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Scholpp

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[54] **METHOD OF MAKING METAL-CARBON BRUSHES FOR ELECTRICAL MOTORS**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **75/201,** 29/182.5, 29/630 E, 75/211, 75/213, 241/3, 252/503

[51] **Int. Cl.** **B22f 1/00,** H01r 9/00

[58] **Field of Search** ..... 75/201, 213, 211; 29/182.5, 630; 252/503; 241/3, DIG. 2

[56] **References Cited**

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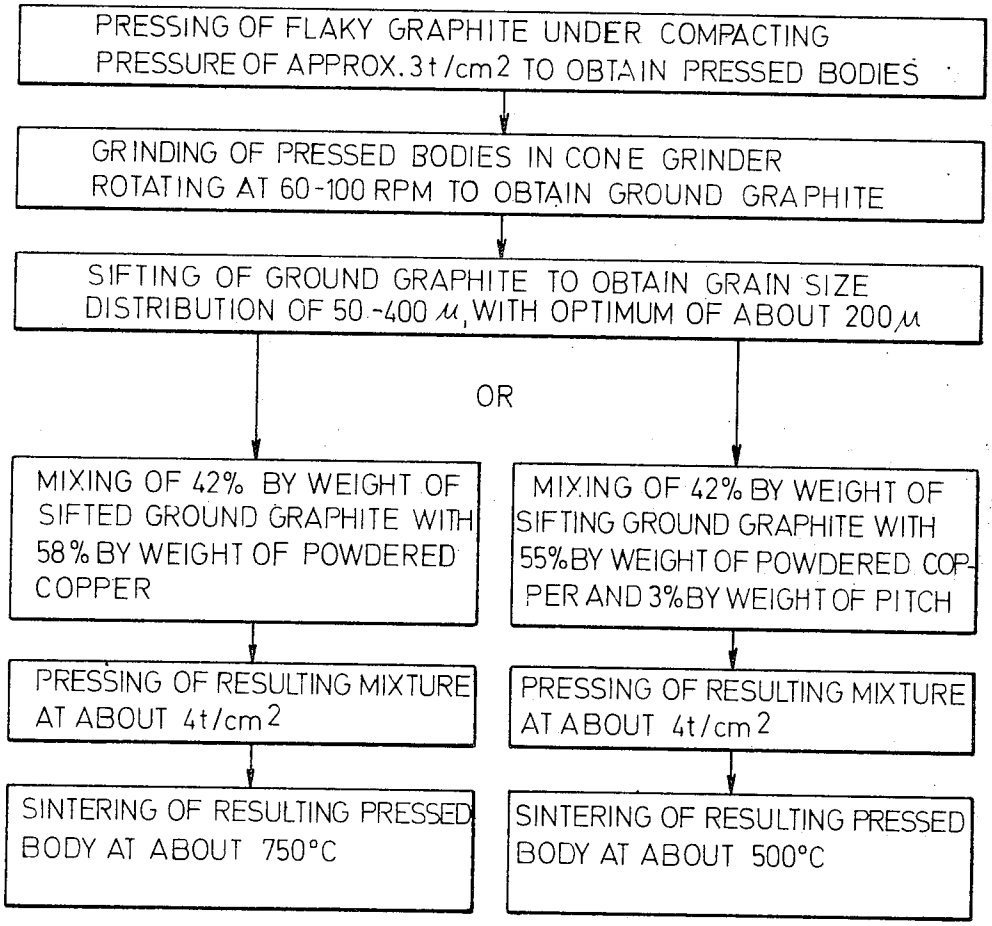
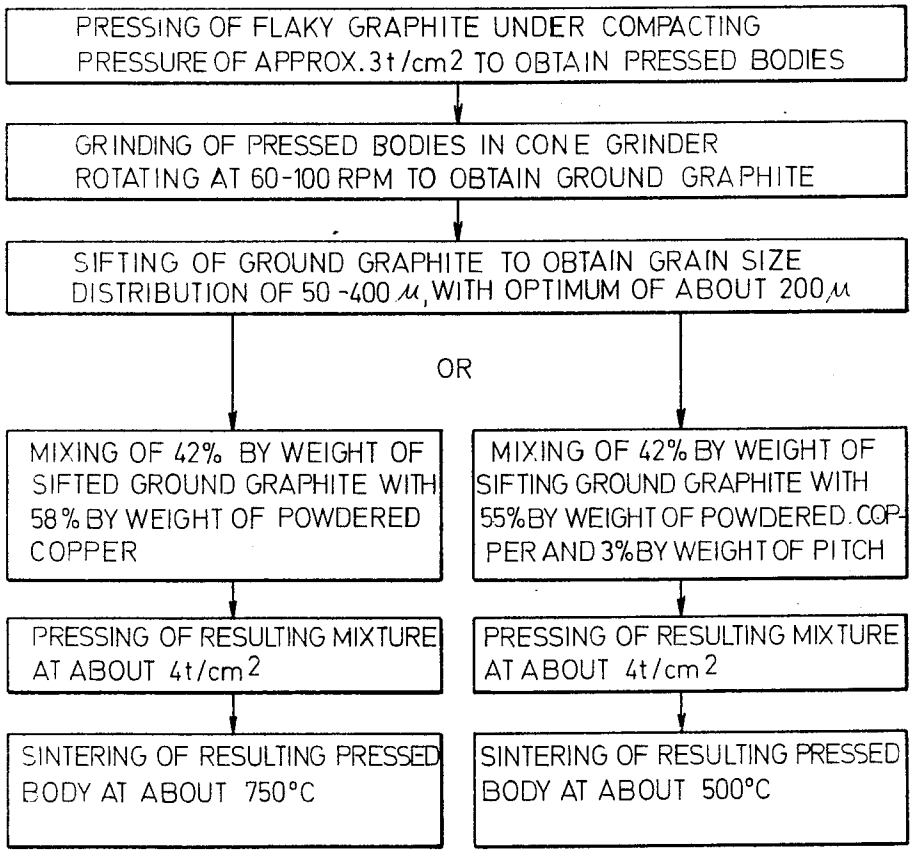
[57] **ABSTRACT**

Leaf graphite is compressed to form bodies having a gross density of at least 1.5 g/cm³. The bodies are then comminuted in a cone-mill to obtain a raw graphite powder whose particles are of essentially ball-shaped configuration and which is then screened or sifted to have a particle size distribution between 50 and 400 microns. The sifted powder is admixed with a predetermined percentage by weight of powdered copper and the mixture compressed to form a brush body, which is sintered to obtain a finished metal-carbon brush.

8 Claims, 1 Drawing Figure




PRESSING OF FLAKY GRAPHITE UNDER COMPACTING PRESSURE OF APPROX. 3 t/cm2 TO OBTAIN PRESSED BODIES
GRINDING OF PRESSED BODIES IN CONE GRINDER ROTATING AT 60-100 RPM TO OBTAIN GROUND GRAPHITE
SIFTING OF GROUND GRAPHITE TO OBTAIN GRAIN SIZE DISTRIBUTION OF 50 -400 μ, WITH OPTIMUM OF ABOUT 200 μ
OR
MIXING OF 42% BY WEIGHT OF SIFTED GROUND GRAPHITE WITH 58% BY WEIGHT OF POWDERED COPPER
MIXING OF 42% BY WEIGHT OF SIFTING GROUND GRAPHITE WITH 55% BY WEIGHT OF POWDERED COPPER AND 3% BY WEIGHT OF PITCH
PRESSING OF RESULTING MIXTURE AT ABOUT 4t/cm2
PRESSING OF RESULTING MIXTURE AT ABOUT 4t/cm2
SINTERING OF RESULTING PRESSED BODY AT ABOUT 750°C
SINTERING OF RESULTING PRESSED BODY AT ABOUT 500°C

METHOD OF MAKING METAL-CARBON BRUSHES FOR ELECTRICAL MOTORS

BACKGROUND OF THE INVENTION

The present invention relates generally to the making of brushes for electrical motors, and more particularly to a method of making metal-carbon brushes for electrical motors.

Brushes of the type here under discussion are well known and are used particularly frequently in starter motors for combustion engines. They are made from a composite of natural graphite and metallic powder, particularly copper powder, with the latter constituting a percentage by weight of at least 70 percent. The high percentage of metallic powder is necessary in order to provide the finished brush with a penetration lattice of metal, that is copper if such is used. The reason for the provision of this lattice is to provide the brush with sufficient mechanical strength and to give it sufficiently high electrical conductivity.

This percentage relationship of metal powder relative to the graphite powder applies if the graphite is natural graphite of a flake or leaf type. If the very rare type of natural graphite is used which is of the stalky or spiky characteristic rather than of the flaky or leafy type, then it is possible to reduce the metal content of the mixture from which such brushes are formed, to between 60 and 65 percent by weight. The reason for this is that this second type of graphite prevents the formation of layers without copper-copper contact or metal-metal contact, and of parallel orientation, so that despite the lesser metal content a metal penetration lattice is obtained, affording the necessary structural strength and electrical conductivity. Furthermore, a metal-carbon brush made in this manner, that is with the second type of graphite, has actually greater mechanical strength than if the leaf type of graphite is utilized; particularly it has greater cleavage strength. Due to the lesser metal content, such brushes have a higher life expectancy.

Given the advantages which can be obtained by using the spiky type of natural graphite, it would appear advantageous to use such graphite in the manufacture of metal-carbon brushes of the type here under discussion, in preference to the leafy type of graphite. However, the spiky type of natural graphite is very rare, compared to the leafy variety, and is therefore not only expensive but frequently difficult to procure.

Consequently, there exists a definite need to be able to provide metal-carbon brushes of the type here under discussion which have the advantages of those made with spiky graphite but which can be made with a different type of graphite which can be had inexpensively and in any desired quantities.

SUMMARY OF THE INVENTION

It is, accordingly, a general object of the present invention to provide a method of making such metal-carbon brushes which affords the aforementioned advantages.

More particularly, it is an object of the present invention to provide a novel method of making such metal-carbon brushes which have as low as possible a metal content by percentage of weight, but have at least the same advantageous characteristics relative to mechanical strength, electrical conductivity and service life, as metal-carbon brushes in which the carbon is supplied by spiky graphite.

To meet these requirements it is necessary that the invention utilize the leafy type of natural graphite, which is the only one that is readily available in any desired quantities.

In pursuance of the above objects, and keeping in mind the just-mentioned requirement concerning the necessary use of leafy type of natural graphite, the present invention resides in a method of making metal-carbon brushes for electrical motors from leaf graphite, which briefly stated comprises the steps of compressing leaf graphite to form bodies having a gross density of at least 1.5 g/cm^3. Thereupon the thus formed bodies are comminuted to obtain a raw graphite powder composed of particles having essentially ball-shaped configuration. The raw graphite powder is sifted or screened in order to obtain a sifted powder having a particle size distribution between substantially 50 – 400 microns which is then admixed with a predetermined percentage by weight of powdered copper. The resulting mixture is compressed to form a brush body therefrom and this brush body is then sintered in order to obtain a finished metal-carbon brush.

It is advantageous to use as the starting graphite material a leaf-type standard graphite having a carbon content $\geqq$ 96 percent with a particle size of between 5 and 80 micron.

The pressure to which this graphite is subjected in order to compress it into the bodies which are subsequently to be comminuted, is between substantially 1 – 5 t/cm^2, and the maximum particle size distribution of the sifted graphite powder should be between substantially 180 and 220 micron.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE is a flow diagram illustrating the steps in the manufacture of brushes according to the present method.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention will be described hereafter with reference to the flow diagram shown in the drawing.

It will be seen that flaky graphite is first compressed and compacted under pressure of approximately 3t/cm^2 in order to obtain pressed bodies, such as tablets or the like. These bodies are then introduced into a cone mill, cone grinder or bell crusher where they are comminuted in order to obtain ground graphite powder whose particles are of substantially ball-shaped configuration. The desired particle configuration can be favorably influenced by rotating the cone mill between substantially 60 and 100 r.p.m.

The ground graphite powder is now sifted or screened in order to obtain a particle size distribution of between 50 and 400 micron, with a maximum or optimum of about 200 micron.

The thus obtained sifted or screened graphite powder can now be further processed in one of the two ways which are illustrated in the flow diagram.

A quantity of it, amounting to 42 percent by weight of the mixture to be produced, may be admixed with 58 percent by weight of powdered metal, usually powdered copper. The resulting mixture is then compressed to form a brush body, at a pressure of about 4 t/cm^2, and the resulting pressed brush body in sintered at about 750° C.

Another possibility is to admix the sifted powder in a ratio of 42 percent by weight with 55 percent by weight of powdered copper or metal, and 3 percent by weight of pitch, the latter serving as a binder. The resulting mixture is then again compressed to form brush bodies, under a pressure of 4 t/cm^2, and the bodies are sintered at about 500° C.

To obtain the sifted or screened graphite powder a standard graphite of the leaf or flake type is utilized, having a carbon content of 98 percent by weight and a particle size of 5–80 micron. Such graphite is commercially available. When compressed to form tablets or the like it is subjected, as pointed out before, to a pressure of about 3 t/cm^2, and the resulting tablets or bodies have a gross density of about 2 g/cm^3.

These tablets are then comminuted in a cone mill or bell crusher of the type well known to those skilled in the art, and described in the literature as far back as 1932 (Ullmann, "Enzyklopaedie der technischen Chemie," 1932, Volume 10, pages 590 ff.).

It is advantageous to operate the cone mill at between 60 and 100 r.p.m. and to comminute the tablets until a particle spectrum or distribution has been reached extending between 50 and 400 micron, and having an optimum at about 200 micron. The rather low rotational speed which has been suggested above is particularly advantageous from the point of view of the invention, because it produces particles which are as nearly ball-shaped in configuration as possible, a desirable result. If the cone mill is operated at higher rotational speeds there exists the danger that the percentage of leafy graphite in the particles will increase, because under such operational circumstances the bonds between the laminar layers of the graphite tend to become loosened.

The sifted or screened graphite powder, which is composed largely of substantially ball-shaped particles, is then admixed with metal according to one of the two possibilities indicated in the flow sheet. It may be admixed in a ratio of 42 percent by weight of graphite powder with 58 percent by weight of powdered copper, and compressed in a press die whose internal configuration corresponds to the form of the brush body to be produced, at a pressure of 4 t/cm^2.

Upon completion of the compressing the compressed brush body is removed from the die and is sintered for approximately one hour at a temperature of approximately 750° C. under a protective gas, for instance nitrogen or a gas mixture composed essentially of hydrogen, methane, and carbon monoxide. When the sintered body is cooled off, the finished metal-carbon brush is ready for use.

According to the other possibility shown in the flow diagram 42 percent by weight of the sifted graphite powder are admixed with 55 percent by weight of powdered copper and with 3 percent by weight of pitch. The latter serves as a binder.

As mentioned above, the mixture is then compressed in a die at a pressure of 4 t/cm^2 to obtain a blank or body having the configuration desired for the finished brush. This blank or body is then sintered for approximately 1 hour under a protective gas (see above) and at a temperature of 500° C. When the sintering is completed and the sintered body has been allowed to cool off, the finished metal-carbon brush is ready for use.

Tests have been carried out on metal-carbon brushes produced in accordance with the present method, and detailed structural examinations have been made. All of these have confirmed that, using graphite powder produced in accordance with the present invention and employing this graphite powder with the percentages of powdered copper which have been set forth herein, an integral copper penetration lattice is obtained in the finished metal-carbon brush. Furthermore, it has been established that metal-carbon brushes made in accordance with the present invention have a mechanical strength and a life expectancy, as well as an electrical conductivity, which have heretofore been impossible of achievement with other mixtures except those using the rare spike-type graphite. A further advantage of the method according to the present invention, utilizing the graphite prepared in accordance with the present invention, is that the details of the mixing and compressing techniques employed are of much less significance in terms of obtaining metal-carbon brushes having the desired characteristics, than in the approaches known from the prior art.

The present invention thus makes it possible to produce improved metal-carbon brushes which have superior characteristics and are less expensive to make because they can be made with graphite types which are readily available, quite aside from the fact that the method eliminates the dependency upon the importation of graphite types (spiky-type natural graphite) from sources which might at any time become unavailable, for instance in the event of political crises. Moreover, the present invention permits the manufacture of metal-carbon brushes of superior characteristics in a simpler manner than heretofore possible, certainly in terms of the elimination of the necessity for previously required close control of mixing and pressing technique parameters.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of applications differing from the types described above.

While the invention has been illustrated and described as embodied in a method of making metal-carbon brushes for electrical motors, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

I claim:

1. A method of making metal-carbon brushes for electrical motors from leaf graphite, comprising the steps of compressing leaf graphite to form bodies having a gross density of at least 1.5 g/cm^3; comminuting the thus formed bodies to obtain a raw graphite powder composed of particles having essentially ball-shaped configuration; sifting the raw graphite powder to obtain a sifted powder having a particle size distribution between substantially 50 and 400 microns; admixing the sifted graphite powder with a predetermined percentage by weight of powdered copper; compressing the resulting mixture to form a brush body therefrom; and sintering said brush body to obtain a finished metal-carbon brush.

2. A method as defined in claim 1, wherein the step of compressing leaf graphite comprises utilizing a leaf graphite having a carbon content $\geqq$ 96 percent by weight and a particle size of between substantially 5 and 80 microns.

3. A method as defined in claim 1, wherein the step of compressing leaf graphite comprises subjecting said leaf graphite to pressure of between substantially 1 and 5 t/cm^2.

4. A method as defined in claim 3, wherein said pressure is 3 t/cm^2.

5. A method as defined in claim 1, wherein the step of comminuting comprises comminuting said bodies in a cone mill so as to obtain graphite powder whose particles are of said essentially ball-shaped configuration.

6. A method as defined in claim 5, wherein comminuting of said bodies in a cone mill comprises rotating the cone mill at substantially 60 – 100 RPM.

7. A method as defined in claim 1, wherein the step of sifting comprises sifting the raw graphite powder to obtain a sifted powder having an optimum particle size distribution of between substantially 180 and 220 microns.

8. A method as defined in claim 7, wherein said optimum particle size distribution is near 200 microns.

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