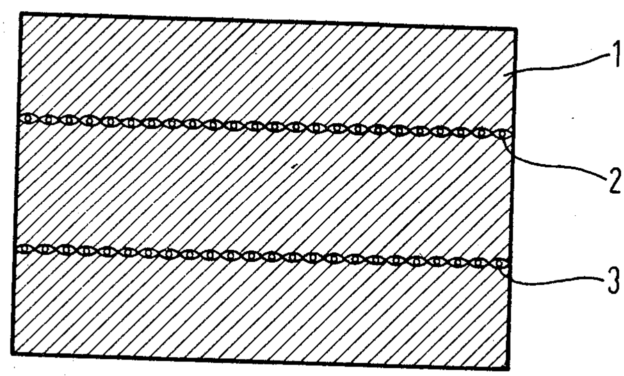
April 28, 1970 P. CONRATH 3,509,400

COMMUTATOR CARBON BRUSH AND METHOD OF ITS MANUFACTURE

Filed May 17, 1967



United States Patent Office

3,509,400

Patented Apr. 28, 1970

1

3,509,400

COMMUTATOR CARBON BRUSH AND METHOD OF ITS MANUFACTURE

Paul Conrath, Bad Ischl, Austria, assignor to Sigri Elektrographit Gesellschaft mit beschrankter Haftung, Meitingen uber Augsburg, Germany, a corporation of Germany

Filed May 17, 1967, Ser. No. 639,221
Claims priority, application Germany, May 17, 1966, S 103,855
Int. Cl. H02k *5/14;* H01r *39/24*
U.S. Cl. 310—248 2 Claims

ABSTRACT OF THE DISCLOSURE

A commutator brush consists essentially of a carbon body with one or more embedded layers of mesh material extending longitudinally of the brush body. The mesh material is formed of artificial carbon and may consist of a carbonized woven fabric of animal fiber such as wool. The brush is produced by embedding one or more such webs in the green carbon mass when the brush is being molded, and thereafter carbonizing or graphitizing the embedded layers together with the green mass.

My invention relates to commutator brushes of carbon, such as those made of industrial carbon or electrographite, and has for its principal object to secure a high ratio of transverse resistance to longitudinal resistance.

A highest feasible transverse resistance of commutator brushes is desirable for securing a satisfactory commutation performance, particularly in alternating-current commutator machines operating with high commutator lamination or sector voltages. Adverse to this desideratum is the slight anisotropy of electrographite brushes. As a rule, such brushes exhibit a transverse to longitudinal resistance ratio of no more than 1.1:1 to 1.3:1. For example, an electrographite brush, on the average, has a longitudinal resistivity of about 40 ohm mm.^{2}/m. and a transverse resistivity of about 52 ohm mm.^{2}/m.

The requirement for high anisotropy of resistance is considerably more satisfied by brushes made of natural graphite. With these, the ratio of transverse resistivity to longitudinal resistivity is 4:1 to 6:1. Brushes of natural graphite however, have the disadvantage of withstanding relative low current loads only. Modern motors, for example railroad motors, operating with high current intensities amounting on the average to 10–12 amp/cm.^{2} and with peak loads of 20–22 amp/cm.^{2}, thus call for the use of electrographite brushes because of their much higher current-carrying capacity.

It has time and again been attempted to produce electrographite brushes with a higher ratio of transverse to longitudinal resistivity. For this purpose, for example, so-called layer-type brushes or sandwich brushes have been produced. These are composed of several individual layers extending transverse to the longitudinal direction and being cemented together. By employing an insulating cement, the longitudinal resistivity of such brushes can be kept unchanged while considerably increasing the transverse resistivity. The drawback of this type of brushes, however, resides in the fact that the cement masses are not able to withstand the high mechanical, electrical and thermal stresses occurring in the running surface of the brush. At this surface there occur high temperatures partly due to arcs and partly due to transient high contact resistances, and these high temperatures overstress the insulating mass composed essentially of different kinds of synthetic resinous plastics. As a result, the brushes lack sufficient mechanical stability in continuous operation and suffer from reduced insulation ability at the running surface due to formation of conducting coke bridges. Such impairments greatly reduce the initially high transverse resistance of the brush. Such brushes, therefore, still leave much to be desired.

2

It is further known to subdivide brushes twice or three times, using a twin or triplet brush instead of a single homogeneous block-type brush. It has been found, however, that in practice such brushes are subjected to non-uniformities with respect to current distribution.

Recently there have been developed methods which afford the production of carbon fibers by carbonization of natural fibers and which also permit the production of mesh material or woven fabrics of carbon by carbonization of natural-fiber fabrics (U.S. Patent 3,297,405). Such carbon fibers or webs can be graphitized and thus be converted to graphite fibers or graphite woven webs. Fibers and webs of this kind have very high electrical resistivities. Their electrical resistance is greatly dependent upon orientation; the resistance in the fiber direction being considerably lower than transversely thereof. It is also known to compress several layers of the graphite web while applying a carbonizable binding agent, and to convert the resulting body to coke or subsequently to graphite. The artificial bodies of carbon or graphite are applicable for a variety of purposes, including commutator brushes. The current-carrying capacity of such brushes, however, is lower than that of the conventional electrographite brushes.

It is an object of my invention to devise a commutator brush having a high ratio of transverse to longitudinal resistance but avoiding the above-mentioned disadvantages of the brushes heretofore available.

According to the invention, a commutator brush, generally of the above-described type, is provided with one or more layers of mesh material formed of artificial carbon which is embedded within the bulk material of which the body of the brush is otherwise constituted, the mesh layer extending longitudinally of the brush body and preferably consisting of a web or woven fabric made from animal fiber such as wool.

A brush structure thus composed is illustrated by way of example on the accompanying drawing which schematically shows a longitudinal cross section.

The body **1** of the brush consists essentially of industrial carbon which need not be different from that employed for conventional brushes. Embedded within the body of carbon and integrally bonded therewith are two woven web layers **2** and **3** consisting of artificial carbon or graphite. The two layers are parallel to each other. The spacing between them is approximately equal to the spacing of each from the nearest longitudinal side of the brush body, although it will be understood that other distance relations are applicable and that a larger or smaller number of embedded mesh layers may be provided.

A brush as exemplified by the above-described embodiment is made by pressing the green mass of bulk material in a die or other mold in the conventional manner but placing the web layers of artificial carbon into the green mass so that upon completion of the pressing operation the inserted web material is either located in the middle of the pressing height or, as shown on the drawing, as approximately the position indicated. In this manner, the brush body being molded and pressed may be provided with two or more inserted webs of woven carbonaceous material.

The pressing operation forces the particles of the green mass into the mesh openings of the web of artificial carbon. Thus the green mass enters into an intimate and fast bond with the web. Since the individual threads of carbon or graphite have a porous structure, a further anchoring in the brush body is achieved by virtue of the fact that binding agents, contained in the green mass, will penetrate into the threads of the web material and become bonded thereto. For these reasons, the subsequent coking as well as any subsequently applied graphitization, results in a uniform body with a homogeneous bonding of the embedded webs. The bonding can be further improved by moistening or impregnating the webs with binding agent prior to embedding the webs in the green mass. The binding agent, for example, may be applied as a spray of tar, synthetic resin or the like plastic. Moistening of the carbon or graphite webs with furfuryl alcohol prior to embedment is particularly recommended.

After coking (carbonizing) the brush bodies with the embedded web layers and, if desired, after subsequent graphitizing treatment, the resulting commutator brushes possess the desired anisotropy of the specific electrical resistivity. The attainable ratio of transverse to longitudinal resisivity is about 6:1 or more.

Brushes according to the invention have the further advantage of excellent running qualities. This is due to the fact that the carbon or graphite fibers of the embedded web are of the same kind as the bulk material of the brush body, and for that reason are no cause of trouble. In contrast thereto, any inhomogeneous structure of the brushes at the running surface may result in vibration and rattling apt to mechanically disturb the quiet running of the brush. This is avoided with brushes according to the invention.

It has been found preferable to employ embedded webs of fabrics produced by carbonization of animal fibers, for example wool.

The embedding of a web of artificial carbon into the brush body may also be effected by inserting into the green mass a web that is not yet completely coked (carbonized), especially a web of animal fiber material, whereafter the conventional carbonizing and, if desired, graphitizing operation is performed. When thus employing an incompletely carbonized web layer, the subsequent carbonization of the shaped brush body causes cracking, and the evolving reaction products improve the bonding between the webs and the bulk material.

The invention will be further described with reference to examples.

EXAMPLE 1

The green mixture is prepared from lamp black (noodle) coke powder and tar-pitch binder. When ready for pressing, the mixture is filled into a mold of 100 mm. by 150 mm. cross section, up to a height of 30 mm., and the top is smoothed to planar shape. Then a roughly woven mesh of artificial carbon, of 0.7 mm. thickness is placed on top and covered with the same quantity of green mixture. Thereafter, a pressure of 2 metric tons per cm.^{2} is applied for molding the laminated body.

The pressed bodies are inserted into crucibles and fired in a gas-heated chamber furnace at a temperature up to 900° C. Thereafter, a graphitizing treatment is applied by subjecting the fired body to a maximum temperature of 2800° C. The resistivity in the pressing direction, i.e. perpendicular to the plane of the embedded web, was measured as 290 ohm mm.^{2}/m. The resistivity parallel to the web was 50 ohm mm.^{2}/m. This corresponds to

an anisotropy coefficient of electrical resistivity in the amount of 5.8.

EXAMPLE 2

The green mixture of Example 1 is pressed in a mold as described, except that two layers of artificial carbon fiber are employed in the form of webs made of fine threads and having a thickness of 0.2 mm. For this purpose, one third of the total quantity of green mixture is placed into the press mold and then covered with the first web layer. Thereafter, the second third of the green mixture quantity is placed into the mold. After the second web is put on top, the remaining third of the mixture quantity is filled in. To improve bonding, the artificial-carbon webs are sprayed with furfuryl alcohol prior to placing them into the mold. The further fabrication is in accordance wtih Example 1. The electrical resistivity of the graphitized brushes was measured as:

	Ohm mm.^{2}/m.
In the direction of the webs	42
Perpendicular to the webs	255

This coresponds to a 6.1 ratio of transverse to longitudinal resistivity.

EXAMPLE 3

A petrol-coke mixture bonded to tar-pitch is filled up to a height of 25 mm. into a mold of 100 x 150 mm. cross section. The mixture is covered with a partially coked wool fabric (largely dehydrated by chemical and thermal treatment up to 300° C.). Ultimately, a second layer of the green mixture is filled into the mold, up to an additional height of 25 mm. Then the body is pressed, fired and graphitized as described in Example 1.

The brushes were found to have the following resistivity values:

In the web direction—19 ohm mm.^{2}/m.
Perpendicularly to the webs—97 ohm mm.^{2}/m.
Anisotropy—5.1

I claim:

1. A commutator brush comprising carbon bulk material and at least one layer of artificial carbon characterized by a transverse-to-longitudinal resistance ratio of at least 5.1/1.00.

2. In a commutator brush according to claim **1**, said layer consisting of a woven web of carbonized animal fiber.

References Cited

UNITED STATES PATENTS

531,707	1/1895	Wallace	310—248
701,369	6/1902	Mills	310—248
1,117,965	11/1914	Becker	310—248
1,556,990	10/1925	Henry	310—248
2,338,409	1/1944	Conradty	310—248
3,297,405	1/1967	Sperk	23—209.1

FOREIGN PATENTS

17,688 8/1902 Great Britain.

ORIS L. RADER, Primary Examiner
L. L. HEWITT, Assistant Examiner

U.S. Cl. X.R.

310—252