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PROCESS OF ELECTROSTATIC PRINTING

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This invention relates to printing and more particularly to novel methods and materials for making permanent prints from powder images.

Powder images may be prepared by several processes, including those processes which utilize electrostatic means. For example, U. S. Patent No. 1,784,912 to B. F. Scott issued December 16, 1930 discloses a method of stenciling on an electrostatically charged surface. By this process, a printing powder is passed through a stencil to a surface that is electrostatically charged. The powder adheres to the surface thereby forming a powder image where the stencil exposes the surface. U. S. Patent No. 2,297,691 to C. F. Carlson issued October 6, 1942 discloses methods of forming electrostatic images by means of photoconductive insulating material layers. U. S. Patent No. 2,357,809 to C. F. Carlson issued September 12, 1944 discloses methods of forming electrostatic images by means of photoemissive layers. In the latter two processes, a printing powder is dusted on the electrostatic image, and adheres to the electrostatic image thereby forming a powder image.

In many previous processes, some type of pigment must be incorporated in the printing powder in order to increase the contrast between the powder image and the background. Specially prepared powders and carefully controlled processes are often required.

An electrostatic image is sometimes formed on a dark colored plate, for example, a plate coated with photoconductive selenium. A powder image is formed on this plate and then is transferred to a light colored printing base. Since the use of a dark colored powder on a dark-colored plate makes it difficult to observe the powder image, a light colored printing powder is more desirable during printing. However, it is often preferred to have a dark image on a light background in the finished product, hence, a printing powder that is light-colored during printing and dark-colored in the final product is desirable, when a dark colored image plate is used.

Many of the pigments previously used in such printing powders tend to fade with time. Hence, it is desirable to employ a pigment which does not fade, or one which may be easily reintensified. Another disadvantage of some of the previously employed printing powders is that an adhesive is often required to fix the powder image to the printing base. The elimination of such an adhesive provides a more economical and efficient process.

An object of the invention is to provide novel methods and materials for printing permanent powder images.

Another object of the invention is to provide novel methods and materials for printing from electrostatic images.

A further object of this invention is to eliminate the use of dyes and pigments in improved methods and materials for printing from powder images.

Another object of the invention is to provide methods and materials for forming a light-colored powder image which may later be converted to a dark colored image print.

A further object of the invention is to provide a powder image print which may be reintensified easily at some later time.

An additional object of the invention is to eliminate the necessity for a separate adhesive to fix a powder image to a printing base and thus to provide improved methods and materials for producing a fixed visible image from a powder image.

Another object of the invention is to provide printing powders which are easily and economically prepared.

In general, the foregoing objects may be accomplished in accordance with the instant invention which includes the method of producing a black-colored material by fusing a resin containing vinyl and chloride radicals with a zinc-containing material. In one embodiment, the resin is incorporated in the printing base of the print. A powder image is formed on the printing base with a zinc-containing powder. The powder is then fused into the printing base thus forming a permanent print. In a second embodiment, the zinc-containing material is incorporated in the printing base. A powder image is formed on the printing base with a powdered resin containing vinyl and chloride radicals. The powder image is then fused into the printing base thus forming the permanent print. The invention also includes improved prints produced by the novel processes of the invention.

The instant invention also includes the novel printing powder comprising a finely divided resin containing vinyl and chloride radicals in conjunction with a printing base comprising a backing sheet containing zinc.

The invention further includes a printing powder comprising a finely divided material containing zinc, in conjunction with a printing base comprising a backing sheet containing a resin having vinyl and chloride radicals.

The foregoing and other objects and advantages will be more apparent and the invention will be more fully understood from the following detailed description.

Example 1.—A sheet of paper is coated with zinc oxide in a suitable vehicle such as a clear silicone resin. An electrophotographic paper of the type described in my U. S. Patent application No. 248,937 filed September 29, 1951 now abandoned, provides an excellent zinc oxide coated surface for the instant process except that the vinyl chloride copolymers disclosed therein should not be used as the film-forming material in the present process. The surface of the paper is given a blanket negative electrostatic charge in darkness, for example, by a corona discharge. The charged surface is exposed to a reverse light image. The illuminated areas thus are discharged, leaving an electrostatic image on the surface of the paper. A mixture of about 100 parts of about 0.015 inch diameter beads and about 0.5 part of a powdered polyvinyl-chloride-acetate copolymer resin, for example, composed of 90% polyvinyl chloride and 10% polyvinyl acetate, is cascaded across the electrostatic image. The powdered resin in the mixture adheres to and forms a powder image on the electrostatic image. The paper with the powder image thereon is heated until the resin fuses into the paper and reacts with the zinc in the paper. The temperature range for fusing the resin is about 150° C. to about 175° C. and fusing may be accomplished in less than a minute. The resin and the zinc oxide coating are ordinarily white or nearly white in color. Upon fusing with zinc oxide, the resin turns deep black and adheres to the surface thereby forming a fused black image on a light-colored background. If the print fades upon prolonged exposure to light, it may be intensified to its original black by reheating to the fusing temperature of the resin.

Example 2.—A plate coated with photoconductive selenium is given a blanket positive charge, for example, by rubbing or by means of a corona discharge. The

charged surface is exposed to a positive light image. The illuminated areas on the surface thus are discharged, leaving an electrostatic image in the unlighted areas. A mixture of about 100 parts of about 0.015 inch diameter glass beads and about 0.5 part of powdered polyvinyl chloride resin is cascaded over the electrostatic image. The powder adheres to the electrostatic image charged areas of the plate surface thereby forming a light-colored powder image on the dark selenium background. The powder image may be inspected much more easily at this stage because of the contrast in colors. A sheet of paper which has been impregnated with zinc chloride is laid over the powder image, being careful not to disturb the powder. The paper sheet is given a blanket positive charge to transfer the powder image from the plate to the paper sheet. The paper sheet with the powder image thereon is stripped from the plate and heat is applied until the resin fuses into the paper. The resin reacts with the zinc chloride to form a jet black image on the paper. The temperature range for fusing the resin is about 150° C. to about 175° C. The finished print is very similar to the print described in Example 1.

The deep black coloration which occurs when a resin containing vinyl and chloride radicals is fused with a zinc-containing material is an important feature of the invention. Thus, the resin may be contained in the printing base and the zinc-containing material may be contained in the developing powder, or the resin may be contained in the developing powder and the zinc-containing material may be contained in the printing base, or the resin and the zinc-containing material may be contained in the developing powder. While the reactants initially are light-colored, when they are fused together, the product is deep black in color. This coloration is relatively permanent, but it may fade to a light brown on prolonged exposure to light. A faded print may be restored to a deep black by reheating the print to the fusing temperature of the resin.

Any resin containing vinyl and chloride radicals may be used. However, resins chosen from the polyvinyl chlorides, vinylidene chlorides and polyvinyl chloride copolymers such as polyvinyl chloride-acetate, are preferred.

While zinc oxide and zinc chloride are used in the examples described herein, any zinc-containing material which does not adversely affect the above mentioned reaction may be used. For example, zinc metal, zinc oxide, and zinc salts such as zinc sulphate, zinc acetate and zinc chloride may be employed. The preferred zinc-containing material is zinc oxide.

In the examples described, the printing powder comprising a resin containing vinyl and chloride radicals is used in conjunction with a printing base comprising a zinc-containing material. The process is equally efficient if the materials are reversed and the printing powder comprises a zinc-containing material used in conjunction with a printing base comprising a resin containing vinyl and chloride radicals.

While paper is a suitable backing for the printing base, as in the above examples, other materials may be used. The backing is merely a carrier for one of the reactants, and for the final print. The reactant may be coated on or impregnated in the backing material. Hence, the backing may be porous or solid, and may be made of any material which will not interfere with the reaction.

The powder image may be formed by any convenient method. The foregoing examples employ an electrostatic image as a means of producing the powder image. However, the image may be formed by stencilling as in U. S. Patent No. 1,784,912 mentioned heretofore, or by other means.

There has thus been described improved methods and materials for printing permanent powder images. The uses of pigments or adhesives are eliminated, since the reactant materials perform the functions of these materials.

What is claimed is:

1. A process of printing comprising forming a dry powder image in a particular configuration with a powder comprising a member of the group consisting of (1) a resin containing vinyl and chloride radicals and (2) a zinc-containing material, contacting said powder image with the other member of said group and then heating said combination until said contacted members react to convert said powder image to a black color.

2. The process of claim 1 including incorporating said resin in a printing base and incorporating said zinc-containing material in a printing powder.

3. The process of claim 1 including incorporating said zinc-containing material in a printing base and wherein said resin is a printing powder.

4. The process of claim 1 wherein said resin is selected from the group consisting of vinyl chloride resins, polyvinyl chloride copolymer resins, vinylidene chloride resins, and said zinc-containing material is selected from the group consisting of zinc metal, zinc oxide and a zinc salt.

5. A process of electrostatic printing which comprises coating a surface of a backing sheet with an electrically-insulating composition comprising a resin containing vinyl and chloride radicals, forming an electrostatic image of the configuration to be printed on said coated surface, applying a printing powder comprising a zinc-containing material to said electrostatic image thereby forming a powder image, and then heating said powder image on said coated surface to at least 150° C. until said resin reacts with said zinc-containing material to convert said powder image to a black color.

6. A process of electrostatic printing which comprises coating a surface of a backing sheet with an electrically-insulating composition comprising a zinc-containing material, forming an electrostatic image of the configuration to be printed on said coated surface, applying a printing powder comprising a resin containing vinyl and chloride radicals to said electrostatic image thereby forming a powder image, and then heating said powder image on said coated surface to at least 150° C. until said resin reacts with said zinc-containing material to convert said powder image to a black color.

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