

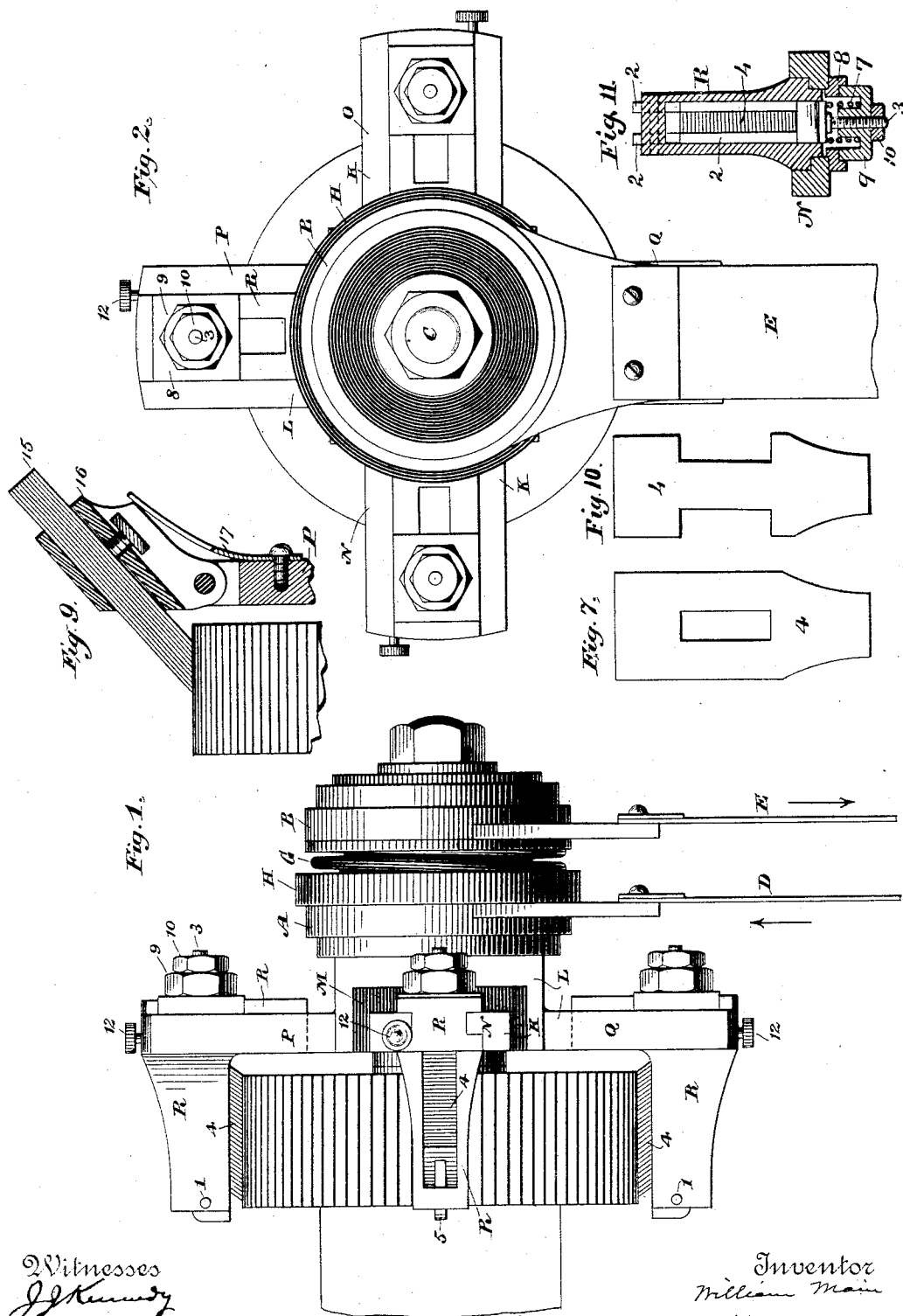
(No Model.)

2 Sheets—Sheet 1.

W. MAIN.  
COMMUTATOR BRUSH.

No. 447,469.

Patented Mar. 3, 1891.



Witnesses  
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*T. H. Palmer*

Inventor  
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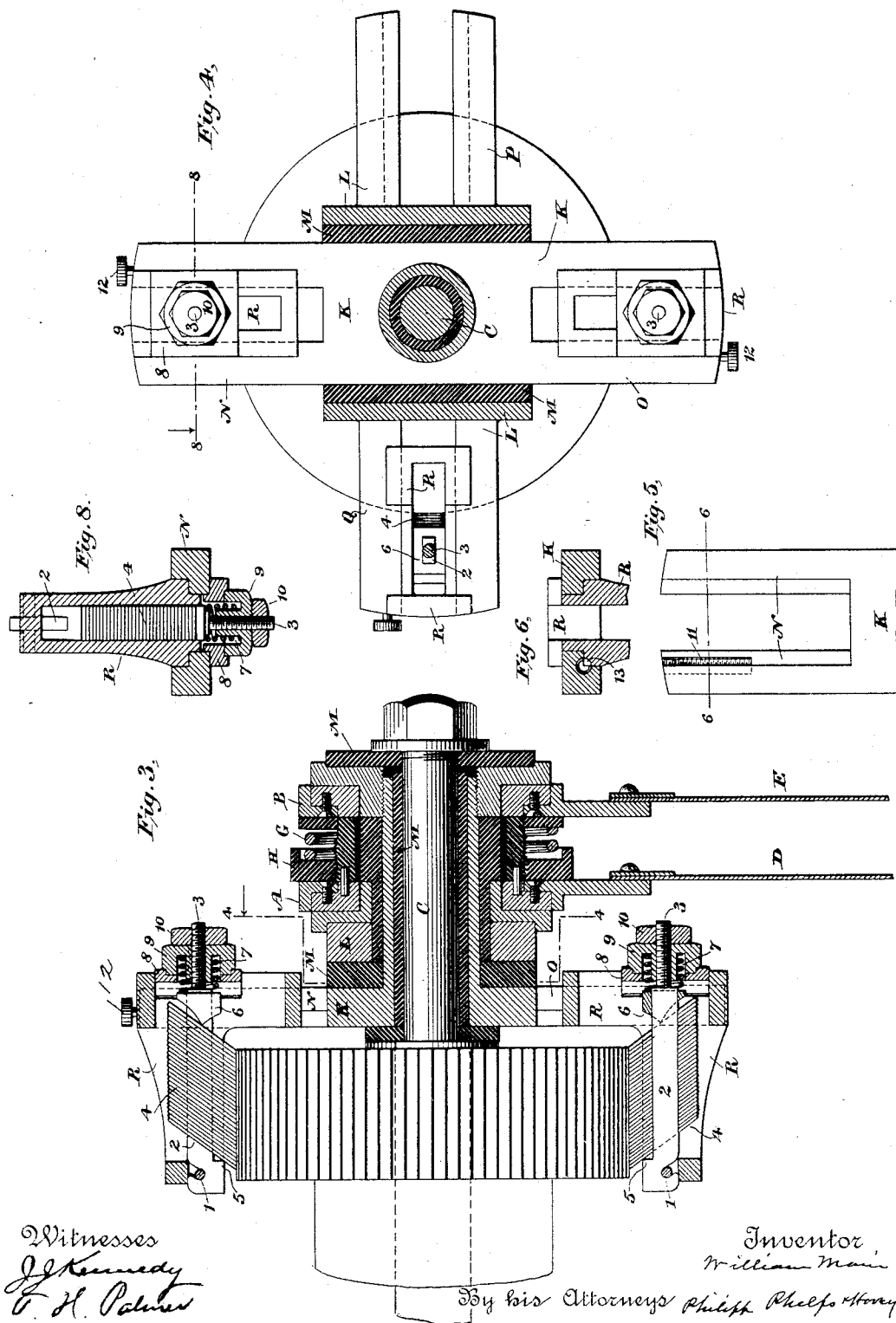
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# UNITED STATES PATENT OFFICE.

WILLIAM MAIN, OF BROOKLYN, NEW YORK.

## COMMUTATOR-BRUSH.

SPECIFICATION forming part of Letters Patent No. 447,469, dated March 3, 1891.

Application filed December 23, 1889. Serial No. 334,643. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM MAIN, a citizen of the United States, residing at Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Commutator-Brushes, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to commutator-brushes for dynamo-electric machines, its general object being to improve the construction of such brushes, to render them more efficient and better adapted for the different constructions with which such brushes are employed, while lessening their cost and increasing their durability.

A serious difficulty heretofore met with in the use of the ordinary tangential brush is that where the ends of the brush rest on the commutator-segments reversal of the machine causes the ends of the brushes to catch on the commutator-segments, frequently breaking the brushes and stopping the machine. Where the brush extends across the curve of the commutator the wear of the segments is likely to cut a shoulder in the brush, which, on reversal, may catch and injure the brush, as in the case above mentioned. As reversals are very frequently necessary, especially in the case of railway-motors, for which this brush is specially valuable, these difficulties are serious.

It is one of the objects of my present invention to devise a brush which shall overcome them and suffer reversal without injury, and which shall not be injured by ordinary wear, thus combining superior efficiency, durability, and economy.

Another difficulty heretofore experienced quite as serious is the fact that where the brush rotates centrifugal force tends to throw the brush off the commutator, and where there are irregularities in the surface of the commutator these, aiding the action of centrifugal force, will frequently cause the brush to leave the segments entirely at times and to jump from one prominence to another, thus effecting very imperfect contact when moving at a high rate of speed. To overcome this difficulty I propose to bring into play centrifugal force to hold the brush to the commu-

tator, so that contact shall become, if anything, more instead of less perfect as the speed of revolution increases.

In addition to the above, my brush possesses the advantage of having a large number of independent contact-points in the form of independent plates so adjusted and held in relation to the commutator that any interference with the contact of one plate shall not affect the relative position of the commutator and other plates to prevent contact of the latter, so that irregularity at a point of a commutator-segment will not prevent the brush from resting against another part of the same segment. In the brushes heretofore in use, moreover, the noise produced by the metallic plates as set in vibration by the movement of the commutator or brush has been such as to render the use of dynamo-electric machines objectionable on this account. By the position in which the contact-plates of my brush are placed relative to the surface of the commutator and the rigid support furnished them my brush is practically noiseless in operation.

In attaining these objects my invention consists, primarily, in a commutator-brush consisting of a series of contact-plates so arranged as to be held in contact with the commutator preferably by centrifugal force when used with a stationary commutator and rotating brush-carrier, or by a spring when the brush-carrier is at rest or moving slowly, and in various constructions and combinations of parts, which will be more particularly described in this specification and pointed out in the claims.

In the accompanying drawings, forming a part of this specification, Figure 1 is a plan view showing such parts of a dynamo-electric machine as are necessary to illustrate my invention. Fig. 2 is an end view of Fig. 1. Fig. 3 is a side sectional elevation showing the connections and insulation of the brush-arms. Fig. 4 is an end view in section on line 4 4 of Fig. 3, and having parts removed for better showing of the brush-arms and means for mounting the brush-carriers. Fig. 5 is a detail view of one of the brush-arms. Fig. 6 is a cross-section taken on the line 6 6 of Fig. 5, with the brush-carrier in place. Fig. 7 is a view on an enlarged scale of one of the

brush-plates, and Fig. 8 is a detail section on line 8 8 of Fig. 4. Fig. 9 is a modified form of brush. Figs. 10 and 11 are views corresponding, respectively, to Figs. 7 and 8, showing a modified form of brush-plate and support.

It is to be understood that my invention may be applied to a dynamo-electric machine of any ordinary construction, and only a brief description of the parts of the machine not constituting my invention need here be given.

A and B are two collars surrounding the shaft C and having connected thereto, respectively, the conductors D and E for the incoming and outgoing currents, as indicated by the arrows in Fig. 1. The collars A and B are held apart by the springs G, which may be of insulating material, as rubber, or, if the spring be of metal, an insulating-collar H will be inserted between the conducting-collars. Carried by the shaft C and insulated from each other are the two cross-pieces K L, one being bent at right angles in the center to form a recess to receive the other, these cross-pieces connecting, respectively, with collars B and A. Each of the cross-pieces K L is provided with two arms slotted to provide adjustable supports for the brush-carriers R. These brush-arms N O on cross-piece K and P Q on cross-piece L form two pairs of north and south poles for the passage of the current. It is to be understood that while a multipolar brush is shown a single north and south pole may be used, if desired, either with a rotary or stationary commutator.

The manner in which the cross-pieces and collars are mounted and insulated from each other and from the shaft is fully shown in section in Fig. 3, the insulation being by means of insulating-pieces M. This construction, however, forms no part of the present invention, and other means of connection and insulation may be used.

Referring now to the specific construction of the brush-carrier and other parts directly supporting the brush and to the construction of the brush itself, the brush-carrier R consists of a slotted piece sliding in the brush-arm, which is slotted and recessed to receive it, as best shown in Fig. 6. The brush-carrier extends over the commutator and has at one end a pin 1, adapted to support a bar 2, preferably of rectangular form, which is hooked over the pin at one end and provided at its other end with a screw-threaded extension 3, passing through the slot in the brush-carrier. The brush proper consists of a number of thin plates 4, preferably of copper, slotted at the center, as best shown in Fig. 4, through which slots is passed the bar 2, the plates thus being supported upon the bar with their edges inclined to the surface of the commutator, and so as to permit pivotal and sliding movements of the plates longitudinally of the bar and commutator, but to hold them against transverse movement, as shown in plan view in Fig. 1. While the plates swing and slide together longitudinally of the bar, it will be

seen that they are independent of each other in respect to their movement in the direction of their own lengths. Instead of the plates being slotted in the center and threaded upon the bar, it is evident that they may be recessed upon each side and the bar slotted or forked to receive the recessed portions, as shown in Figs. 10 and 11, and that the construction may be modified otherwise in details without departing from my invention.

To hold the plates in contact with the commutator there slides freely upon the end of the bar 2, opposite the shoulder 5, a pressure-piece 6, adapted to press upon the sides of the contact-plates, thus forcing them against the shoulder 5 and throwing their outer ends outward and pressing their inner ends against the surface of the commutator. This pressure-piece 6 is acted upon by spring 7, surrounding the threaded extension of bar 2, which spring is of sufficient length and strength to hold the parts in position, very little strength of spring being required for this purpose, and is held under tension by the set-nut 9 and locking-nut 10, the set-nut being formed with a circular recess to receive the spring, as shown in Figs. 3 and 8.

The brush has thus far been described with special reference to its use in a commutator where the brush-carriers are stationary and the commutator-segments rotate. As I have above stated, however, my brush is intended for use with a rotating as well as a stationary brush-carrier, and a very important part of my invention consists in introducing, in connection with the features above described, provision for causing the centrifugal force developed by the rotation of the brush-carrier to act upon the brush with a tendency to force its contact-surfaces against the commutator-segments. The provision for this purpose consists, in that construction of brush which I have herein shown, in so cutting the slots in the plates and determining the position of the bar 2 that its inner edge shall be inside the centers of gravity of the plates—that is, between the center of gravity and the contact-surface of the commutator, so that as the center of gravity of the brush tends to move outward the contact edges of the plates are pressed against the contact-surface of the commutator. The centrifugal force developed by the rotation of the brush-carrier will therefore act to throw the outer ends of the plates outward, causing them to turn or pivot upon the inner edge of the bar 2 as far as is permitted by the contact of the inner ends of the plates against the commutator-segments. I thus secure in effect a pivoted brush with its center of gravity so placed that centrifugal force tends to throw its contact-surface against the commutator-segments. Any other method for supporting the plates may be used, provided the essential feature of my construction be retained, by which the center of gravity and contact-surface of the brush tend to move in opposite

directions relatively to its axis of rotation of the brush—that is, the center of gravity tends to move outward or away from the axis of rotation, and the contact-surface of the brush tends to move inward or toward the surface of the commutator; and I wish it understood that I desire to claim and protect this construction of brush broadly without reference to the particular form of brush herein shown.

It is also to be understood that it is immaterial, where the brush-carrier is stationary, whether the inner edge of the bar 2 is within or without the center of gravity of the plates, since in this case the spring alone holds the plates in contact with the commutator and no centrifugal force is developed. So, also, this feature of construction may be disregarded, although with serious disadvantage, even where the brush is to be used upon a rotating carrier if the spring is made strong enough to hold the plates in contact with the commutator without the aid or against the action of centrifugal force.

The brush-arm is provided with a screw-threaded groove 11 upon the inside, in which moves the thumb-screw 12, which engages with a shoulder 13 upon the brush-carrier R, as shown in Fig. 6, the movement of this thumb-screw thus serving to adjust the position of the brush-carrier and brush. The carrier when adjusted is held firmly in position upon the arm by the washer 8 and nuts 9 and 10, the washer being pressed against the outside of the brush-arm, the carrier being recessed for the purpose, as shown in Figs. 4 and 8.

The operation of the brush is as follows: The contact-plates 4 and pressure-piece 6 having been threaded upon bar 2 and the bar placed in the carrier R by passing it through the slot in the carrier and hooking the end over the pin 1, the washer, spring, and nuts are put loosely upon the threaded extension 3, and the carrier is moved in the arm to a position in which the contact-plates are in proper relation to the commutator by means of the thumb-screw 12. The parts are then locked in position by set-nut 9 and locking-nut 10. The contact-plates 4 will now stand as shown in section in Fig. 3, being held in this position by the shoulder 5, forming a fulcrum, and by the pressure of the spring 7 upon pressure-piece 6, tending to press the outer ends of the plates to the left, as shown, thus holding the inner ends in contact with the commutator, the plates being held from endwise movement away from the commutator by the inner side of the bar 2. It is plain that reversal of the machine will not injuriously affect the brushes or their efficiency, the edges of the plates being tangential to the commutator and in the plane of rotation.

If a fixed brush-carrier and movable commutator be used, the plates will be held in contact at all times by the pressure of the spring. With rotating brush-carriers, however, the spring affords the pressure on the plates only

until the brush-arms and carriers have attained sufficient speed to bring into play centrifugal force, which will then hold the plates in contact independent of the spring. It will be seen that in this case the pressure of the plates upon the commutator will increase with the speed of the rotating brush-arms, a closer contact thus being secured with increase of rapidity in the operation of the machine. As the speed of the machine is lowered, the spring is relied upon to support the plates again, the plates thus being held in contact with the required pressure by the spring or centrifugal force, or both, at whatever speed the brush-arms are run, and by the spring alone when the arms are at rest.

As the plates wear upon the edge in contact with the commutator the pressure of spring 7 will force them to a position more nearly vertical, thus compensating for the wear and preserving a close contact. When desired, on account of excessive wear, the brush-carrier and plates may be moved toward the commutator by loosening the binding-nut 10 and set-nut 9 and adjusting the carrier by thumb-screw 12, the brush-plates therefore being capable of use for a long time. The plates, moreover, may be changed readily without removing the brush-carrier by loosening the nuts 9 and 10, so as to slide washer 8 out of the recess in the carrier, when the bar 2 and plates may be tilted outward by sliding the threaded end of bar 2 in the slot in carrier R and the bar unhooked from the cross-pin 1 and drawn out of the carrier.

The thin edges of the contact-plates being in contact with the commutator, a slight motion is sufficient to remove any roughness or irregularities due to a lack of finish, and it is therefore possible to manufacture these contact-plates at a slight cost by stamping them out of sheet-copper or other suitable material, little or no finish being necessary. This, added to the infrequency with which the plates need to be changed, owing to the adjustability of parts by set-screw 12, as pointed out above, greatly lessens the cost of running the dynamo.

While the plates are held in position with sufficient firmness by means of the spring and centrifugal action and act as a single or solid brush, they still present to the commutator a large number of contact-points so far independent of each other that any irregularity in the face of the commutator or any unequal wear in one of the contact-plates will not affect the contact of the other plates. A brush is thus secured which insures reliable contact under all ordinary conditions of use, either with direct or reverse motion or low or high speed. I do not, however, confine myself to the use of a number of independent plates, as a single plate would have a certain measure of usefulness.

It will be seen that the contact edges of the plates lie in the direction of movement of the commutator or brush instead of at right an-

gles thereto, as in brushes heretofore in use. The result of this construction is that the force tending to vibrate the plates is exerted on the line of greatest resistance to vibration, and this feature, together with the rigid support furnished the plates by the brush carrier and arm, renders the brush almost absolutely noiseless in operation.

Under the term "brush-carrier" I mean to include both a rotatory and a stationary brush-support.

In Fig. 9 I have shown a modification illustrative of that feature of my invention which consists in the utilization of centrifugal force to press a rotating commutator-brush against the commutator-segments. In this case a brush consisting of a bundle of metallic filaments, wires, or, preferably, plates 15 is rigidly fastened in a holder 16, this holder being pivoted to the arm P in such manner that the center of gravity of the brush and brush-holder is on the side opposite from the commutator of a line drawn perpendicular to the axis of the commutator through the pivotal point of the holder. The action of centrifugal force will therefore be to hold the brush in the position shown in Fig. 9. In order to supplement the action of centrifugal force when the machine is moving at a very slow speed and to hold the brush in contact with the commutator when the machine is at rest, a spring 17 is provided. It is of course obvious that the brush may be of any desired construction or form, the invention as regards this feature residing in the mounting of the brush in such a manner that centrifugal force will operate upon it as described.

What I claim is—

1. The combination, with a commutator and a brush-carrier, of a commutator-brush consisting of a series of parallel plates inclined to the surface of the commutator and having their contact edges parallel to the plane of rotation of the commutator or brush-carrier, said plates being independently pivotally mounted in the carrier, and means for pressing the plates together and holding their contact edges against the commutator, substantially as described.

2. The combination, with a commutator and a brush-carrier, of a commutator-brush consisting of a series of parallel plates inclined to the surface of the commutator and having their contact edges parallel to the plane of rotation of the commutator or carrier, said plates being independently pivotally mounted in the carrier, and a spring pressing against the plates outside of their pivotal points, whereby the plates are pressed together and their contact edges held against the commutator, substantially as described.

3. The combination, with a commutator and a brush-carrier, of a commutator-brush consisting of a series of parallel plates inclined to the surface of the commutator, said plates having a common pivotal bearing in the carrier, on which they are mounted to

swing together in a plane transverse to the plane of rotation of the commutator or carrier, but to have a lengthwise movement independently of each other, and means for pressing the plates together and holding their contact edges against the commutator, substantially as described.

4. The combination, with a commutator and a rotating brush-carrier, of a brush carried by said carrier outside the commutator, said brush being so mounted in the carrier that its center of gravity and contact-surface tend to move in opposite directions relatively to the axis of rotation, substantially as described.

5. The combination, with a commutator and a rotating brush-carrier, of a brush carried by said carrier and pivotally mounted therein between its center of gravity and the contact-surface of the commutator to swing to and from the commutator, whereby the brush is held in contact with the commutator by centrifugal force when the carrier is rotated, substantially as described.

6. The combination, with a commutator and a rotating brush-carrier, of a brush carried by said carrier outside the commutator, said brush being pivotally mounted on one side of its center of gravity to swing to and from the outersurface of the commutator, whereby the brush is held in contact with the commutator by centrifugal force when the carrier is rotated, substantially as described.

7. The combination, with a commutator and a rotating brush-carrier, of a brush carried by said carrier and pivotally mounted therein between its center of gravity and the contact-surface of the commutator to swing to and from the commutator in a plane transverse to the plane of rotation of the carrier, whereby the brush is held in contact with the commutator by centrifugal force when the carrier is rotated, substantially as described.

8. The combination, with a commutator and a rotating brush-carrier, of a brush carried by said carrier and pivotally mounted therein between its center of gravity and the contact-surface of the commutator to swing to and from the commutator in a plane transverse to the plane of rotation of the carrier, whereby the brush is held in contact with the commutator by centrifugal force when the carrier is rotated, and means for holding the brush in contact with the commutator when centrifugal force is insufficient for this purpose, substantially as described.

9. The combination, with a commutator and a rotating brush-carrier, of a brush consisting of a series of parallel plates inclined to the surface of the commutator and having their contact edges parallel to the plane of rotation of the carrier, said brush being pivotally mounted between its center of gravity and the contact-surface of the commutator to swing to and from the commutator in a plane transverse to the plane of rotation, whereby the brush is held in contact with the commu-

tator by centrifugal force when the carrier is rotated, substantially as described.

10. The combination, with a commutator and a rotating brush-carrier, of a commutator-brush consisting of a series of parallel plates inclined to the surface of the commutator and having their contact edges parallel to the plane of rotation of the carrier, said plates being pivotally mounted in the carrier independently of each other between their centers of gravity and the contact-surface of the commutator to swing in a plane transverse to the plane of rotation, whereby the plates are held in contact with the commutator by centrifugal force when the carrier is rotated, substantially as described.

11. The combination, with a commutator and a rotating brush-carrier, of a commutator-brush consisting of a series of parallel plates inclined to the surface of the commutator and having their contact edges parallel to the plane of rotation of the carrier, said plates being pivotally mounted in the carrier independently of each other and between their centers of gravity and the contact-surfaces of the commutator to swing in a plane transverse to the plane of rotation, whereby the plates are held in contact with the commutator by centrifugal force when the carrier is rotated, and means for holding the plates against the commutator when centrifugal force is insufficient for this purpose, substantially as described.

12. As a commutator-brush or an element thereof, a plate inclined to the surface of the commutator and pivotally mounted in a rotating carrier on one side of its center of gravity to swing to and from the outer surface of the commutator, whereby the plate is held in contact with the outer surface of the commutator by centrifugal force when the carrier is rotated, substantially as described.

13. As a commutator-brush or an element thereof, a plate inclined to the surface of the commutator and having its contact edge parallel with its plane of movement and pivotally mounted in a rotating carrier inside its center of gravity so as to swing to and from the commutator, whereby the plate is held in contact with the commutator by centrifugal force when the carrier is rotated, substantially as described.

14. The combination, with a commutator and a brush-carrier, of a brush-supporting bar on said brush-carrier extending transversely to the plane of rotation of the commutator or carrier, a brush consisting of a series of parallel plates inclined to the surface of the commutator and independently pivotally supported to swing longitudinally of said bar, and means for holding the contact edges of the plates in contact with the commutator, substantially as described.

15. The combination, with a commutator and a brush-carrier, of a brush-supporting

bar on said carrier extending transversely to the plane of rotation of the carrier or commutator, the brush consisting of a series of parallel plates inclined to the surface of the commutator and independently pivotally supported on said bar to swing longitudinally thereof, and means for holding the contact edges of the plates in contact with the commutator, substantially as described.

16. In a commutator-brush, the combination of a series of contact-plates provided with slots, and a bar passing through said slots upon which the plates are independently pivotally supported to slide in the direction of their own length or to swing or slide longitudinally of the bar, but are held from sidewise movement transversely to the bar, substantially as described.

17. In a commutator-brush, the combination of a series of slotted contact-plates inclined to the commutator, a supporting-bar passing through the slots in said plates, a shoulder forming a rest or bearing for said plates as a whole, a pressure-piece on the bar, and means for pressing said pressure-piece against the plates outside the line of support, whereby the inner ends of the plates are pressed against the commutator, substantially as described.

18. The combination, with a commutator, of a brush consisting of a series of parallel contact-plates having independent movement with respect to each other to and from the surface of the commutator and having their edges in contact with the commutator and parallel to the plane of movement of the commutator or brush, substantially as described.

19. The combination, with a commutator, of a brush consisting of a series of parallel contact-plates having their edges in contact with the commutator and parallel to the plane of movement of the commutator or brush, and means for pressing the plates together and their edges against the commutator with a yielding pressure, substantially as described.

20. The combination of a supporting-bar 2, parallel plates 4, mounted to swing and slide on said bar, a shoulder or bearing, as 5, for the plates as a whole, and means whereby the plates are held against the shoulder and their contact edges pressed against the commutator, substantially as described.

21. The combination of supporting-bar 2, provided with a shoulder 5, plates 4, threaded on said bar, and a spring-pressed pressure-piece 6, sliding on said bar and pressing the plates against the shoulder, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

WILLIAM MAIN.

Witnesses:

T. H. PALMER,  
G. M. BORST.