divisions as may be necessary.

It will be seen that the arrangement of equalizer above described operates with respect to the generators in the same multipolar machine in a manner similar to the arrangements for equalizing the pressure between different dynamos or machines of the same station.

It is obvious that the principles of my invention are applicable to all kinds of multipolar electric machines, whatever the specific construction thereof. It is also obvious that many changes in the particular arrangement and details would readily suggest themselves to persons skilled in the art and still fall within the spirit and scope of my invention. I do not desire, therefore, to be limited or restricted to the exact details of construction and arrangement shown and described; but,

Having now set forth the object and nature of my invention and a form of apparatus and arrangement embodying the same and having explained the purpose, function, and mode of operation thereof, what I claim as new and useful and of my own invention, and desire to secure by Letters Patent, is—

1. In a multipolar electric machine, means for equalizing the electric pressure at the various poles, comprising auxiliary electrical connections between the armature-windings and independent of the machine-circuit, as and for the purpose set forth.

2. In a multipolar electric machine, a frame carrying the field-magnet pole-pieces, and an armature, in combination with an auxiliary conductor independent of the machine-circuit and electrically connected to the armature-windings at various points around the armature, whereby the electric pressure is equalized and balanced throughout the machine, as and for the purpose set forth.

3. In a multipolar electric machine, a frame carrying the field-magnet pole-pieces, and an armature, in combination with an auxiliary conductor independent of the machine-circuit and electrically connected to the armature-windings at points of the same polarity around the periphery thereof, whereby the electric pressure is equalized and balanced throughout the machine, as and for the purpose set forth.

4. In a multipolar electric machine, a frame carrying the field-magnet pole-pieces, and an armature, in combination with auxiliary conductors independent of the machine-circuit, said conductors electrically connected to the armature-windings at equal distances apart, the connections of one of said conductors alternating with those of the other conductors, whereby the electric pressure is equalized and balanced throughout the machine, as and for the purpose set forth.

In witness whereof I have hereunto set my hand, this 26th day of October, 1898, in the presence of the subscribing witnesses.

SIDNEY H. SHORT.

Witnesses:
M. A. KENSINGER,
JOHN J. BEVER.