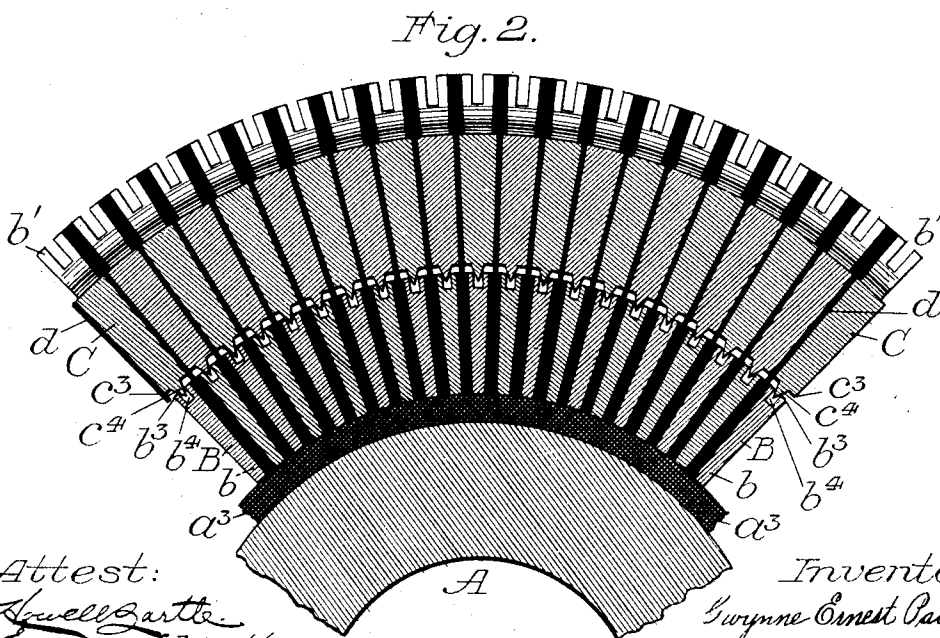
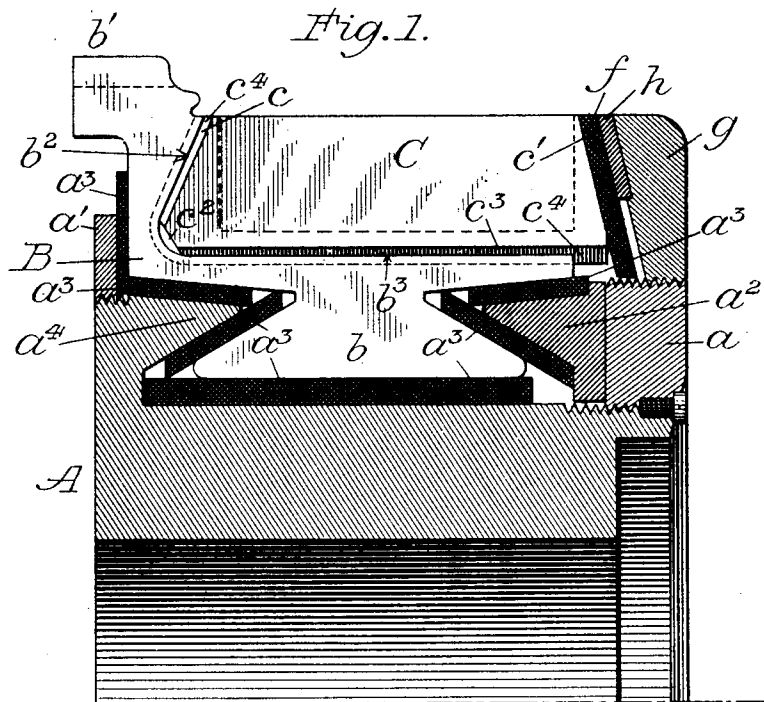


G. E. PAINTER.
COMMUTATOR.

No. 537,480.

Patented Apr. 16, 1895.



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Fig. 3.

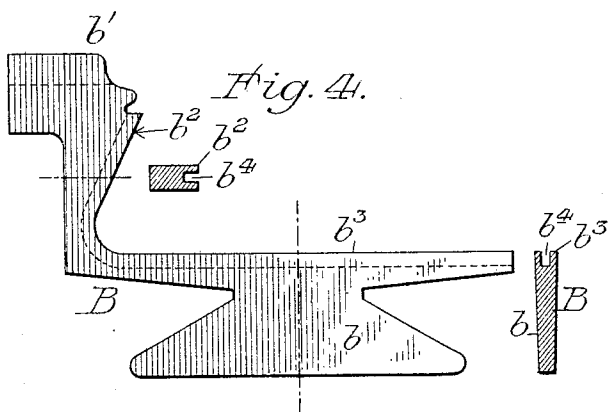
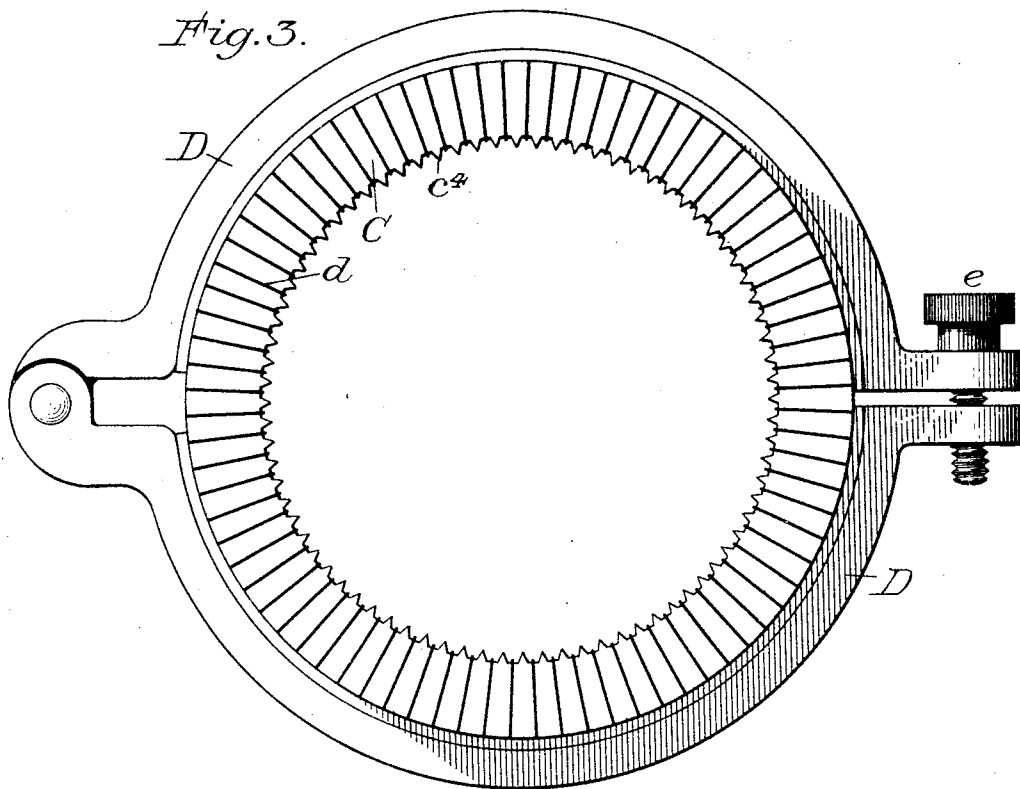


Fig. 5.

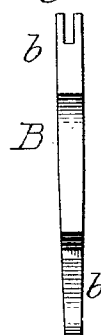
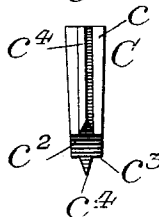


Fig. 6.



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Fig. 7.

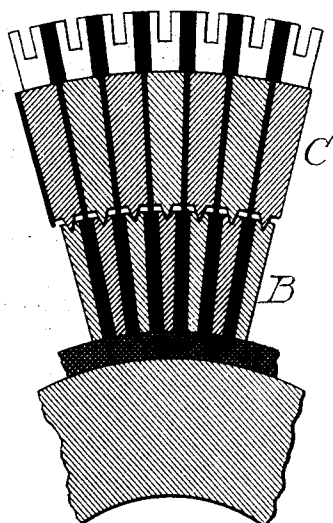


Fig. 8.

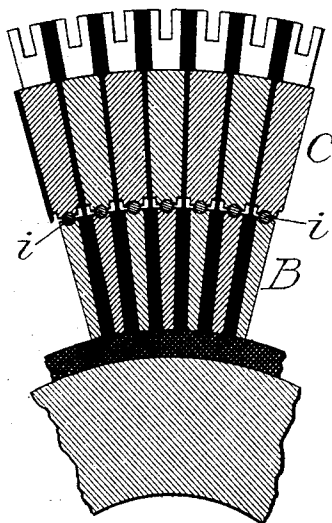
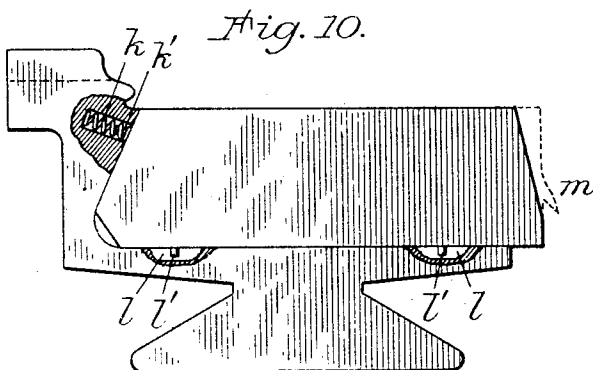


Fig. 9.



Fig. 10.



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UNITED STATES PATENT OFFICE.

GWYNNE ERNEST PAINTER, OF BALTIMORE, MARYLAND.

COMMUTATOR.

SPECIFICATION forming part of Letters Patent No. 537,480, dated April 16, 1895.

Application filed February 28, 1895. Serial No. 540,014. (No model.)

To all whom it may concern:

Be it known that I, GWYNNE ERNEST PAINTER, of Baltimore, in the State of Maryland, have invented certain new and useful
5 Improvements in Commutators; and I do hereby declare that the following specification, taken in connection with the drawings furnished and forming a part of the same, is a
10 clear, true, and complete description of my invention.

My invention pertains to that class of dynamo machine commutators, which embody what may be termed composite bars, or segments, in that each commutator bar is composed of separable parts, one serving as a base
15 bar, securely attached to the hub of the commutator, and electrically connected with appropriate terminals of the armature winding, the other part, serving as a brush contact bar
20 or shoe which is electrically connected with, but detachably mounted upon the base bar.

The objects of my invention are to secure all of the advantages which could possibly have accrued from the use of composite bar
25 commutators as heretofore devised and patented, with certain other valuable results, which could not possibly have been attained therewith. Said prior patented organizations, were devised with a view to enabling the main
30 portion or body of the commutator to remain intact, notwithstanding the inevitable destructive abrasion due to the action of the brushes, and also for enabling the winding connections with the base bars to be permanently maintained during the removal of worn
35 out contact shoes or bars, and the substitution of new bars or shoes.

Commutators embodying my invention have contact shoes, mounted in a novel manner upon the base bars, resulting (even under very high voltage), in specially reliable,
40 effective and durable electric conductivity from the usual brushes through said contact shoes to the base bars, and thence to their winding connections, and these latter need never be disturbed except for repairing the armature winding.

My said improvements also afford additional novel and important results, in that as
50 I believe for the first time, the contact shoes with appropriate insulation, may be applied in mass to and secured upon a hub having

suitably constructed and properly mounted base bars, although if desired, any one or more injured or defective contact bars or shoes may
55 be detached without disturbing the others, and new shoes may be inserted which have been made to conform to the reduced worn dimensions of the others. So also may the shoes and their insulating material be maintained and kept intact, as a complete annular
60 structure during handling and transportation. So also, if the entire commutator is to be re-clad, the several shoes or contact bars may, if desired, be applied one by one, until all are
65 in place, and then all of them may be firmly secured in position, by a clamping device common to all, which assures a practically uniform and effective metallic junction of the shoes and the base bars, and of such areas of
70 contact, as to assure reliable conductivity.

When my contact or shoe bars, are applied in mass, only a few minutes will be required for removing a set of worn out shoes and substituting a new set, and the larger part of such
75 time would need be expended in detaching and lifting out the armature, and replacing it; but if a shoe or two should have become injured, as from the fall of a wrench or hammer, they could be readily removed and new
80 ones substituted without even loosening the journal box covers of the armature shaft, if as is usual, enough space has been provided for, between the end of the commutator and the adjacent box cover.

My novel shoe bars, can be and are as firmly
85 clamped to the base bars, as the latter are clamped to the hub, and the clamping force as before stated is so applied, as to secure good metallic contacts, between the shoes and
90 the base bars; and with respect of resisting torsional strains, the shoes have equal capacity with the base bars, because they are practically interlocked, and if need be, throughout their junctions, preferably by
95 what are in substance, splined connections, and the clamping device for the shoes, or contact bars, is as effective as, and is in fact supplementary to, the separate clamping device
100 which is relied upon for confining the base bars and their insulation in proper position.

To more particularly describe my invention, I will refer to the accompanying drawings, in which—

Figure 1 illustrates in longitudinal central section, a commutator embodying my invention in one of its best forms. Fig. 2 is a partial cross section of the same through a portion of the shell or hub, and also through the overlying base bars and contact bars or shoes. Fig. 3 illustrates in end view, a set of my contact shoes or bars properly insulated, detached, and held in mass by a suitable temporary grip, and ready to be applied in mass to a hub provided with suitable base bars to which the winding terminals have been already properly secured. Fig. 4 illustrates one of my base bars, in side view and in several sections. Figs. 5 and 6 illustrate respectively the terminal or stem end of a base bar, and the inner end of a co-operating shoe or contact bar for illustrating their relative thicknesses, and the consequent wide insulating spaces, which are or may be afforded between the stems or terminal ends of the several base bars. Fig. 7 in section, illustrates a base bar, and a shoe bar, with a V shaped tongue and groove at the points of junction. Fig. 8 in section illustrates a base bar and a shoe bar, both of which are grooved at their longitudinal points of junction, and have a suitable wire or rod serving as a spline, and a coupling conductor, and when desired said wire may be resilient and maintain a spring contact with the base bar and shoe bar. Fig. 9 in section illustrates a base bar and a shoe bar having at the points of junction a V tongue, and a split V groove, affording a reliable self adjusting metallic contact. Fig. 10 illustrates the use of a housed spiral spring in the stem of the base bar serving as a supplemental contact with the shoe, and also the use of studs and recesses for assuring mechanical union.

In Figs. 1 to 6, inclusive, I have illustrated a specially desirable embodiment of my invention which has been well tested with thoroughly satisfactory results, in connection with electric currents under as high voltage as is generally employed in operating either stationary or traction motors.

It is to be understood that the hub or shell A, of the commutator may be constructed in any approved form, and variously applied to an armature shaft, and that the base bars B, may be variously formed with reference to their application to the hub, and variously insulated from each other, and from the hub, without departure from my invention.

As here shown, the hub A, is provided as heretofore, with screw threaded ends, an outside clamping screw collar a , and an inside screw collar a' , and the clamping collar or annular nut a , has an inner face, bearing against a specially formed ring a^2 , which serves as a wedging washer, between said collar and appropriate insulating material, a^3 , which with additional similar material at a corresponding annular wedge shaped portion a^4 , of the hub, and also on its periphery and adjacent to the inside collar a' , precludes

electric conductivity, between the base bars B, and said hub.

The base bars B, are usually composed of copper and have each a dovetailed shank, b , having ends which generally conform to the inner faces of the wedging washer a^2 , and the annular wedge shaped portion of the hub at a^4 , the base bars being thus solidly confined or secured and insulated in a manner well known, and practically permanently and solidly mounted. Each base bar, has a terminal stem b' , which is slotted for the reception of the terminals of the armature winding, it being usual to unite them by soldering, for securing good conductivity, although other modes of coupling the winding and the stem may be employed without departure from my invention. It will now be understood, that commutator bars or segments, as heretofore constructed, often have a radial depth, equal to, or greater than, twice the depth of these base bars, at their centers, and that it is not uncommon for such segments to be worn away by the commutator brushes, until their depth is about equal to the depth of these base bars, or in other words, equal to the depth of the shank, plus say one eighth of an inch. It is practicable to afford in each detachable contact bar, or shoe C, a bulk of copper equal to the extreme quantity ever worn away from the ordinary bar or segment, plus enough to always afford a reliable mechanical union with the base bars, and enable a proper control over said shoes by the clamping device, but the facility with which the shoes may be renewed, renders it only necessary that they should have a reasonably moderate wearing depth, say from one half to three quarters of the maximum depth to which the ordinary bars are worn. In Fig. 1, on the side of the bar or shoe C, dotted lines fairly indicate the interior boundaries of the portion of the metal which may be safely worn away in service, and the entire outer portion of each shoe is available for smooth and uniform brushing contact. These base bars B, and their contact shoes C, are mechanically and electrically coupled as follows: As clearly indicated, the interior edge b^2 , of the stem b' , of each base bar, is inclined inwardly forming a re-entrant angle, and said edge is curved at the bottom of the incline so as to merge with a straight longitudinal surface or bearing portion b^3 , and this entire edge is in this instance, provided with a groove b^4 , which is rectangular in cross section.

Each shoe C, is inclined at its inner end c , to conform to the inclination or angle of the edge b^2 , of the stem of the base bar, and its outer end c' , is also inclined, but at a reversed, and somewhat lesser angle. Its inner lower corner is cut away, at c^2 , and its longitudinal inner or bottom edge c^3 , is straight and parallel with the coincident edge or surface b^3 . The inner or bottom edge c^3 , and the end edge c , is beveled to form a V shaped tongue or spline c^4 , which is so proportioned in its width,

to the width of the groove b^4 , in the base bar, that said spline will have at all points, a wedging engagement, or close contact with the sides of the groove. These base bars, and also the shoes, are formed by special tools, and hence the bars are counterparts and so also are the shoes. The base bars having been once properly mounted, need never thereafter be disturbed. A set of the counterpart shoes, each having a proper sized piece of mica d , or other suitable insulating material, adhesively applied at one side thereof, can be annularly assembled, as indicated in Fig. 3, and temporarily secured in mass as an annular structure, by means of an elastic band, twine or wire. It will be desirable however, to employ an annular clamp D , constructed in two semi-annular sections, hinged together, and provided with a thumb screw e , and preferably clad at the inner side with felt or elastic rubber. When so held, the several contact bars (as one device) may be slipped in mass upon the base bars, each V edge registering with a groove in an appropriate base bar. Upon being well forced longitudinally into proper position, an annular insulating washer f , (preferably flexible vulcanized fiber,) is placed in contact with the outer inclined ends of the shoes. Outside of this insulating washer, there is a shoe clamping ring, or screw nut g , seated upon the base clamping nut a , which is peripherally screw threaded. The inner face of the shoe clamping nut g , is inclined, and also recessed for the reception of a dished metal washer h , interposed between the nut and the insulating washer f . It will now be seen, that upon forcibly turning the shoe nut g , the shoes will be not only forced longitudinally into good electric contact, with the stem of the base bar, but also forced depthwise into equally good contact with the supporting portion of the base bar, and that the mechanical union of the shoes and the bars, precludes the displacement of the shoes, either by centrifugal forces, or by the torsional or brush strains. The shoes having thus been mounted, the temporary clamp can be readily removed. If at any time a shoe should be injured, the temporary clamp may be lightly applied with its joint opposite to the shoe, the clamping nut released, and the shoe removed, and a properly reduced new shoe inserted, it being obvious that the removal of one or all of the shoes, and the substitution of others can be done in a few minutes. The clamping nuts are provided with the usual radial holes for engagement by a suitable wrench, and with radial screws for locking them against rotative displacement from their proper positions.

It will of course be understood, that the pre assembling and temporary clamping of the shoes, with their insulation, constitutes only a valuable feature in the practical uses of my invention, and that such assembled shoes, will be maintained intact by their tempo-

rary binding device, during handling, storage and transportation, and being kept at hand, and suited for use upon a motor appropriately adapted to receive them, will enable the renewal of a worn out commutator, a matter of a few minutes work, and result only in a minimum of loss in motor services, this being often very important with electric locomotives. In the construction of new commutators, the first cost will of course be somewhat greater than that of an ordinary commutator, but the saving involved in the first renewal will quite balance said greater initial cost, with corresponding economy at each subsequent renewal.

Many old commutators now in use, have hubs, and an inner clamping nut, both of which may be retained, and employed with a suitable outer clamping nut for receiving my novel base bars and their shoes.

It will be seen that the base bars at shanks and stems may be quite thin, thus providing for liberal intermediate insulation, this being specially desirable between the stems, they being sufficiently separated to sometimes warrant reliance upon air insulation, especially for working under low voltage. Also that the insulation between the contact shoes or bars is wholly independent of the base bar insulation, which therefore need never be disturbed. It will also be seen, that however thin and numerous the bars or segments may be, the shoes and base bars may be suitably coupled both mechanically and electrically, and that the form of the splined connection may be quite widely varied without departure from my invention; as for instance, as shown in Fig. 7, wherein each base bar B , is provided with a V groove for the reception of a correspondingly shaped tongue on the shoe C . Another form is shown in Fig. 8, wherein the shoe C , and the base bar B , have coincident round bottomed grooves, and a rod or wire i , is inserted between them to serve as a spline, in which case the wire may be either of very soft copper or, it may be sufficiently hard, and so bent, that when inserted, its resilience will be radial.

In Fig. 9, the base bar B , is provided with a beveled tongue, and the shoe C , has a split V groove. For supplementing the electric contact between the shoe and the stem of the base bar B , the stem may be chambered as shown in Fig. 10, and provided with one or more springs k , housed therein, and having a broad abutment against the coincident portions of the shoe and base bar.

Knowing that effective and reliable conductivity can be secured between two pieces of suitable metal having well surfaced joints, I do not restrict my invention, to tongues and grooves for assuring the mechanical union of the base bars and shoes. As shown in section in Fig. 10, the tops of the base bars are recessed as at l , l , and these recesses are occupied by short studs l' , l' , which with a stud k' , within the spring k , will afford with the clamp-

ing nut *g*, a desirable mechanical union of the base bars and shoes.

Inasmuch as the base bars are usually composed of soft copper, and as the stems are quite narrow and thin at their smallest portion, it will sometimes be desirable to bend them inwardly slightly, so that when the shoes are properly forced, their inclined inner ends, and the stems will be made to more closely engage with each other, because of their rubbing contact, while returning the stems to their proper positions.

In all cases, I prefer that the inner lower corner of the shoe should be so cut away, as to not afford a wedging corner at the stem, and prevent self adjustment at the main contact surfaces.

Referring now to the two clamping nuts *a*, and *g*, it is to be understood, that it is not new to employ two separate nuts in connection with non composite bars or segments, but with such bars, the outer nut or clamping ring is not inclined at its inner side, and does not therefore have any such radial clamping effect, as is exerted by the outer clamping ring or nut *g*, which is common to all of the shoes, and not only forces them lengthwise, but also toward and upon the longitudinal portions of the base bars.

Although the best results will be assured by the use of a clamping ring *g*, having an inclined inner face, a similarly desirable effect can be secured, with a straight faced nut, and an insulating washer *f*, which will admit of its being penetrated by angular studs on the outer ends of the shoes, as indicated in dotted lines at *m*, Fig. 10. When thus constructed, the shoes will be properly forced longitudinally, their inner ends will be mechanically locked against displacement, by their engagement with the base bar stems, and also forced depthwise or radially, while at the outer ends, the studs *m*, in penetrating the washer *f*, will be forced radially and also locked into the washer, which would have ample strength to resist the tendency to the centrifugal displacement at the outer ends of the shoes.

Having thus described my invention, I

claim as new and desire to secure by Letters Patent—

1. In a commutator, the combination substantially as hereinbefore described, of a suitable hub, a series of base bars or segments insulated from each other and from said hub, each bar being firmly mounted and solidly secured thereon, and provided with radial stems for coupling with armature winding; a series of detachable contact bars or shoes occupying specially prepared seats on said solidly mounted base bars and their stems, and means for clamping said contact bars, in or to their seats.

2. In a commutator, the combination substantially as hereinbefore described, of a series of base bars or segments appropriately mounted and insulated with reference to each other, a series of contact shoes or bars, seated upon said base bars, and insulated from each other, and a clamping device common to all of said contact shoes or bars, for confining them in their proper positions, and maintaining them in reliable electric connection with the base bars.

3. In a commutator, the combination of a set of securely clamped and insulated base bars, each provided with a radial stem or terminal, and a set of detachable shoes or contact bars, insulated from each other independently of the base bar insulation, seated against the base bar stems, and having brush contact surfaces wider than the thickness of said stems, substantially as and for the purposes specified.

4. A series of commutator contact bars or shoes in combination with suitable insulating material, and adapted to be applied in mass to an appropriately constructed hub provided with suitable base bars or segments, and means for securely temporarily clamping said shoes for maintaining them in annular form, during handling and transportation and enabling them to be properly applied in mass, to the hub and base bars.

GWYNNE ERNEST PAINTER.

Witnesses:

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ISABEL M. MILLIKUS.