July 9, 1968 A. L. SEBOK 3,392,295

ELECTRICAL BRUSH CONTACTS

Filed May 3, 1965

Fig. 1

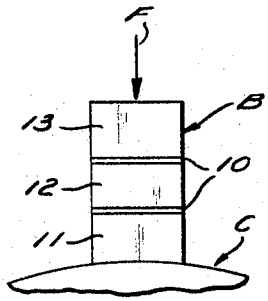


Fig. 2

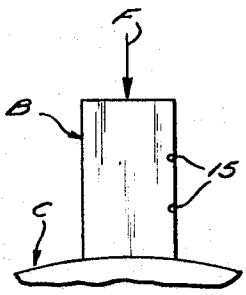
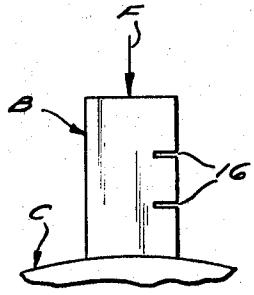


Fig. 3



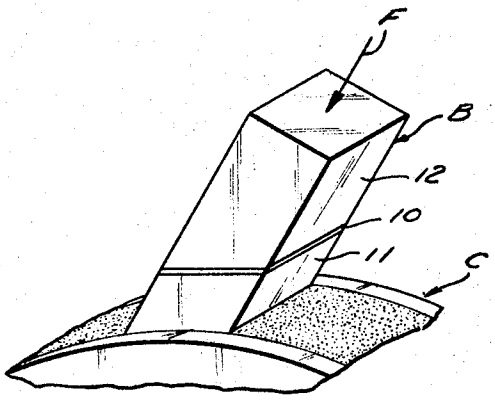


Fig. 4

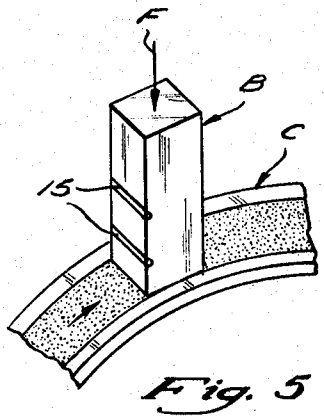


Fig. 5

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ELECTRICAL BRUSH CONTACTS

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ABSTRACT OF THE DISCLOSURE

A sliding electrical contact brush having between successive longitudinally fed portions of like composition and hardness a structural or compositional discontinuity over that entire brush cross dimension parallel to the contact area and extending perpendicular to the direction of sliding motion; a slot or notch as a structural discontinuity decreasing contact area temporarily increasing contact pressure, or a localized stripe or layer of harder material as a compositional discontinuity, both giving a short period of, e.g. commutator, smoothing abrasiveness to increase brush life.

The present invention is concerned generally with the art of electrical brush type contacts; more particularly with an improvement in the combination of a relatively movable conductor structure or element and brush element making electrical contact therewith for conduction of current; and specifically with a novel type of brush and its arrangement in such combination.

Though the invention is hereinafter specifically disclosed and described in terms of a rotating commutator as a conductor structure with a stationary brush longitudinally slidably guided and biased into contact therewith, it is to be understood that the disclosed features may have advantages in other types of brush rigging and in other environments wherein an electric conductive contact is made between relatively movable brush and conductor elements.

In dynamoelectric machines, such as motors, generators or alternators having brushes making electrical current conductive contact with a radial or cylindrical surface of a conductor structure such as a commutator or slip ring, the moving contact between the elements causes mutual wearing, firstly by simple mechanical frictional wearing or abrasion, and the brush is purposely selected of softer material so that primarily it, rather than the commutator, will wear away under this action. However an arcing normally occurring also tends to erode material particularly from the surface of the conductive structure, such as the commutator or slip ring along the contact path of the brush on the moving surface. This path tends to become rough and pitted due to even normal arcing over the area of instantaneous contact. Once begun, this roughening increases the arcing, which in turn increases the rate of roughness increase in a mutually causative and progressively rapidly deteriorating fashion.

In addition, the deterioration of the contact surface of the commutator and the increasing roughness thereof causes progressively faster wear at the contacting end of the brush, decreasing brush life. Also the resultant increased arcing objectionably entails poorer electrical performance, increased heating, and often line disturbances or radio frequency interference.

For these reasons, during the designed life of most such machines, servicing will be required one or more times to replace brushes and to dress the contact surface of the moving structure, for example, by commutator turning for motors or generators. In some cases where the machine is not designed to be serviced in these ways so that the effective life is that of the brushes, the disadvantages

adverted to obviously represent a shorter life of the machine.

It has been found that by changing the effective abrasiveness of the brush on the commutator for a relatively short time at some point or points in the brush life, the time required before servicing, or in some cases the effective commutator or even machine life, is markedly increased. Obviously also great advantage follows in minimizing the extent of occurrence of the untoward features consequent upon the growing roughness of the commutator.

It is the general object of the present invention to provide a combination of a brush and conductive structure of the type described which attains an increase in one or more of these lives or periods. A further object is the provision of a brush structure in a combination of the character described, which results in an increased brush life. A still further object is the provision of a brush resulting in improved performance in a combination of the character described over the effective life period of the brush.

For such purposes by the present invention, it is proposed that, at one or more locations spaced longitudinally from the initial contact face or end of the brush, there be provided certain discontinuities in the brush structure representing means affording an increased abrasiveness. Hence at distinct periods of brush life the path of brush contact is automatically renewed on the commutator by the very operation of the machine.

The means at each such location may be for example, a layer of harder brush material extending entirely across the brush section transversely to its length, in such disposition as in the combination to be advancing, feeding, parallel to the area of contact on the moving element. Thus with a flat contact surface, the layer would be perpendicular or oblique to the brush length as the brush is perpendicular or oblique to the surface; while with the latter cylindrical and the layer not curved, the layer would be disposed to be parallel to a plane tangent to the cylindrical rotating surface approximately at the center of the brush contact area.

Thus when the brush wears to the layer, over the entire width of the path of contact there begins an increased abrasive action enduring until the layer is worn through. This action begins and ends rather abruptly for resumption of normal rate of wear not only with a flat commutator, but even with and despite a planar layer structure and the curvature of a cylindrical commutator.

During the time of wearing through the layer of harder or more abrasive material, in effect there is a dressing of the commutator surface, tending to smooth down roughness which had occurred prior therto.

In a carbonaceous brush for example, the layer structure may be obtained by simultaneously extruding two or more relatively thick slabs of normal brush composition into adherence with interleaved thin layers of a material either containing some abrasive or of such character as will result after the carbonizing or graphtizing of the resulting composite extruded bars in thin layers of greater hardness or abrasivness than the normal brush material Thereafter the composite bar may be sliced down through the layered structure into a multitude of brush blanks or brush elements.

For the same purpose, a stripe of abrasive material may be adherently applied at a similar location on one face of the brush either directly on the flat face or preferably in a transverse groove entirely across the face whereby the abrasive material will be protected from dislodgment in passing through brush rigging guide tubes or in handling. Here the stripe preferably extends across that face toward which the commutator surface or other

moving contact surface will be approaching during its normal movement, so that the abrasive material will be not only contacting the commutator at the groove location, but in being carried away from the groove will also pass under the remainder of the brush face for continuing the abrasive action.

By a still further modification, such a longitudinal face of the brush may have a narrow inward slot running entirely across one face toward which the moving surface of the commutator travels, with plane of the slot being disposed in the manner described for the layers. In this case when the slot encounters the commutator surface there is obviously a sudden decrease in the brush area in contact with the commutator and consequently a sudden increase in the pressure of contact. This apparently causes an increase in the effective abrasiveness of the brush on the commutator surface which continues for the relatively short period while the brush wears away through the width of the slot. Thereafter the full cross section of the brush is again encountered and the effective contact pressure of the brush drops because the brush biasing or spring force is applied over an increased area of contact. In this discussion the biasing force of the spring or other means forcing the brush toward the commutator is considered substantially constant for the small brush length change involved in wearing through the slot.

Objects and advantages additionally will appear from the following description and the drawings wherein:

FIG. 1 is a schematic representation of a first embodiment of the invention showing a portion of a slip ring or commutator and a first form of brush in which there is a layer structure;

FIG. 2, generally similar to FIG. 1, shows a modification in which the abrasive material is localized in spaced transverse grooves in a longitudinal face of the brush;

FIG. 3 shows a still further modification in which a slotted brush appears;

FIG. 4 shows a brush form similar to that of FIG. 1 wherein the axis and feed direction of the brush are nonradial with respect to the commutator; and

FIG. 5 shows a combination of a brush such as that of FIG. 2 or FIG. 3 making contact on a radial face of a commutator or slip ring.

In the drawings, showing various embodiments of or diverse use environments of the invention, generally schematic or of generalized form, the brush is indicated by the reference character B, the slip ring or commutator shown in fragmentary form by C, and the direction of the biasing force applied to the brush by the arrow F, the direction of movement of the commutator or slip ring being indicated by the arrow applied thereto. The brush is here considered stationary and the commutator rotating, although obviously the relative motion could be reversed in certain cases. The usual rigging to guide the brush feeding toward the commutator, usually either brush guide and insulating tubes, biasing compression spring, and brush pig tail or a pivoted spring biased brush mounting arm, are here omitted for simplicity and clarity of representation, and in any event not being necessary to disclose the essence of the invention.

In FIGS. 1, 2 and 3 the brush moves parallel to its axis or longitudinal centerline toward the axis of rotation of the commutator; in FIG. 5, perpendicularly toward the radial face of the commutator or slip ring; and in FIG. 4, with brush axis directed in the plane of rotation but skew to the commutator axis.

Here, for example, the commutator or slip ring may be considered comprised of copper or like conductive portions, and the major structure of the brush as comprised of graphite or other carbonaceous material, as commonly used in many smaller motors and generators. In FIGS. 1 and 4 at locations spaced longitudinally from the lower or contact end of the brush, there are thin layers **10** representing discontinuities in the brush structure, which layers have a higher abrasive action when in contact with the commutator than the major and adjacent brush body portions **11, 12, 13.** This may be achieved by incorporating in such layers **10** either harder graphite or other carbonaceous material, or substances of the types usually designated as abrasive, such as Carborundum, emery, etc.

In FIGS. 2 and 5 the material of the brush body throughout its length may be substantially homogeneous in character, but in one longitudinal face, preferably that face toward which the commutator surface is moving, though possibly on the opposite face, in place of the layers **10** above described, there are shallow grooves **15** extending parallel to the commutator surface and filled with an abrasive composition as a preferred alternate to having the material merely painted or striped onto the very face at like locations, since in the latter case it would not be protected against dislodgment in handling or in passing through brush guides or rigging.

In FIG. 3 throughout its length the brush composition is homogeneous or constant, but at the location of the layers **10** or filled grooves **15** of the previously described figures, there are narrow transverse slots **16** across the upstream brush face transverse to the direction of commutator movement, which slots could occur also or alternatingly on the opposite face of the brush.

Were the structure of FIG. 3 to be used in the environment of FIG. 4, the planes of the slots would be disposed similarly to those of the layer **10** relative to the commutator surface.

I claim:

1. In the combination of a conductive element and brush element bearing upon a surface of the conductive element to provide an electric current conducting movable contact between the elements, wherein the said surface is subject to inception of and thereafter progression of roughening over the path of brush contact on said surface, said brush biased longitudinally toward the moving element to maintain contact under wearing at the contact areas of both elements, the improvement comprising said brush having in at least one location spaced longitudinally inwardly from its contact end face means representing a transverse discontinuity between successive like portions in the brush structure for causing an increased abrasion of the path contacted by the brush while the brush wears through said location, whereby roughness of said path is diminished.

2. The improvement as described in claim **1**, wherein said means comprises a transverse slot entirely across a longitudinal brush face disposed across the path of brush contact on the conductive element.

3. The improvement as described in claim **1** wherein said means comprises a band of highly abrasive material extending entirely across a longitudinal brush face disposed across the path of brush contact with the conductive element.

4. The improvement as described in claim **3** wherein said band is reecived in a shallow brush face groove.

5. The improvement as described in claim **1** wherein said means comprises a layer more abrasive than adjacent portions of the brush and extending entirely across the brush cross section at said location.

6. The improvement as described in claim **5** having a carbonaceous brush wherein greater abrasiveness of said layer results by inclusion of harder carbonaceous conductive material than that in the rest of the brush.

7. The improvement as described in claim **5** wherein the greater abrasiveness is attained by inclusion in said layer of hard non-conducting particles.

8. In the combination of a rotary commutator and a stationary carbon brush biased longitudinally upon the commutator surface wherein the said surface is subject to inception of and thereafter progression of roughening over the path of brush contact thereon, the improvement comprising said brush having at a plurality of locations, spaced longitudinally successively inwardly from its contact end face, means representing respective transverse

discontinuities between successive similar portions in the brush structure for causing temporarily increased abrasion of the commutator area contacted by the brush while the brush wears through each said location whereby roughness of said path is diminished.

References Cited

UNITED STATES PATENTS

297,584	4/1884	Edison	310—248 X
475,668	5/1892	Coffin	310—248
545,347	8/1895	Coffin	310—248
551,033	12/1895	Hirsch et al.	310—248
1,658,677	2/1928	Hanna	310—248
2,153,049	4/1939	Myers	310—248
1,757,611	5/1930	Binney	310—248 XR

FOREIGN PATENTS

370,321	2/1907	France.

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