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ELECTRIC CONTACT CARBON BRUSH

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This invention relates to contact brushes for electric motors or generators or other electrical equipment intended for operation in arduous conditions such as at high altitudes or in other environments of relatively low pressure and/or low water vapour content.

As is well known, a brush as of carbon or graphite, making sliding contact with a co-operating contact member such as a slipring or commutator, is often employed on electrical equipment to permit transfer of current between relatively rotatable parts. It is also well known that due to a reduction in the amount of water vapour in the atmosphere at high altitudes brush wear is often excessive, so that it becomes necessary to provide some means which will become effective at least at these high altitudes to reduce the brush wear without seriously impairing the transfer of current between the brush and the cooperating contact member.

With this requirement in view it has been previously proposed to treat a contact brush of porous carbon by incorporating sodium pyrophosphate in it as a wear reducing agent. This substance is, however, soluble in water and at ground level tends to form on the surface of the brush a crust which may impede free movement of the brush in its holder.

According to the present invention, porous brush material having sodium pyrophosphate incorporated therein, contains also a polyester resin polymerised to a substantially solid state in the brush by a suitable treatment of the latter.

Preferably the sodium pyrophosphate is incorporated in the brush material prior to impregnating the remaining space therein with the resin. The amount of addition which it is possible to introduce into the brush material depends on the porosity of the latter and on the degree to which the interstices within it are interconnected. It is contemplated however that the sodium pyrophosphate content, expressed in terms of the weight of the untreated material, would usually lie between 0.5% and 10% with a preferred range of 2% to 7%, the remaining space within the brush material being substantially completely filled with the resin. Polymerisation of the resin to convert it to a solid, substantially infusible state can be effected by the action of heat in the presence of a catalyst.

It is found with a brush treated according to the invention that not only does the impregnated resin serve to provide a substantial sealing effect against efflux of the sodium pyrophosphate, but the life of the brush under high altitude conditions is increased as compared with that of a brush impregnated with the resin or pyrophosphate alone. Moreover, in addition to decreasing the amount of wear under high altitude conditions, the wear at ground level can be significantly reduced compared with a brush containing only one of the two impregnants.

The incorporation of the sodium pyrophosphate in the

brush material is preferably effected by impregnating the material with a solution of disodium hydrogen phosphate, drying, and subsequently heat treating to convert the disodium hydrogen phosphate to sodium pyrophosphate. To this end the following process may be employed:

Example 1.—First the brush material is heated to drive off volatile products. A bake of 10 minutes at 400° C. has been found to be suitable. Immediately on cooling, the brush material is immersed in an aqueous solution of disodium hydrogen phosphate. The concentration of the disodium hydrogen phosphate solution will affect the concentration of the sodium pyrophosphate to be finally retained by the brush material. The impregnation of the brush material with the disodium hydrogen phosphate solution is completed either by boiling for about 15 minutes or by the use of vacuum and/or pressure. The brush material is removed from the solution, dried slowly at a temperature of less than 100° C. and when dry it is heated to a temperature of at least 250° C. to convert the disodium hydrogen phosphate into sodium pyrophosphate. In practice it has been found convenient to heat the brush material to 400° C. for 10 minutes to bring about this conversion.

The following, more specific examples may be cited:

Example 2.—A piece of electrographitic carbon 1 inch long and ¼ inch square in cross-section and of density 1.60 was heated to 400° C. for 10 minutes. Immediately after it had cooled to near 100° C. it was immersed in an aqueous solution containing 35% by weight of disodium hydrogen phosphate. The solution, with the carbon immersed in it, was brought to a boil and kept boiling for 15 minutes under reflux. The carbon was removed and dried on the surface and then placed in an oven at 90° C. for 12 hours to complete the drying out process. Conversion of the disodium hydrogen phosphate to sodium pyrophosphate was effected by heating at 400° C. for 10 minutes. The sodium pyrophosphate content of this sample was 3.51%.

Example 3.—A similar sample of brush material as use in Example 2 was impregnated with a 20% solution of disodium hydrogen phosphate and treated in a similar manner to that employed in Example 2. The resultant sodium pyrophosphate content was 1.59%.

Example 4.—A similar sample of brush material as used in Example 2 was impregnated with a 50% solution of disodium hydrogen phosphate and treated in a similar manner to that employed in Example 2, resulting in a sodium pyrophosphate content of 6.8%.

For the resin it is preferred to use an unsaturated polyester resin mixture impregnated into the brush material after incorporation of the sodium pyrophosphate and subsequently polymerised. A preferred resin mixture is one prepared as follows:

Example 5.—An unsaturated polyester resin was prepared from the following ingredients:

	Percent by weight
Part 1:	
Dipropylene glycol	37.8
Maleic anhydride	27.7
Tetrahydrofurfuryl alcohol	4.1
Part 2:	
Styrene	30.4
Quinone	.009

The Part 1 components were heated to 225/230° C. under nitrogen and this temperature maintained until an acid value of 32/33 was reached. The brew was then cooled and dissolved in the solution of Part 2 components.

By way of example of the manner of impregnating the resin and subsequently treating it, the following may be cited:

Example 6.—A sample of brush material containing sodium pyrophosphate and prepared in accordance with Example 2 was immersed in the cold resin described in Example 5 to which had been added 2% of tertiary butyl perbenzoate (based on the weight of the resin). The pressure over the resin was reduced to 15 mms. Hg for 30 minutes and then increased to 70 p.s.i. for 1 hour. The sample was removed from the resin and baked for 5 hours at 125° C. to convert the resin into a substantially infusible solid. The sample of brush material treated in this way was found to contain 3.51% sodium pyrophosphate and 11.49% of resin, based on the weight of the untreated brush.

It will be appreciated that this last example represents an application of the vacuum and pressure technique of impregnation. As an alternative, the impregnation with the resin could have been effected by progressive dipping in the catalysed resin mixture.

With a carbon brush incorporating 6.8% by weight of sodium pyrophosphate followed by impregnation with 10.6% by weight of polyester resin (the percentage weights being based on the weight of the untreated brush), comparative tests conducted under conditions simulating those commonly found at an altitude of 80,000 feet have shown substantially reduced brush wear as compared with brushes treated with only one of the impregnants. Thus it was found that whereas a brush impregnated with 13% by weight of polyester resin alone gave a wear of 3.9 thousandths of an inch per hour and a brush impregnated with 6.1% of sodium pyrophosphate alone gave a wear of 3.6 thousandths of an inch per hour, the brush impregnated with both to the respective percentage weights of 10.6 and 6.8, as indicated, showed a wear of only 1.2 thousandths of an inch per hour. For these tests carbon brushes of the EG11 type marketed by the Morgan Crucible Co. were employed and the additives incorporated therein to the percentages indicated.

What we claim is:

1. Porous electric contact carbon brush material having sodium pyrophosphate incorporated therein, and containing also a polyester resin material polymerised to a substantially solid state in a brush composed of said material by a suitable treatment of said brush.

2. Brush material as claimed in claim 1 having a sodium pyrophosphate content of between 0.5% and 10% of the weight of the brush material, the remaining space in the interstices of the brush material being substantially filled with the resin material.

3. Brush material as claimed in claim 1 having a sodium pyrophosphate content of between 2% and 7% of the weight of the brush material, the remaining space in the interstices of the brush material being substantially filled with the resin material.

4. Porous electric contact carbon brush material having sodium pyrophosphate incorporated therein, and containing also an unsaturated polyester resin mixture polymerised to a substantially solid state in the brush by a suitable treatment of the latter.

5. Brush material as claimed in claim 4 having a sodium pyrophosphate content of between 0.5% and 10% of the weight of the brush material.

6. Brush material as claimed in claim 4 having a sodium pyrophosphate content of between 2% and 7% of the weight of the brush material.

7. A method of treating porous electric contact carbon brush material to reduce wear thereof in use, said method comprising the steps of impregnating said material with a solution of disodium hydrogen phosphate, drying, heat treating to convert the disodium hydrogen phosphate to sodium pyrophosphate, impregnating an unsaturated polyester resin mixture into the material so treated and subjecting it to a polymerising treatment to convert it into a substantially solid and infusible state.

8. The method of treating porous electric contact carbon brush material according to claim 7, in which the impregnation of the resin mixture into the sodium pyrophosphate containing brush material is effected by immersing said brush material in the resin material in the presence of a catalyst, reducing pressure over the resin material for a predetermined period, increasing said pressure above atmospheric for a further predetermined period, removing the brush material and baking it to convert the resin material therein to a substantially infusible solid state.

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