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IMPREGNATED ELECTRICAL CONTACT BRUSH AND METHOD OF PRODUCING THE SAME

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This invention relates to an electrical contact brush of the type generally used on motors and generators. More particularly, the invention relates to an electrical contact brush, and the method of preparation thereof, which has exhibited excellent operating properties at high altitudes as well as at sea level.

The performance of conventional electrical contact brushes made of carbon or graphite is known to be affected to a considerable extent by atmospheric conditions. A brush which is in every way satisfactory at sea level under normal conditions will often prove to be inoperable at altitudes of several thousand feet above sea level. Many brushes disintegrate, or "dust" as it is descriptively referred to, at altitudes easily obtainable with today's aircraft. This behavior is believed to be attributable to the paucity of oxygen and water vapor at these altitudes since oxygen and water contribute to the formation of a film on the surface of a commutator. A film on which the brush rides is essential to proper commutation and brush performance.

The prior art teaches the addition of certain materials to carbon or graphite brushes to improve their operating properties. Metals such as silver and copper have been added to change the resistance of the brush and to lower the contact drop between the brush and the commutator. Other additives have been used to alter or form a film on the surface of a commutator. Some treatments which are excellent for brushes to be used at high altitudes render them unsatisfactory for operating at sea level. The reverse is also true.

The principal object of the present invention is to provide an electrical contact brush with generally improved operating properties. Another and more specific object of the invention is to provide an electrical contact brush which gives excellent service at high altitudes.

The objects of the invention are accomplished by including in a conventional carbon or graphite brush a compound of an alkaline earth metal and a compound of silver bonded in and to the brush by means of a coked resin.

The preferred embodiment of the invention is an electro-graphitic brush containing barium fluoride and silver sulfide bonded to the brush by a coked phenolic resin. Best results have been obtained with an electrographitic brush containing about seven to nine percent, by weight, of barium fluoride, bonded to the brush by a coked resin (about 0.1 to one percent, by weight), and about one to three percent silver-silver sulfide. This brush has exhibited excellent commutating properties at sea level and at simulated altitude conditions up to 60,000 feet.

The means whereby the objects of the invention are achieved comprise impregnating suitably shaped and sized electrographitic brush stock in a saturated aqueous solution of barium acetate at reduced and increased pressures followed by heating to decompose the acetate to carbonate. Aqueous solutions of other salts, which decompose on heating to yield barium carbonate, can be employed to impregnate the brushes of the invention. When

high concentrations of barium carbonate are desired, or when solutions containing a small percentage of the soluble salt are used, multiple impregnations may be necessary to introduce sufficient barium carbonate into the brush. The stock is then placed in hydrofluoric acid saturated with barium fluoride, washed and heated. The resin impregnation is achieved by impregnating the stock, at reduced and increased pressures, in a volatile solvent solution of resin. The solvent is then removed by reduced pressure and heat, packed in coke and heated to coke the resin. This step is required to bind the barium fluoride to the carbon to prevent dusting at high altitudes. An alternative method is to fire the brush directly, not packing it in coke. The amount of coke retained in the brush depends on the amount of resin introduced into the brush pores and the manner in which it is coked. For example, packing in coke and heating slowly to 400° C., the coke retained for a given amount of resin is greatest. The use of either method of bonding the barium fluoride results in a sufficient bonding to prevent brushes from dusting at a simulated altitude of up to sixty thousand feet. It will be understood that many resins can be used, the requirement being their capability of being coked. Experiments have shown that both thermosetting resins, for example, phenol-formaldehyde resins and thermoplastic resins, for example coumarone-indene resins, have produced the desired results. The silver sulfide impregnation, the final step, is achieved by impregnating the treated stock with aqueous silver nitrate at reduced and elevated pressures, rinsing in water, and placing in ammonium hydrosulfide solution to convert the nitrate to sulfide, followed by drying, packing in coke and heating.

The following treatment is an example of the preferred manner in which brushes of the invention may be prepared: Electrographitic brush stock, suitably in the shape and size of the finished brushes, is placed in an aqueous, saturated solution of barium acetate, the impregnation being carried out at reduced and increased pressures (29–30 in. Hg and 90 lb./sq. in.) of 5 minutes each. The stock is then heated to about 650° C. for about 5 minutes, thus decomposing the barium acetate to form barium carbonate. The stock so treated is then introduced into a container of barium fluoride saturated hydrofluoric acid until the evolution of carbon dioxide ceases, usually about 16 hours, converting the barium carbonate to barium fluoride, followed by washing with water for four hours and then heating at 150° C. to drive off the water and residual hydrofluoric acid.

The barium fluoride impregnated stock is then impregnated with the resin as follows: The stock is placed in a solution of one part, by weight, of a phenol-formaldehyde resin, to eight parts, by weight, of acetone, the impregnation taking place at 21 in. Hg, following which the stock is air dried for about 16 hours and then pumped at 29–30 in. Hg for two hours to remove any residual acetone. The stock is then heated for two hours at 150° C. to cure the resin, packed in coke and heated for six hours at 400° C. to 700° C. to partially coke the resin.

The final treatment is vacuum-pressure impregnation with a 25%, by weight, aqueous solution of silver nitrate, after which the stock is rinsed in water, and placed in a container of 8 to 12% ammonium hydrosulfide solution and soaked for 16 hours converting the silver nitrate to silver sulfide. The stock is then removed, oven dried for one hour at 150° C., packed in coke and heated for two hours at 400° C. to 700° C. This completes the brush treatment.

The brushes as prepared in the foregoing example performed satisfactorily on a motor operating at 6500 revolutions per minute while carrying a current density of 90 amperes per square inch in an atmosphere simulating conditions up to sixty thousand feet above sea level.

The brush stock which is impregnated to make the brush of the invention can be any of the conventional carbonaceous materials conventionally employed in the making of brushes. Carbon flour, lamp-black, and graphite, both natural and artificial, are examples of such carbonaceous materials. In the appended claims the term "carbonaceous brush stock" includes all of the conventional brush forming material.

The composition and the method of its achievement were substantially disclosed but not claimed in that patent application by M. T. McCrary et al. entitled "Electrical Contact Brush," Serial No. 302,246, filed August 1, 1952.

What is claimed is:

1. An electrical contact brush comprising carbonaceous brush stock and containing from 5% to 12%, by weight, of a compound of an alkaline earth metal bonded therein and thereto by a coked resin, and containing from 0.5% to 10%, by weight, of a water-insoluble silver compound.

2. An electrical contact brush comprising carbonaceous brush stock and containing from 5% to 12%, by weight, of a compound of an alkaline earth metal and containing from 0.5% to 10%, by weight, of a water-insoluble silver compound, bonded therein and thereto by a coked resin.

3. An electrical contact brush comprising carbonaceous brush stock and containing from 5% to 12%, by weight, of a compound of an alkaline earth metal bonded therein and thereto by a coked, heat-hardenable, thermosetting, phenol-formaldehyde resin, and containing from 0.5% to 10%, by weight, of a water-insoluble silver compound.

4. An electrical contact brush comprising carbonaceous brush stock and containing from 5% to 12%, by weight, of a compound of an alkaline earth metal and containing from 0.5% to 10%, by weight, of a water insoluble silver compound, bonded therein and thereto by a coked, heat-hardenable, thermosetting, phenol-formaldehyde resin.

5. An electrical contact brush comprising carbonaceous brush stock and containing from 5% to 12%, by weight, of barium fluoride bonded therein and thereto by a coked, thermoplastic, coumarone-indene resin, and containing from 0.5% to 10%, by weight, of silver sulfide.

6. An electrical contact brush comprising carbonaceous brush stock and containing from 5% to 12%, by weight, of barium fluoride, and containing from 0.5% to 10%, by weight, of silver sulfide, bonded therein and thereto by a coked, thermoplastic, coumarone-indene resin.

7. An electrical contact brush comprising carbonaceous brush stock and containing from 5% to 12%, by weight, of barium fluoride bonded therein and thereto by a coked, heat-hardenable, thermosetting, phenol-formaldehyde resin, and containing from 0.5% to 10%, by weight, of silver sulfide.

8. An electrical contact brush comprising carbonaceous brush stock and containing from 5% to 12%, by weight, of barium fluoride, and containing from 0.5% to 10%, by weight, of silver sulfide, bonded therein and thereto by a coked, heat-hardenable, thermosetting, phenol-formaldehyde resin.

9. A method of producing a carbonaeous electrical contact brush containing a compound of an alkaline earth metal bonded therein and thereto by a coked resin and containing silver sulfide, which method comprises impregnating such brush with an aqueous solution of an alkaline earth metal compound; converting said alkaline earth metal compound to an insoluble alkaline earth metal compound by heating; introducing into said brush, in volatile solvent solution, about 11 per cent by weight of a resin capable of being coked; heating said brush, thus removing said solvent and coking said resin; introducing silver nitrate in aqueous solution into said brush; converting said silver nitrate to silver sulfide; drying, packing in coke and heating said brush at a temperature in the range from 400° C. to 700° C.

10. A method of producing a carbonaceous electrical contact brush containing 5% to 12% barium fluoride bonded therein and thereto by a coked resin and containing 0.5% to 10% silver sulfide, which method comprises impregnating such brush with an aqueous saturated solution of barium acetate by vacuum-pressure means; converting said barium acetate to barium carbonate by heating; converting said barium carbonate to barium fluoride with hydrofluoric acid; impregnating said brush at reduced pressure with an 11%, by weight, solution in acetone of a heat-hardenable, thermosetting, phenol-formaldehyde resin; heating said brush at a temperature in the range from 125° C. to 200° C. for a period of time sufficient to set the resin; packing said brush in coke; heating said brush from 5 to 7 hours at a temperature in the range from 400° C. and 700° C.; impregnating said brush at reduced pressure with a 25%, by weight, aqueous solution of silver nitrate; converting said silver nitrate to silver sulfide with ammonium hydrosulfide; drying said brush; packing said brush in coke; heating said brush from 1½ to 2½ hours at 400° C.

11. In an electrical contact brush composed of carbonaceous brush stock, and containing as impregnants, an alkaline earth metal compound and a water insoluble silver compound, the improvement which comprises said impregnants being bonded to and in said brush stock by coked resin, whereby said impregnants are retained in said stock under extreme operating conditions.

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