(No Model.) 4 Sheets—Sheet 1.

C. M. GREEN.

DYNAMO ELECTRIC MACHINE.

No. 587,576. Patented Aug. 3, 1897.

Fig. 1.

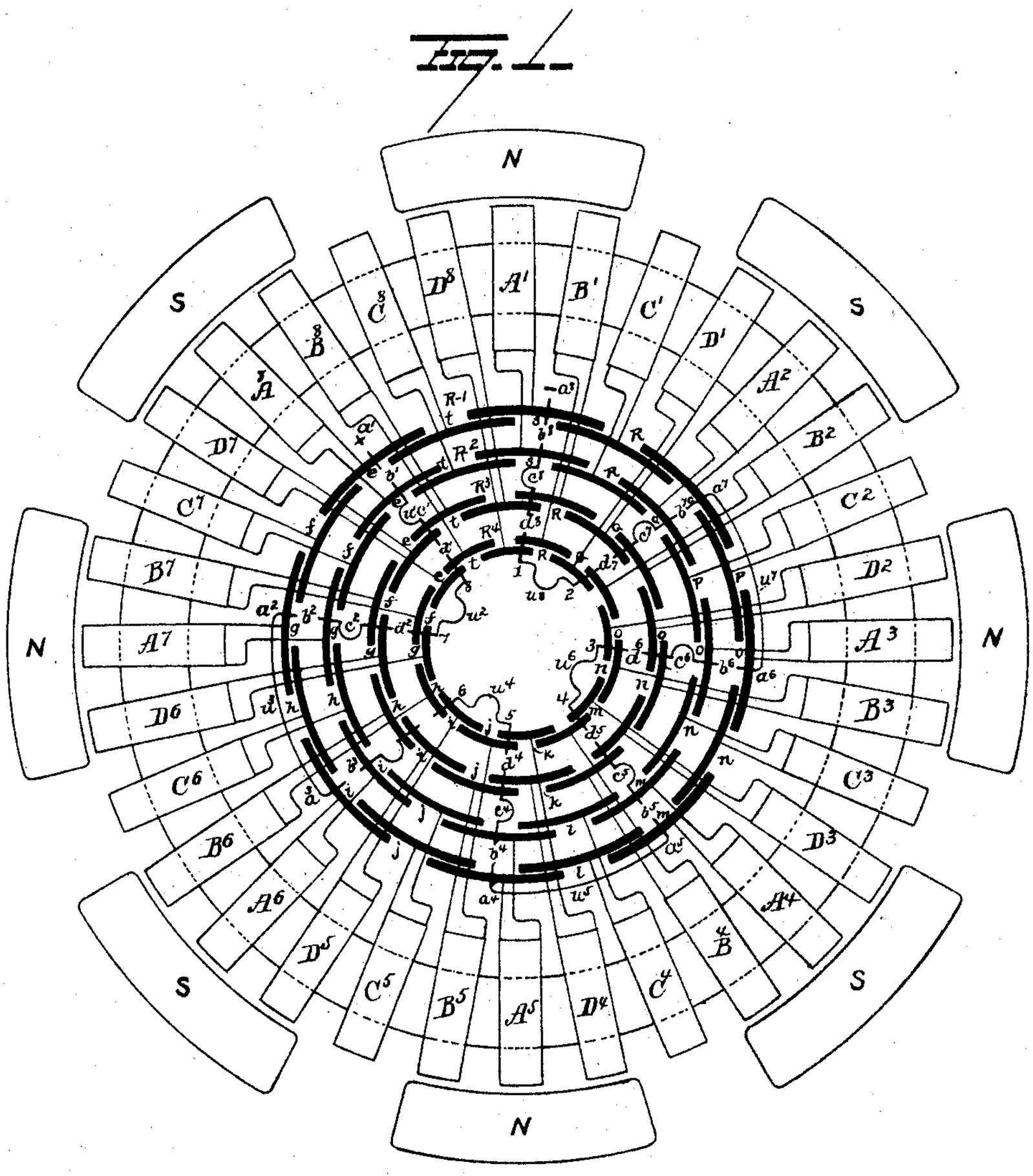

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Fig. 2.

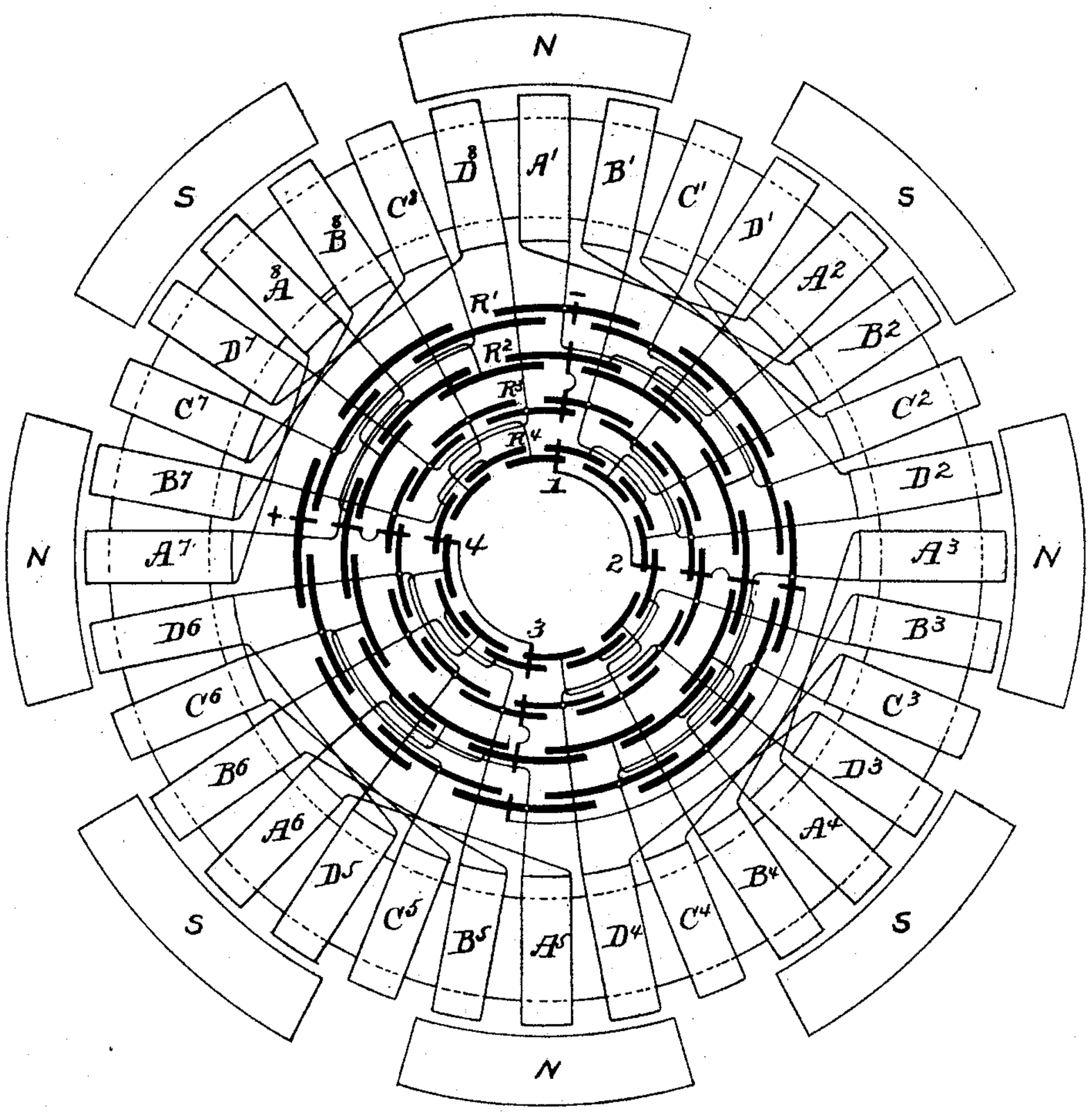

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Fig. 3.

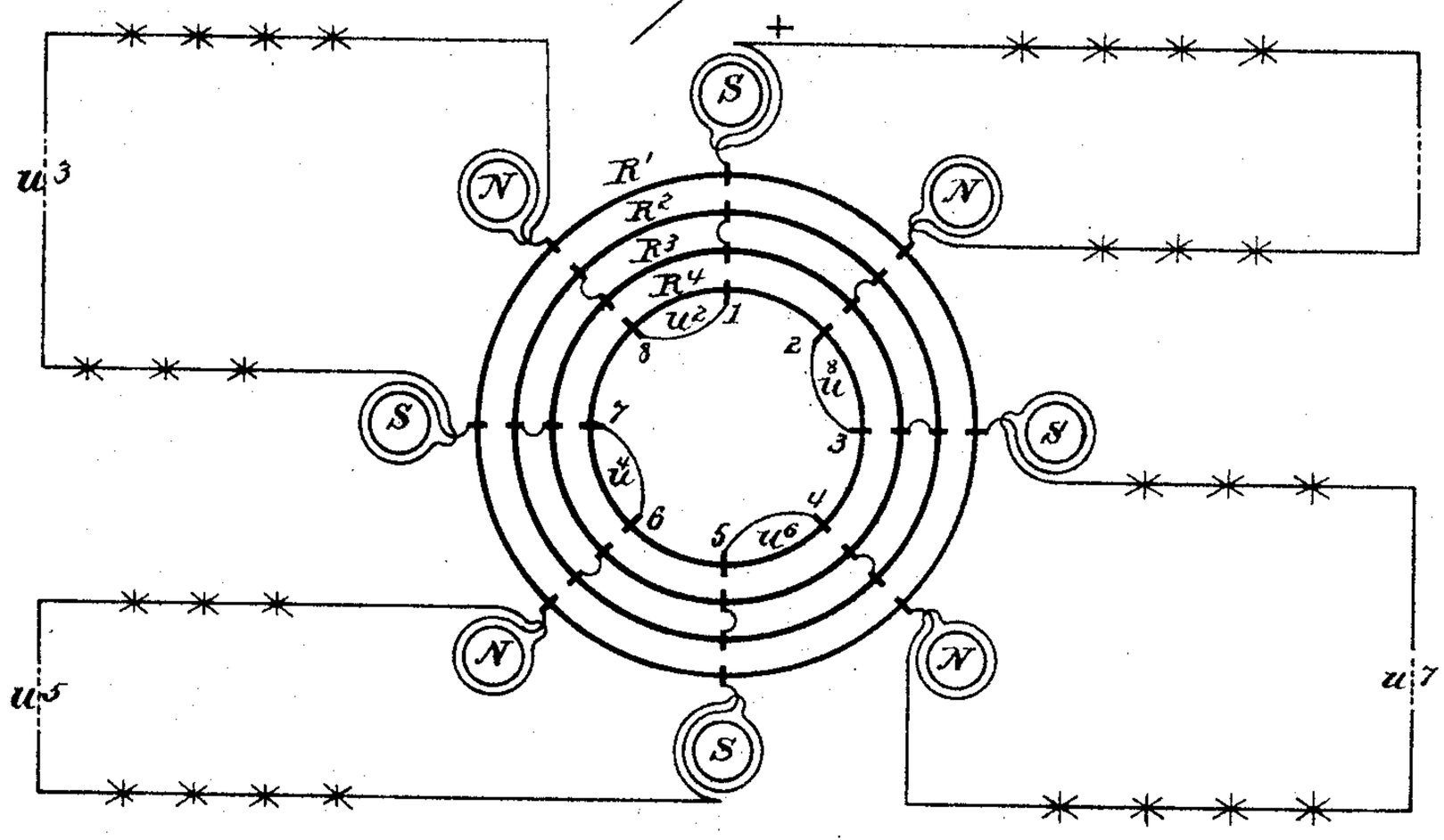

Fig. 4.

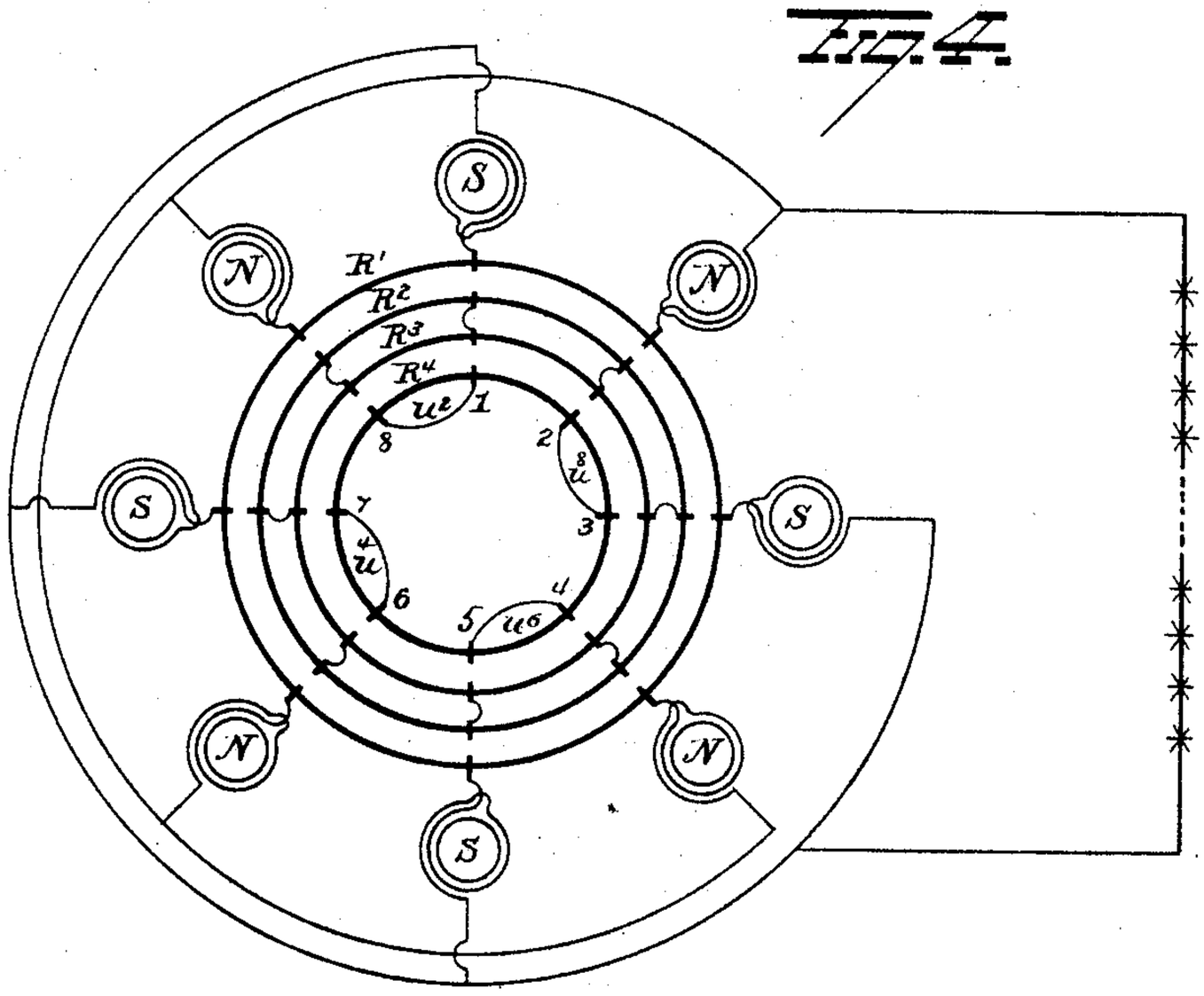

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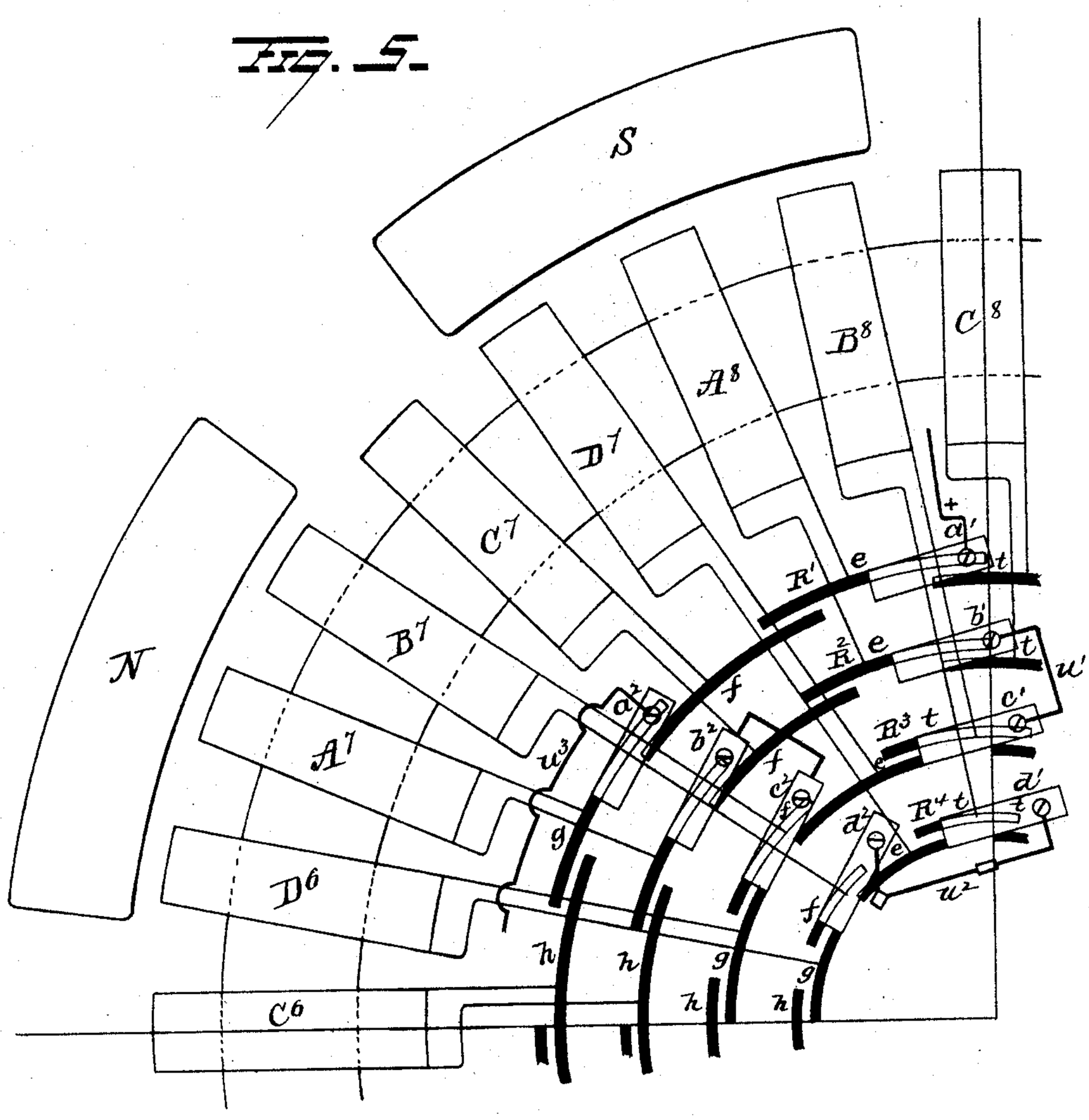
FIG. 5.



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UNITED STATES PATENT OFFICE.

CHARLES M. GREEN, OF CLEVELAND, OHIO.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 587,576, dated August 3, 1897.

Application filed November 10, 1896. Serial No. 611,663. (No model.)

To all whom it may concern:

Be it known that I, CHARLES M. GREEN, of Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Dynamos; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to an improvement in dynamo-electric machines, and relates to an improvement in the armature and commutator connections for a multipolar machine.

In the operation of multipolar machines it has been found that whenever an attempt is made to "push up the voltage" much above the normal output of such machines difficulty has been experienced in effecting satisfactory commutation. In building multipolar machines of a greater capacity than any which have been built up to the present time, one-hundred-and-twenty-five-light arc-machines being the largest that have thus far gone into commercial use, it is desirable that such larger machines be rendered more stable than the one-hundred-and-twenty-five-light arc-machines now in use, since "flashing" on a machine having a capacity of operating three hundred and sixty or more arc-lamps would be attended by much more serious consequences than on a machine operating only one hundred and twenty-five lamps. It has been found that two thousand volts is about the maximum voltage that can be safely commutated on a single commutator-ring employed with open-coil arc-machines, and in order to keep within this prescribed limit of not over two thousand volts on each commutator-ring of a three-hundred-and-sixty-arc-light machine nine commutator-rings would be required under the present method of commutation. Such a commutator would be so long and cumbersome as would render it most undesirable.

The objects of my invention are to so construct an armature and commutating device that the aggregate output of the armature-coils will be distributed among several sets of commutator-brushes, to reduce the number of commutator-rings to a minimum for a multipolar machine having an armature comprising a large number of bobbins, and to employ more than two brush-studs around the commutator.

With these objects in view the invention consists in certain novel features of construction and combinations and arrangements of parts, as will be hereinafter set forth, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a diagrammatical view illustrating one embodiment of my invention. Fig. 2 is a view showing the groups of armature-bobbins cross-connected. Fig. 3 is a diagram showing a method of reducing potential. Fig. 4 is a view showing the sets of armature-bobbins and field-coils connected in parallel with each other. Fig. 5 is an enlarged detail view of a portion of the machine.

I have illustrated my invention as applied to an eight-pole dynamo having an armature with thirty-two bobbins, the ends of the various bobbins being connected with commutator-segments located directly in line with said bobbins and the brush-studs and brushes disposed practically at right angles to the various pole-pieces, so that the ends of a bobbin or bobbins generating current at a given time are connected with brushes and studs opposite one pole of the field-magnets instead of with opposite brushes or studs, as in some bipolar machines. The brushes are rocked forward as the load in the working circuit is decreased, as practiced in arc-machines of to-day.

In the drawings I have designated the field-magnets poles N as "north" poles and S as "south" poles, there being eight poles, four north and four south, which alternate with each other as usual in a multipolar machine.

For sake of convenience in explaining my improvements the armature-coils will be divided into eight sets of four bobbins each and are designated A′ B′ C′ D′ A^2, &c., and so on, ending with D^8.

Each commutator-ring comprises two annular series of segments spaced apart, the segments of one set alternating with those of the other set. These commutator-rings are designated R′, R^2, R^3, and R^4, and the segments of each ring are lettered consecutively, beginning with the letter *e*.

The brush-studs are indicated by the numerals 1, 2, 3, 4, 5, 6, 7, and 8. Eight sets of

commutator-brushes are employed, four brushes being carried by each stud, and are indicated by a' b' c' d' a^2, &c., to a^8.

In tracing the circuit through the armature we may for convenience start with the plus brush A', which in the drawings is shown bearing on segment e of commutator-ring R', with which segment one end of the bobbin A^8 is connected. From bobbin A^8 the circuit may be traced to segment e of commutator-ring R^2, on which brush b' bears, thence by conductor u' to brush c', which bears on segment e and t of ring R^3, thence from segment e of ring R^3 through bobbin D^7 to brush d', which bears on segment e and t of ring R^4, the circuit extending, therefore, also through bobbin B^8. Thus bobbin A^8 will be connected in series and bobbins D^7 and B^8 in parallel.

The brush d' is connected by a conductor u^2 with brush d^2 of the next set of brushes. The circuit can now be readily traced through the bobbins B^7 and D^6 in parallel and bobbin A^7 in series, thence by conductor u^3 to brush a^3, thence through bobbins A^6 in series and B^6 and D^5 in parallel, thence by conductor u^4 from brush d^3 to brush d^4 of the next set, thence through B^5 and D^4 in parallel and A^5 in series, thence by conductor u^5 to brush a^5 of the next set, thence through bobbins A^4 in series and B^4 D^3 in parallel, thence by conductor u^6 to brush d^6 of the next series, thence through bobbins B^3 and D^2 in parallel and A^3 in series, thence by conductor u^7 to brush a^7 of the next set, and thence through bobbins A^2 in series and B^2 and D' in parallel, thence by conductor u^8 to brush d^8 of the next set, thence through bobbins B' and D^8 in parallel and A' in series and to minus brush a^8. Thus it will be seen that two of each set of four armature-bobbins will be connected in parallel, one bobbin of each set will be connected in series, and the remaining bobbin of each set will be cut out, the ends of the fourth bobbin being connected with commutator-segments on which no brush bears for the time being. With the armature in the position shown in the drawings and the circuits arranged for the time being in the manner above explained the bobbins C', C^2, C^3, C^4, C^5, C^6, C^7, and C^8 are in the weakest part of the field and open-circuited.

From the above it will be observed that the current generated in the various sets of coils or bobbins will be commutated simultaneously by a corresponding number of sets of commutator-brushes and that the various sets of brushes are in effect connected in series with each other.

By my improvements I am enabled to take off currents of high voltage from a large multipolar dynamo capable of operating three hundred and sixty arc-lamps without employing a large number of commutator-rings with only two brush-studs. I am also enabled to and in practice would divide the output of the machine and utilize the current generated in several lamp-circuits, thereby reducing the difference of potential between different parts of the machine and circuits. For instance, the conductors u^3 u^5 u^7 can be extended, as shown in Fig. 3, to form several external circuits, in which lamps or other translating devices may be included. The conductors u^2 u^4 u^6 u^8 might also be extended or drawn out to constitute external circuits. Thus several external circuits may be taken from the machine and all of said circuits be in series with each other.

It has heretofore been proposed to independently commutate the current generated in each pair of armature-coils in a bipolar machine and with an armature composed of a comparatively small number of coils, but it would not be practical to adopt this method of commutation with a multipolar machine employing an armature with a large number of coils, (thirty-two coils, for instance,) because a commutator of excessive length would be necessary. By my improvements I am enabled to in effect independently commutate the current generated in several series of the armature-coils and produce results equal in efficiency to those accomplished by using a commutator with a sufficient number of rings to independently commutate each pair of coils without the necessity for a long commutator.

By the construction and arrangement of the apparatus as above described I am enabled to regulate the amperage of the machine by merely altering the relations of the sets of bobbins to each other. For instance, when a large voltage and low amperage is desired the several sets of coils would be connected in series, as above explained, but when it is desired to raise the amperage the several sets of coils may be connected in parallel, as shown in Fig. 4, thereby doubling or quadrupling the amperage and reducing the voltage in the same proportion. This can readily be accomplished by changing the exterior connections on the machine and without disturbing any of the internal connections.

In the form of the invention shown in Fig. 2 only four sets of commutator-brushes are employed and each two groups of armature-bobbins are cross-connected. On account of the cross connection of the bobbins some of the commutator-segments must also be cross-connected. It will be remembered that the ends of the bobbins in the form of the invention shown in Fig. 1 are connected, respectively, with segments of two adjacent commutator-rings and that there are eight sets of bobbins and eight sets of commutator-brushes. Now with the form of the invention shown in Fig. 2, which shows the same number of bobbins as in Fig. 1, there is just one-half the number of sets of commutator-brushes, and the groups of bobbins are cross-connected, as above stated. Hence the commutator-segments with which one set or group of bobbins is connected must be cross-connected with the

commutator-segments with which the adjacent set of bobbins is connected. Thus in Fig. 1 one end of bobbin A^7 is connected with a segment of commutator-ring R′ and the other end of this bobbin is connected with a segment of the adjacent commutator-ring R^2, and commutator-brushes bear on both of these segments, while in Fig. 2 the outside end of bobbin A^7 is connected with a segment of commutator-ring R′, and the inside end of said bobbin is cross-connected with the bobbin A^8. The outside end of the bobbin A^8 is connected with another segment of the commutator-ring R′, but as no brush is now bearing on this segment the latter must be cross-connected with the segment of ring R^2, with which the bobbin A^7 would have been connected had it not been cross-connected with the bobbin A^8.

My improvements are comparatively simple in construction and effectual in all respects in the performance of their functions.

Slight changes in details might be resorted to without departing from the spirit of my invention or limiting its scope, and hence I do not wish to limit myself to the precise details herein set forth.

In this case I do not broadly claim a system of electric generation and distribution consisting of generating electromotive force in two or more sets or groups of armature-coils and distributing the electromotive force so generated in separate external circuits and connected between and included in series with such separate groups of armature-conductors, such invention being covered, broadly, by claims in my pending application filed April 18, 1896, Serial No. 588,108, and is reserved to be protected by the patent granted thereon.

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

1. In a multipolar dynamo-machine, the combination with a series of commutator-rings, of armature-coils connected with commutator-segments at the same side of the armature at which the coils are located, and several sets of commutator-brushes to engage said commutator-rings.

2. In a multipolar dynamo-machine, the combination with an armature comprising several sets of coils, of a commutator consisting of several segmental rings, and several sets of commutator-brushes, the brushes of each set being located on the same side of the commutator and arranged alternately positive and negative, substantially as set forth.

3. In a multipolar dynamo-machine, the combination with an armature and a commutator comprising several segmental commutator-rings and several sets of commutator-brushes, the brushes of each set being alternately positive and negative and the intermediate positive and negative brushes of each set being electrically connected together, substantially as set forth.

4. In a multipolar dynamo-machine, the combination with an open-coil armature comprising several sets of coils, of several segmental commutator-rings, several sets of commutator-brushes and external circuits between each two sets of brushes.

5. In a multipolar dynamo-machine, the combination with segmental commutator-rings, of armature-coils, each coil having its respective ends connected with segments of two rings, said segments being in line with each other and with the coil connected to them.

6. The combination with an armature having several sets of coils, of a series of commutator-rings, each ring comprising two series of segments, the segments of one series alternating with those of the other series, the segments of one ring being in line with the segments of another ring and several sets of commutator-brushes, the brushes of each set corresponding in number to the number of commutator-rings and each brush adapted to engage both series of segments of the respective rings, the several sets of brushes being connected in series with each other, substantially as set forth.

7. In a multipolar dynamo-machine the combination with an open-coil armature comprising several sets of bobbins, of a commutator comprising several segmental rings, several sets of brushes to bear on said rings, said bobbins, commutator rings and brushes being so arranged that one bobbin of each set will be connected in series, two bobbins of each set in parallel and the remaining bobbin of each set cut out, the several sets of brushes being connected in series and translating devices between the sets of brushes, substantially as set forth.

8. In a dynamo-electric machine, the combination with a multiplicity of field-magnet poles, of an armature having several times as many bobbins as there are field-magnet poles, a series of segmental commutator-rings equal to the total number of bobbins divided by the number of field-magnet poles, sets of brushes corresponding in number to the field-magnet poles, the brushes of each set corresponding to the number of commutator-rings and the various sets of brushes being connected together in series, substantially as set forth.

9. In a dynamo-electric machine, the combination with a series of field-magnet poles and several segmental commutator-rings, of an armature having several sets of bobbins, both ends of the various bobbins being connected to commutator-segments in line with them, on the same side of the commutator, and several sets of brushes bearing against said commutator-rings, substantially as set forth.

10. In a multipolar machine, the combination with a commutator consisting of a series of rings, each ring being composed of two sets of segments arranged side by side, the segments of one set alternating with the seg-

ments of the other set, and armature-bobbins, the opposite terminals of which are connected to commutator-segments on the same side of the commutator, of a set of brushes engaging all of the commutator-rings, part of the brushes of said set being positive and the others being negative, substantially as set forth.

11. The combination with a multipolar machine having two or more commutator-rings, a corresponding number of sets of commutator-brushes and armature-bobbins, each of which has its opposite terminals connected to the same side of the commutator, of circuits interposed between the brushes of two sets and translating devices included in said circuits, substantially as set forth.

12. The combination with a multipolar machine having several commutator-rings, a corresponding number of sets of commutator-brushes, and armature-bobbins having their opposite terminals connected to the same side of the commutator, of several circuits, each of which is interposed between the commutator-rings, substantially as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CHARLES M. GREEN.

Witnesses:
S. M. HAMILL,
C. J. LEEPHART.