

1

2,735,784

PROCESS OF ELECTROSTATIC PRINTING

Harold G. Greig and Charles J. Young, Princeton, N. J.,
assignors to Radio Corporation of America, a corporation
of Delaware

No Drawing. Application July 30, 1953,
Serial No. 371,416

5 Claims. (Cl. 117—17.5)

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 layers and 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. For example, since most printing powders have more than one component, it is necessary to produce an intimate mixture of these components. The components are often fused together, cooled and then milled to the desired particle size. If wet milling is used, the mix must be dried and pulverized. Where milling does not reduce the particle size sufficiently, the fused material is sometimes dissolved in a solvent and then sprayed into a chamber that is heated or evacuated or both. The solvent evaporates from the spray leaving a fine powder.

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.

2

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 a method of printing which comprises forming a powder image on a printing base, said powder image comprising a finely divided and intimate mixture of a zinc-containing material and a resin containing vinyl and chloride radicals, and then fusing said powder image to said printing base. On fusing, the light-colored resin and zinc-containing material react to produce a deep black material, yielding a black image. In one embodiment of the invention, the powder image may be formed electrostatically and then fused directly on the printing base. In a second embodiment, the powder image may be transferred and fused to a second printing base. This invention also includes a print produced by the method of this invention.

The invention also includes a printing powder which comprises a finely-divided and intimate mixture of a resin containing vinyl and chloride radicals and a material containing zinc.

These and other objects will be more apparent and the invention will be more easily understood from the following detailed description.

Example 1.—50 grams of polyvinyl chloride-acetate resin, for example, composed of 90% polyvinyl chloride and 10% polyvinyl acetate, and 2 grams of zinc oxide are milled for about 4 hours with quartz pebbles in a small porcelain ball mill. 0.4 parts of the milled material are mixed with 100 parts of about 0.015 inch diameter glass beads to form the printing mix.

A sheet of paper is coated with a photoconductor in a suitable vehicle. An electrophotographic paper of the type described by H. G. Greig in U. S. patent application No. 248,937 filed September 29, 1951, now abandoned, provides an excellent photosensitive sheet except that only those resins which do not include a resin containing vinyl and chloride radicals should be used to prepare the coated paper. 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 are thus discharged leaving an electrostatic image on the surface of the paper in the unlighted areas. The above mentioned mixture of beads, zinc oxide and resin is cascaded across the electrostatic image. Particles of the mixture of resin and zinc oxide adhere to and form 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 oxide. The temperature range for fusing the resin is about 150° C. to about 175° C. and fusing may be accomplished in several minutes. The resin and the zinc oxide are ordinarily white or nearly white in color. Upon fusing

with zinc oxide, the resin turns a deep black and adheres to the surface of the paper thereby forming a fused black image in 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.—50 grams of a powdered polyvinyl chloride resin and 2 grams of zinc oxide are milled for about 4 hours with quartz pebbles in a small porcelain ball mill. 0.4 part of this material are mixed with 100 parts of about 0.015 inch diameter glass beads to form a printing mix.

A plate, coated with photoconductive selenium, is given a blanket positive charge, for example, by means of a corona discharge. The charged surface is exposed to a positive light image. The illuminated areas on the surface are discharged leaving an electrostatic image in the unlighted areas. The above-mentioned printing mix is cascaded over the electrostatic image. The powder adheres to the electrostatic 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 color between the image and the background. The powder image is transferred to a sheet of paper and then heated until the resin fuses into the paper and reacts with the zinc oxide. 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 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. 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, polyvinyl chloride copolymers such as polyvinyl chloride-acetate, and vinylidene chlorides 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.

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

In the above-mentioned examples, the weight of the zinc-containing material is about 4% of the weight of the resin. The proportions of zinc-containing material to resin is not limited but, preferably, the weight of zinc-containing material should be from 1 to 10% of the weight of resin. The ingredients of the developing powder cannot be blended by the usual method of fusing together and then grinding the fused product because the

mixture will turn black. The developing powder of the present invention may, however, be prepared by any blending process that does not raise the temperature of the mix above the reaction temperature. Suitable methods are for example, ball milling as described above or spray drying a mixture of zinc-containing material and resin in a solvent.

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 stenciling as in U. S. Patent No. 1,784,912 mentioned heretofore or by other means. Furthermore, the developing powder may be applied to an electrostatic image by cascading with a mixture of glass beads as described above, or by dusting, or any other convenient means of application.

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

What is claimed is:

1. A process of printing which comprises forming a powder image in a particular configuration on a printing base, said powder image comprising a finely-divided and intimate mixture of a zinc-containing material and a resin containing vinyl and chloride radicals, and heating said powder image until said resin and said zinc-containing material react to convert said powder image to a black color.

2. A process according to claim 1 wherein said resin is selected from the group consisting of polyvinyl chloride, polyvinyl chloride copolymers and vinylidene chloride, and said zinc-containing material is selected from the group consisting of zinc metal, zinc oxide and zinc salts.

3. A process of electrostatic printing which comprises forming an electrostatic image in the configuration to be printed on an electrically-insulating surface, applying a printing powder comprising a finely-divided and intimate mixture of a zinc-containing material and a resin-containing vinyl and chloride radicals to said electrostatic image thereby forming a powder image and heating said powder image until said resin reacts with said zinc-containing material to convert said powder image to a black color.

4. A process according to claim 3 wherein said powder image is fused to said electrostatic image-bearing surface.

5. A process according to claim 3 including applying said printing powder to said electrostatic image, thereby forming a powder image, then transferring said powder image to a printing base, and then fusing said powder image to said printing base.

References Cited in the file of this patent

UNITED STATES PATENTS

2,067,435	Chatfield et al.	Jan. 12, 1937
2,302,361	Yngve	Nov. 17, 1942
2,466,998	Rogers et al.	Apr. 12, 1949
2,618,551	Walkup	Nov. 18, 1952

OTHER REFERENCES

"Vinylite Resins for Surface Coatings," publication of the Bakelite Corp., Copyright 1942; pages 15, 20 and 21 relied upon.