

United States Patent

McNab

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[54] ELECTRICAL BRUSH STRUCTURE

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[51] Int. Cl. H01r 39/18

[58] Field of Search. 310/219, 231, 239, 248-253

[56] References Cited

UNITED STATES PATENTS

539,454	5/1895	Thomson	310/248
3,153,163	10/1964	Foldes et al.	310/231

539,453	5/1895	Thomson	310/248
3,382,387	5/1968	Marshall	310/219
3,525,006	8/1970	Parr et al.	310/251

Primary Examiner—D. F. Duggan

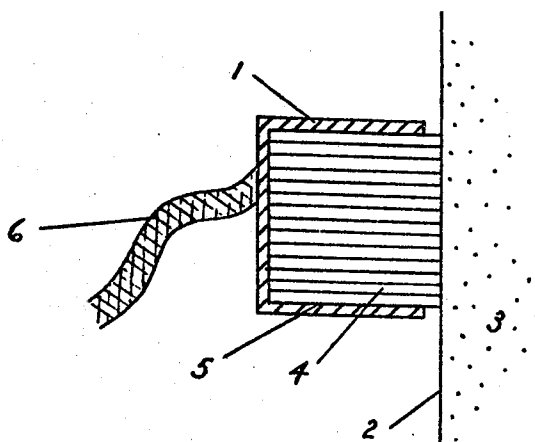
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[57]

ABSTRACT

A current transfer brush for an electrical machine consists of refractory fibers, such as aluminum oxide fibers, with a deposited metallic film. The fibers provide mechanical strength with flexibility while the metallic films carry the current and high current densities can be achieved with low wear rates for the brushes and the contact surface which they traverse.

6 Claims, 2 Drawing Figures



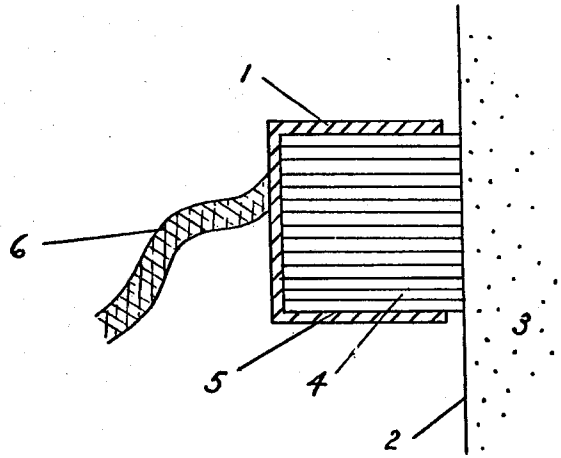


FIG. 1

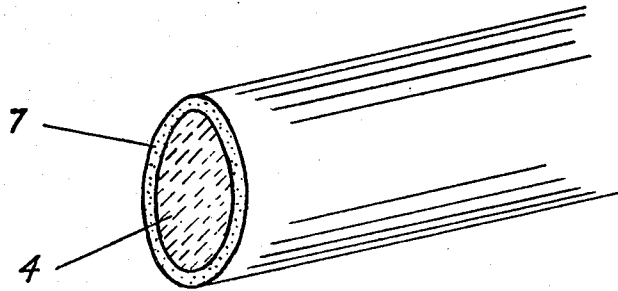


FIG. 2

ELECTRICAL BRUSH STRUCTURE

The invention relates to current transfer brushes for electrical machines.

It is necessary in many electrical machines to provide an electrically conducting path between two parts of a machine moving relative to one another. In dynamo-electric machines, for example, it is common to use brushes of electrically conducting material sliding on the surface of a slip-ring or commutator to provide a current path between the rotor and an external connection. The principal requirements of such brushes are that they should be able to carry a high current per unit area of interface between the brush and the surface which it contacts and that they should have high wear resistance.

It has been proposed in U.S. Pat. No. 3,382,387 to use a brush composed of individual resilient wires each of which consists of a tubular metal sheath having a core of graphite or other lubricant material in powdered form which serves to prevent welding of the wire to the slip ring or other current transfer surface and reduces friction while maintaining electrical contact. The metal tube, which forms 40 percent or more of the cross-sectional area of the wire, provides both the electrical conductivity and the mechanical strength of the wire. Because of the overall diameter and thickness of the tube it is relatively stiff and requires a large contact pressure which gives rise to substantial wear both of the brush wires and of the current transfer surface with which they are in contact. Also the relatively small number of wires in a brush means that the absence of adequate contact between one or two wires and the current transfer surface will cause a noticeable irregularity in the current-carrying capacity of the brush.

In accordance with the present invention it is proposed to form the brush elements of refractory non-conducting fibers which provide high strength and flexibility, each of the fibers having a metallic film deposited on the surface thereof to carry the current. Since the current is carried by the metallic film it is not necessary for the refractory non-metallic fiber to be electrically conductive. It is therefore possible to use fibers of boron nitride or refractory metal oxides such as aluminum oxide and even glass fibers. These fibers can be of very small diameter, less than 10 thousandths of an inch, and with a relatively thin metallic coating are much less stiff than the metallic tubes of U.S. Pat. No. 3,382,387 referred to above and therefore require less contact pressure. Moreover the use of a large number of metal-coated fibers makes for greater uniformity in the current carrying capacity of the brush despite variations in the degree of contact of individual elements of the brush with the contact surface.

The electrically-conducting metal film is preferably formed of a noble metal such as silver, or may take the form of an alloy of a noble metal and a metal such as copper. It may be applied to the fibers by electro-plating, vacuum deposition or any other suitable process.

According to a further feature of the invention one or more brushes constructed in accordance with the invention are used in conjunction with a surface moving relatively to the brush and to or from which the brush transfers current, the surface being constructed of a material having a lubricating effect such as, for example, graphite or metal-graphite composite materials. Alternatively, the moving surface may comprise a conventional metallic material, such as copper or steel, in which case a suitable lubricant, such as molybdenum disulfide or graphite, is employed to reduce friction between the brush and the moving surface. Alternatively the moving surface may be metal with a surface coating of silver or other noble metal. Alternatively an alloy of two or more metals may be employed, for example, silver alloyed with copper.

The invention will be further described with reference to the accompanying drawing in which:

FIG. 1 is a cross-section of part of an electrical machine showing a fiber type of brush in accordance with one embodiment of the present invention in contact with a moving conductor.

FIG. 2 shows an individual fiber of the brush of FIG. 1 provided with a metallic coating.

Referring to FIG. 1, an electrical machine comprises a brush 1 for current transfer purposes in contact with the surface 2 of an electrically conducting member 3. The member 3 may comprise, for example, a slip-ring or commutator segment in a dynamo-electric machine, or alternatively it may comprise a continuous rail from which the brush 1 collects current for, say, traction purposes in vehicle systems.

Brush 1 comprises a plurality of fibers 4 retained in mutual contact with each other along substantially their entire length by a casing 5 of metallic material. A braid 6 of electrically conductive material carries current to or from the brush to windings or terminals of the machine.

FIG. 2 shows one of the fibers 4, which is a non-metallic refractory fiber, provided with a metallic film 7 extending over the whole peripheral surface of the fiber along its full length. In this instance the metallic film is of silver.

The diameter of each fiber is less than 10 thousandths of an inch and the thickness of the metallic coating is typically 0.6 thousandths of an inch and generally no more than one tenth of the diameter of the fiber.

Fibers of boron nitride or aluminum oxide can be formed as coherent high strength fibers by methods similar to the method described in "The Engineer" Vol. 221, 27th May 1966, Page 815, by W. West, L.N. Philips, and W. Johnston, under the title "High strength, high modulus, carbon fibers" and in British Patent No. 1,110,791.

Brushes of the kind described can be used for current densities of the order of 1,000 amps per square inch and with relative speeds of movement between the brushes and the current transfer surface of as much as 18,000 ft/min. The brush wear can be as little as 1 cm for 10^{12} cm of travel of the brushes over the surface and the wear of the surface itself is of the same order of magnitude, being less than 1 mm for 3×10^{10} cms of relative movement of the brush and the current transfer surface.

The casing 5 clamps the metal coated fibers in mutual contact over a major part of their length and thus maintains electrical continuity between them. The fibers may alternatively be joined to each other along a portion of their length by welding together of their metallic films. It is important however that the ends of the filaments which engage the current transfer surface should be free to flex individually in the manner of the bristles of a brush.

The electrical connecting braid 6 may be soldered, welded or rivetted to the casing 5, or alternatively it may be directly joined to the fibers using soldering, welding or other suitable methods. The brush may be held in a conventional brush holder allowing it to be held against the surface 2 under the action of a spring.

WE CLAIM:

1. A current transfer brush for an electrical machine comprising a plurality of refractory non-conducting fibers extending generally parallel to one another, each of said fibers having a metallic film deposited thereon, said film extending along the length of the fiber.
2. A current transfer brush as claimed in claim 1 in which each of said fibers has a diameter less than 10 thousandths of an inch.
3. A brush as claimed in claim 1 having means holding said fibers with their metallic films in mutual contact.
4. A brush as claimed in claim 3 in which said holding means comprises a metallic casing surrounding the fibers at one end thereof.
5. A current transfer brush as claimed in claim 1 in combination with a movable contact member having a lubricated surface.
6. A current transfer brush as claimed in claim 5 in which the surface of the contact member is composed of graphite or a metal-graphite composite material having a lubricating effect.

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