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METHOD FOR FORMING AN ELECTRICALLY CONDUCTING MARK ON A NON-CONDUCTING SURFACE

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This invention relates to a new and improved process for positioning an electrically conducting mark on a non-conducting surface. In its most practical application the invention relates to the application of electrically conducting marks on paper surfaces.

Many attempts have been made heretofore to provide a satisfactory method of writing, printing, or otherwise applying an electrically conductive mark on paper or similar non-conductive surfaces. Writing or printing with graphite or metallic inks or pencils on paper has not been heretofore satisfactory. Either such written or printed marks were not sufficiently conductive, or they did not adhere sufficiently well to the paper.

It is, therefore, an object of this invention to provide an improved method for the application of electrically conducting marks on paper.

It is a further object to provide a permanent, adherent, highly electrically conductive mark on paper or like non-conductive surface.

Other objects of the invention will become apparent by the description that follows.

These objects may be accomplished by coating or impregnating paper with an aqueous solution of a hydrazine sulfate, drying the same and subsequently writing, printing or otherwise applying marks or indicia of any kind on said dry paper with an aqueous ammoniacal complex silver salt solution. Even though the dry paper containing a hydrazine sulfate is exposed to atmospheric conditions for weeks, the ammoniacal silver salt solution will react with the dry hydrazine sulfate to produce a continuous film of metallic silver which is highly electrically conductive.

The hydrazine sulfate may be monohydrazine sulfate, $N_2H_4 \cdot H_2SO_4$, dihydrazine sulfate $(N_2H_4)_2 \cdot H_2SO_4$, or hydrazine disulfate, $N_2H_4 \cdot 2H_2SO_4$. All three substances are solids that can be characterized by their physical and crystallographic properties. On the basis of its greater solubility in water, the dihydrazine sulfate is preferred. At least 1% of the hydrazine sulfate is dissolved in water and the paper coated with a sufficient quantity thereof to at least partially impregnate the paper. The paper is then dried, preferably at atmospheric temperature after which it is ready to be written or printed on with the ammoniacal silver salt solution. The complex silver salt may be ammoniacal silver chloride nitrate or sulfate, preferably ammoniacal silver nitrate.

The aqueous ammoniacal silver salt solution may contain between 5% and 75% silver nitrate. The solution may be contained in a fountain pen, ball-point pen, or on an ink pad for printing purposes. A line drawn or printed on the hydrazine sulfate-containing surface of the paper will operate to precipitate metallic silver in a continuous electrically conductive mark.

The following examples are given to illustrate, in detail, the process of this invention.

Example I

A piece of paper is coated with a 20% water solution of hydrazine sulfate and allowed to dry at room temperature or at a slightly elevated temperature but below the decomposition point of the reducing agent. An ink is made by dissolving 50 grams silver nitrate in 50 cc. water and adding concentrated ammonia water until the precipitate which is first formed dissolves. An excess of about 5 cc. of ammonia is then added. When the ink is applied to the paper by means of a pen, a clear watery image is first obtained but in less than 2 seconds the image darkens and then becomes very black. This black image is sufficiently conducting to actuate electronic reading devices, i.e. less than 50,000 ohms for 1/16 inch. Frequently resistances as low as 10 ohms for 1/16 inch are obtained.

Example II

Example I was repeated using concentrations of hydrazine sulfate varying from 1% to 50%. Metallic silver marks produced on the dry hydrazine sulfate-containing paper had adequate conductivity to actuate electronic reading devices. The silver in marks on paper prepared with over 35% hydrazine sulfate had a tendency to spread but the conductivity was satisfactory.

Example III

The process of Example I was repeated using ammoniacal silver chloride instead of silver nitrate. Also the concentration of the ammoniacal silver nitrate solutions was varied from 5% to 75%.

In all cases the conductivity of the lines or marks produced was adequate for use in mark sensing devices.

Throughout the specification and claims percentages, parts and proportions refer to percentages, parts and proportions by weight unless otherwise specified.

Since it is obvious that many changes and modifications can be made in the above-described details without departing from the nature and spirit of the invention, it is to be understood that this invention is not to be limited to said details except as set forth in the appended claims.

I claim:

1. The method of forming an electrically conducting mark on paper which comprises applying on said paper surface an aqueous solution of a hydrazine sulfate, drying said surface, and marking on said surface by marking thereon with an aqueous ammoniacal silver salt solution substantially at room temperature.

2. The method of claim 1 in which the ammoniacal silver salt is ammoniacal silver nitrate.

3. The method of claim 1 in which the aqueous solution of a hydrazine sulfate has a concentration between 1% and 50% by weight.

4. The method of claim 1 in which the ammoniacal silver salt solution is an ammoniacal silver nitrate solution having a concentration of 5% to 75% by weight.

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