

UNITED STATES PATENT OFFICE

2,331,479

ELECTROGRAPHITIC BRUSH

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No Drawing. Application November 23, 1942,
Serial No. 467,260

8 Claims. (Cl. 171—325)

This invention relates to electrographitic brushes, particularly those possessing an abrasive or cleaning action.

The carbons used for making brushes for electric machines contain inorganic impurities, or ash, which are abrasive in nature, at least after being heated to elevated temperatures. Consequently, brushes made from such carbons which have been baked at temperatures below the graphitizing range possess a scouring or cleaning action on the commutator with which they are associated. This is desirable because it eliminates the necessity of servicing the commutator to keep it in good condition, free from excessive smutting, blackening, burning or glazing.

Electrographitic brushes are usually made by shaping carbon, baking the shapes to carbonize the binder, and then heating to convert the carbon to graphite or pseudo-graphite. The temperatures used for graphitizing are such as to cause the inorganic matter to be volatilized. Consequently, electrographitic brushes do not possess any substantial abradant or cleaning action. This has militated against their more widespread use despite the fact that such brushes exhibit long life and low friction and possess excellent electrical properties, such as high contact drop and good commutation. This lack of cleaning and abrading action makes necessary frequent servicing of commutators used with electrographitic brushes, especially where vibration, the composition of the atmosphere in which they operate, and other factors increase the difficulty of proper operation.

Various means have been proposed for conferring cleaning action upon electrographitic brushes. Many years ago it was proposed to incorporate hard metal carbides, such as tungsten carbide or boron carbide, in these brushes, but with poor success because the graphitized brushes exhibited little additional cleaning action, and their life was short.

Only mediocre success has attended the idea of depositing abrasive material in electrographitic brushes after the graphitizing operation, as by impregnating the graphitized brush with a material which is subsequently decomposed, usually by heat, to deposit silica or some other abrasive material throughout the brush. Also, it has been proposed to make electrographitic brushes from a mixture of carbon and hard metal carbide which is then subjected to a graphitizing temperature and finally impregnated with a resin, the idea being that otherwise the carbide particles will be torn from the brush by the commutator. All

such impregnation procedures are undesirable, however, because they involve additional operations with consequent retardation of output and increased costs, and because it may be difficult to control the impregnation to obtain uniform deposition of the impregnant throughout the brush section, and although such procedures have attained some success, they are far from solving the problem of providing, satisfactorily and economically an electrographitic brush which has satisfactory properties in all respects.

It is among the objects of this invention to provide electrographitic brushes which possess satisfactory electrical characteristics and service life in combination with good cleaning action upon the commutator with which they are associated.

Another object of the invention is to provide carbon-bonded electrographitic brushes containing hard metal carbides which are held in place without impregnants.

Still another object is to provide a process of making electrographitic brushes containing hard metal carbides as abrasive or cleaning agents, which is simple, easily practiced, requires no material change in existing modes of making electrographitic brushes, and is productive of brushes which embody good electrical characteristics and in which the abrasive character of the carbides is fully available.

Yet another object is to provide a process of this type in which hard metal carbide is incorporated initially in a carbon mix for subsequent graphitizing, and no subsequent impregnation is necessary.

A further object is to provide a process of the type included in the objects of this invention by which the abrasive or cleaning action of the brush is controllable and may be varied according to need for any particular purpose.

Other objects will be understood from the following specification.

It is demonstrable experimentally that graphitization of carbon begins at about 2250° C., but to insure substantially complete conversion in a reasonable time, the practice in making electrographitic brushes has been to heat the material to about 3000° C. I have discovered that the erratic results and short life that have been encountered with electrographitic brushes containing a hard metal carbide as made heretofore, are due to the use of such high temperatures. That is, in prior attempts to make electrographitic brushes from mixes containing a hard metal carbide the high temperatures used

in graphitizing have caused the finely divided particles of carbide to become fused, or at least incipiently fused at the sharp edges which contribute abrasive action, so that the particles or their edges became round. Thus, although the carbides were retained in the graphitized brush their desired effect was not had because the rounding of the particles or their edges caused them to slide or roll on the commutator instead of exerting the expected scouring or cleaning action.

I have discovered further, and it is upon this that my invention is predicated in part, that the foregoing difficulty is avoided and electro-graphitic brushes possessing the desired cleaning or scouring action may be made from carbon-carbide compositions by effecting the graphitization at a temperature below that which causes fusion or incipient fusion of the carbide particles. In this way the desirable electrical characteristics of graphite are obtained while the carbide distributed through the graphite body retains its abrading action. Such brushes possess satisfactory life in addition to good commutating characteristics.

In general, the materials and procedures used for the manufacture of brushes can be followed in the practice of the present invention, due regard being had to the graphitizing temperature as just stated. Generally speaking, the brushes are made from a mixture of carbon base material, finely divided hard metal carbide, and a binder. The base materials may be such as are commonly used, such as lamp black or a calcine of lamp black and a carbonaceous binder, such as tar or pitch, which has been baked and pulverized. Other forms of carbon such as coke, gas black, graphite, or the like, or mixtures of them with lamp black, may be used. For most purposes it is preferred to use a carbonaceous binder, such as tar, pitch, or the like material productive of a carbon bond.

The finely divided hard metal carbide may be added to the carbon flour in a mixer, preferably heated, and the dry flour mixed for fifteen to twenty minutes, or long enough to obtain a uniform blend. The pitch, or other binder, is then added and mixing continues until the carbon and carbide particles are well coated, and generally from one to two hours will suffice for this purpose. This base mix is then removed from the mixer, cooled, pulverized and molded into plates which are then baked in ovens, for instance from between 1800° to 2200° F., to carbonize the binder. Thereafter the plates are baked at a graphitizing temperature, and either batch or continuous type electrical ovens may be used for this purpose.

The present invention is dependent upon this last, or graphitizing, step, which is critical in obtaining the results which characterize the invention. Accordingly, the temperature of the furnace is controlled so as to graphitize the carbon of the plates but to be below that which will cause the finely divided particles of carbide to become rounded, or to round their edges. This maximum temperature is, of course, dependent upon the particular carbide present in the mix, and the purity of the carbide, some carbides containing small amounts of impurities which will tend to lower the temperature at which the edges of the particles will undergo incipient fusion. The temperature is, of course, easily controlled by adjustment of the power input to the oven. The continuous method of graphitizing is

advantageous in the practice of the invention because of easier and closer control of the temperature.

I have found that where the carbides of zirconium, columbium, tantalum and titanium are used it is satisfactory to graphitize, in accordance with this invention, at temperatures between about 2700° and 3000° C., in which temperature range the abrasive character of those carbides is not detrimentally affected. Tungsten and vanadium carbides, however, require lower graphitizing temperatures.

The cleaning or scouring action of brushes made in accordance with the invention will be dependent upon such factors as the particular carbide used and the amount present. Generally speaking, it is now preferred that the brush shall contain from about 0.1 to 1.5 per cent by weight of carbide. The scouring or cleaning action may additionally be controlled by varying the particle size, which is particularly important in its effect upon the commutator. It is generally true that the finer the carbide the more completely and uniformly it is distributed throughout the brush, with consequent improved uniformity of commutator cleaning action during the life of the brush. If the carbide is too coarse it may cause threading, and even grooving, of the commutator. On the other hand, if the carbide is too fine its cleaning action may be undesirably low, and even negligible. I now prefer to use the carbide in a form in which all of it passes a 200-mesh sieve. For severe conditions of service, where considerable cleaning action is necessary, it is advisable to have the majority of the carbide particles toward the coarser end, i. e., passing but close to 200-mesh, but where more of a polishing than an abrading action is desirable, the carbide may suitably be such as will pass a 325-mesh screen.

Various modifications are, of course, permissible. Thus, mixtures of carbides may be used, for instance as a further means of controlling the abrading action, and materials, such as sulfur, may be incorporated in the mixes for their known effects.

From what has been said it will be appreciated that no impregnation of the brushes is used in the practice of this invention. I have found that by proceeding as described the particles of carbide are held naturally in place so that the trouble and cost of impregnation with a medium intended to act as a binder for the carbide are avoided.

As exemplifying the practice of the invention, brushes satisfactory for many applications are made from 100 parts by weight of lampblack calcine mixed with 55 parts by weight of soft pitch and $\frac{3}{4}$ part by weight of zirconium carbide (through 325-mesh) in a heated mixer for ninety minutes. The mixture is cooled and pulverized and the flour is molded into plates approximately 1 inch thick. The plates are packed in coke and baked to 1800° F. in a gas fired oven, after which they are passed through a continuous graphitizing oven maintained at a temperature which graphitizes the carbon but does not cause fusion or rounding of the carbide particles. Brushes made from this mix in this manner possess distinct abrasive properties and the desirable commutating properties of ordinary electro-graphitic brushes.

According to the provisions of the patent statutes, I have explained the principle and mode of practicing my invention and have described what I now consider to represent its best embodi-

ment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

I claim:

1. That method of making an electrographitic brush which comprises forming a mixture of carbon, binder, and at least one finely divided hard metal carbide, and heating said mixture to a graphitizing temperature but below a temperature which causes rounding of the sharp edges of said carbide particles.

2. That method of making an electrographitic brush which comprises forming shapes from a mixture of carbon, carbonaceous binder, and at least one finely divided hard metal carbide, heating said shapes to carbonize said binder and effect bonding of said mix, and then heating the shapes to a graphitizing temperature but below the fusion temperature of said carbide particles.

3. That method of making an electrographitic brush which comprises forming shapes from a mixture of a major proportion by weight of carbon, a minor proportion of carbonaceous binder, and from about 0.1 to 1.5 per cent by weight of at least one finely divided hard metal carbide, heating said shapes to carbonize said binder and effect bonding of said mix, and then heating the shapes to a graphitizing temperature below a temperature which causes rounding of the sharp edges of said carbide particles.

4. That method of making an electrographitic brush which comprises forming shapes from a mixture of a major proportion by weight of carbon, a minor proportion of carbonaceous binder,

5 and at least one finely divided hard metal carbide, heating said shapes to about 1800° to 2200° F. to carbonize said binder and effect bonding of said mix, and then heating the shapes to a graphitizing temperature but below the fusion temperature of said carbide.

5. As a new article of manufacture, an electrographitic brush comprising a shaped body consisting of graphitized carbon and at least one hard metal carbide in the form of finely divided sharp edged particles distributed through and bonded in place by said body, and the brush being adapted to exert a cleaning action upon a commutator.

6. An electrographitic brush according to claim 5, said carbide constituting about 0.1 to 1.5 per cent by weight of the body.

7. An electrographitic brush according to claim 5, said graphitized carbon being carbon bonded and said carbide constituting about 0.1 to 1.5 per cent by weight of the body.

8. An electrographitic brush according to claim 5, said carbide being selected from the group consisting of carbides of zirconium, columbium, tantalum, titanium, tungsten and vanadium.

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