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PROCESS OF TREATING CARBON BRUSHES

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This invention relates to the treatment of carbon brushes and more particularly to a process for applying to carbon brushes predetermined amounts of lead halide compounds capable of improving the operating characteristics thereof.

It is known that copper commutators and slip rings, when operating against carbon brushes under ordinary atmospheric conditions, develop a film on the surface of the commutator or slip ring which imparts good operating characteristics to the combination. A particular feature of this film is a low coefficient of friction. With a properly built-up film on the surface of the commutator or slip ring the carbon brush will operate for prolonged periods of time with a relatively insignificant rate of wear.

On the other hand, under certain adverse conditions which may be met at high altitudes, for example, the film on copper commutators is decomposed or broken down and will not be built up. Carbon brushes operating against the commutator lacking the desired film will wear and dust at an exceedingly rapid rate. In aircraft motors and generators, carbon brushes have been known to dust at rates of $\frac{1}{16}$ " an hour and more at altitudes of 40,000 feet. Likewise, in certain transportation service, such as on railway and streetcar service, the beneficial film on copper commutators in the motors thereof may not be present, or only partially present. Carbon brushes in such equipment have been known to wear at an excessive rate, thereby requiring frequent lay-overs of locomotives for replacement of the carbon brushes. In some cases, the coefficient of friction of the commutators of electrical railway locomotives has been so high that the carbon brushes have been broken, thereby causing unsatisfactory service of the equipment.

It has been discovered that certain halide compounds of metals, when applied to, or incorporated within, carbon brushes, promote the building up of a beneficial film on the surface of the commutators even under the most adverse conditions, thereby greatly reducing the rate of wear and dusting of the brushes. However, not all metal halides are satisfactory for this purpose. Hygroscopic or deliquescent metal halides in particular have been found to be undesirable since they will absorb sufficient moisture from the atmosphere for the metal halide to dissolve in the condensed water and to drain out of the brushes. The halides of the alkali metals are not suitable in some cases, since they appear to decompose and form the alkali hydroxides and cause excessive sparking and otherwise detrimentally affect the operating of the carbon brushes against commutators. Therefore only a few metal halides are reasonably useful for brush applications.

A possible explanation for the effectiveness of

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the metal halides in producing satisfactory films on commutators is as follows. The metal halide, for example, lead chloride, within the carbon brush at the point of contact with the copper commutator is heated and by reason of the heat or in combination with the effects of the passage of electrical current decomposition and reaction with the copper surface takes place to produce a copper chloride. However, the copper chloride so produced is unstable and even in the presence of small traces of oxygen readily reacts to form a copper oxide film or coating. Extensive experimentation indicates that the film on copper commutators is a copper oxide coating which is duplicated by the film produced by the interaction of the metal halide with the copper. In any event, results in service indicate that a beneficial film resulting in the optimum performance of carbon brushes and copper commutator results when metal halides are present in the brushes. In fact, in some cases commutators which were in a rough and unsatisfactory condition on certain electric railway motors using untreated carbon brushes were greatly improved after several thousand hours' operation against carbon brushes carrying metal halides.

In order to provide for the retention for the life of the brush of the metal halide applied thereto in predetermined amounts, it is preferred to use metal halides having a high melting temperature and a high boiling temperature, thereby assuring an exceedingly low vapor pressure under the conditions of operation. Brush and commutator temperatures of from 150° C. to 200° C. are not uncommon. Metal halides having a low boiling point by comparison will steadily evaporate when the brush to which they are applied becomes heated during use. Therefore, the latter metal halides will be present in smaller amounts with passage of time and eventually little or no metal halide will be present.

The process of applying to or incorporating in brushes the metal halides is rendered quite difficult when metal halides are selected that meet the desirable requirements herein listed. A high melting point metal halide is difficult to melt and apply in molten state to the carbon brush. Prolonged immersion has been found only moderately satisfactory to cause the metal halide to penetrate the pores of a brush. Due to the high melting temperatures, problems of decomposition and difficulty in handling liquids heated to high temperatures enter the picture. A decided health hazard is encountered since the lead vapors from molten halides are present and are quite dangerous. Solutions of metal halides sufficiently concentrated to permit a practical amount of metal halide to be absorbed by the porous brushes are not feasible in most cases. For certain extreme conditions such as are encountered in aircraft

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operation to be satisfactory brushes must carry as much as 50% by weight of metal halide. The problem of incorporating this amount of metal halide in a carbon brush therefore is considerable.

The object of this invention is to provide a process for impregnating carbon brushes with a predetermined amount of a metal halide.

A further object of the invention is to prepare solutions of lead halides having a high concentration of the halide therein to provide for economically impregnating carbon brushes with predetermined amounts of the lead halide.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

According to the invention, lead chloride, lead bromide and lead iodide have been found to be metal halides meeting all the requirements of a satisfactory impregnant for improving the performance of carbon brushes. The three halides having high melting points of 501° C., 373° C., and 402° C., respectively, and a boiling point of well over 900° C. for each one. These lead halides have a low solubility in water and therefore will not be leached out in service where water may be encountered in one way or another. Carbon brushes impregnated with varying amounts of one or more of these lead halides have given excellent service in cooperation with copper commutators and slip rings in many varieties of extreme surface conditions.

It has been discovered that concentrated solutions of lead chloride, lead bromide or lead iodide or mixtures of any two or all three may be prepared by preparing an aqueous solution containing lead, ammonium, acetate and the respective halide radical. The maximum weight of lead halide which may be dissolved in the solutions is closely related to the weight of the ammonium acetate present in the solution. As the concentration of ammonium acetate in the ammonium solution is increased, an almost equivalent increase of the saturation point of the lead halide in the solution is attained. In addition, the maximum amount of the lead halide soluble in the solution increases somewhat with the temperature.

A typical aqueous solution which has been prepared for the practice of the invention was composed of 40 parts by weight of lead chloride, 50 parts by weight of ammonium acetate and 50 parts by weight of water. In another case, a solution composed of 75 parts by weight of water and 25 parts by weight of ammonium acetate would only dissolve 20 parts by weight of lead chloride. In another case, a solution composed of 70 parts by weight of water and 70 parts by weight of ammonium acetate dissolved 40 parts by weight of lead chloride and 4 parts by weight of lead bromide. All of these solutions were used successfully in impregnating electrographitic brushes.

The lead halide need not be used as such in preparing solutions of this invention. A mixture was prepared by combining:

Water.....	parts by weight..	48.5
Lead acetate	parts..	41.25
Ammonium bromide.....	do.....	21.4
Ammonium acetate.....	parts by weight..	37.5

This solution was equivalent to one produced by dissolving 40 parts by weight of lead bromide in a solution composed of 50 parts by weight of water and 50 parts by weight of ammonium acetate. Solutions have been prepared by mixing predetermined proportions of lead acetate, ammonium chloride, ammonium acetate and water. Mixtures

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of ammonium chloride and ammonium bromide and ammonium iodide or any two may be prepared as decided.

The relatively concentrated lead halide solutions prepared by any of the processes herein set forth may be applied to either carbon plates after graphitizing treatment or to brushes that have been fully machined and cut to shape. The brushes or carbon plates are disposed in the concentrated solutions of the lead halide for a few minutes in order to soak up the solution in the pores of the carbon body. Preferably the brushes are subjected to vacuum before the solution of lead halide is applied thereto in order to expedite the impregnation. Electrographitized carbon has a greater porosity than metal graphite brushes, which are not subjected to the high temperature baking treatment of the former. The extensive porosity of the graphitized brushes renders them more amenable to the practice of the present invention.

After the carbon bodies have absorbed sufficient of the solution, generally a volume of solution equivalent to about 25% of the volume of the brush will be absorbed by a graphitized plate or brush, the carbon bodies may be removed from the solution. The brushes soaked with the solution are then subjected to a heat-treatment first to drive off the water and then the temperature is increased to cause the ammonium acetate to decompose into volatile components. It is believed that the ammonium acetate will decompose into water and acetamide. Five hours heat-treatment at 180° C. has been found sufficient to remove all but the lead halide. The lead halide component of the solution is disposed throughout the pores of the carbon brush member. If the amount of lead halide present is insufficient for the intended use of the brush, one or two additional treatments may be necessary. For brushes to be employed in extreme aircraft applications, three impregnations employing a concentrated lead chloride solution containing 40 grams of lead chloride per 100 cc. of a solution composed of equal parts by weight of ammonium acetate and water will apply to the brush about 20% of its weight of lead chloride. For railway locomotive service, a single application of a similar solution or even a much less concentrated solution is usually entirely adequate. The amount to be applied to the brush depends upon the requirements of the service to which the brushes are to be put.

The electrical properties of carbon brushes incorporating lead chloride, lead iodide or lead bromide are not adversely affected. When applied to electrical generators, the brushes have given excellent electrical service with a long life. Brushes treated according to the invention have met all the requirements imposed thereon and have been found to be fully dependable. The performance of many types of apparatus embodying such brushes has been improved and the necessity of replacing brushes at predetermined intervals previously required in noncritical locations has been reduced. Therefore, the brushes meet commercial and industrial requirements.

The process set forth herein enables the brush manufacturer to economically and conveniently prepare brushes having desirable wear and non-dusting characteristics for all kinds of service, including extreme conditions corresponding to those met at the highest altitudes of airplane operation. The invention enables the preparation of brushes more rapidly than has been possible by any process proposed or known heretofore.

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Since certain changes in carrying out the process embodied in the invention described herein may be made without departing from its scope, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In the process of treating a carbon brush to apply thereto a lead halide compound to improve the operating characteristics thereof, the steps comprising producing an aqueous solution containing substantial amounts of ammonium acetate, dissolving a lead compound selected from the group consisting of lead chloride, lead iodide and lead bromide therein, applying the solution to the carbon brush, and heat treating the brush first to evaporate the moisture, thereby precipitating within the pores of the brush the lead compound and ammonium acetate, and then to decompose the ammonium acetate into substances that volatilize leaving only the lead compound in the pores of the carbon brush.

2. In the process of treating a carbon brush to apply thereto a lead halide compound to improve the operating characteristics thereof, the steps comprising, dissolving in water substantial amounts of substances containing only ammonium, acetate and lead radicals and a halide radical selected from the group consisting of chloride, iodide and bromide, to provide a solution having dissolved therein a large amount of the substances containing the radicals, applying the aqueous solution to the carbon brush and heat-treating the carbon brush to a temperature sufficient to evaporate the water and the ammonium and acetate radicals therefrom thereby precipitating the lead halide compound in the pores of the carbon brush.

3. In the process of treating a carbon brush to apply thereto a lead halide compound to improve the operating characteristics thereof, the steps comprising producing an aqueous solution containing of the order of from 10% to 50% by weight of ammonium acetate, dissolving to about saturation of a lead compound selected from the group consisting of lead chloride, lead iodide and lead bromide therein, applying the solution to the carbon brush, and heat-treating the brush first to evaporate the moisture, thereby precipitating within the pores of the brush the lead

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compound and ammonium acetate, and then to decompose the ammonium acetate into substances that volatilize leaving only the lead compound in the pores of the carbon brush.

4. In the process of treating a carbon brush to apply thereto a lead halide compound to improve the operating characteristics thereof, the steps comprising producing an aqueous solution containing substantial amounts of ammonium acetate, dissolving a lead compound selected from the group consisting of lead chloride, lead iodide and lead bromide therein, applying the solution to the carbon brush, heat-treating the brush first to evaporate the moisture, thereby precipitating within the pores of the brush the lead compound and ammonium acetate, and then to decompose the ammonium acetate into substances that volatilize leaving only the lead compound in the pores of the carbon brush, reapplying the solution to the carbon brush and heat-treating to deposit more lead compound in the carbon brush.

5. In the process of treating a carbon brush to apply thereto a lead halide compound to improve the operating characteristics thereof, the steps comprising, dissolving in water substantial amounts of substances containing only ammonium, acetate and lead radicals and a halide radical selected from the group consisting of chloride, iodide and bromide, to provide a solution containing more radicals than the water by weight, applying the aqueous solution to the carbon brush, heat-treating the carbon brush to a temperature sufficient to evaporate the water and the ammonium and acetate radicals therefrom thereby precipitating the lead halide compound in the pores of the carbon brush, reapplying the solution to the carbon brush and heat-treating to deposit more lead compound in the carbon brush.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
934,988	Adolph	Sept. 28, 1909