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METHOD OF MAKING A COPY SHEET AND RESULTANT ARTICLE

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This invention relates to the production of copies by thermographic technique and it is an object of this invention to provide a new and improved sensitized copy sheet for use in thermographic reproduction processes which rely principally upon reaction between components in a sensitizing composition at elevated temperatures to develop the image therein.

In reproduction processes of the type described, it has been found that at the temperature of reaction to produce the image in the copy sheet, the fibers in the base sheet appear also to enter into the thermal reaction or else burn out at the elevated temperatures existing with the result that ragged copy of inferior quality frequently results. This tendency to burn out the fibers of the base sheet appears to occur more often in a system based upon the use of a sensitizing composition formulated of thio-urea and a water soluble polyvalent metal salt which may be used alone or in combination with an activator of the type sodium acetate or other water soluble metal salt, as described in the copending application of Clarence J. Shoemaker, Serial No. 280,161, filed on April 2, 1952, and entitled "Thermographic Copying Process and Elements for Use in Same," with or without a desensitizer or catalyst, such as magnesium chloride or other inorganic bivalent metal salt as described in the copending application of Clarence J. Shoemaker, Serial No. 286,027, filed on May 3, 1952, and entitled "Method and Materials for Producing Copy."

While the concepts of this invention are not limited to sensitizing systems based upon thio-urea and a water soluble polyvalent metal salt, it has application only to systems wherein the base sheet is formed of heat destructible fibers and sensitized with materials that rely on heat to cause reaction between components in the development of copy therefrom.

In accordance with the practice of this invention, considerable improvement in copy quality, because of less burn-out, is secured when a small amount of an organo-silicon compound is present in combination with the sensitizing compositions in the base sheet. The organo-silicon may be incorporated as a component of the sensitizing composition or applied afterwards, but it is preferred to incorporate the organo-silicon compound in the base sheet in advance of the sensitizing composition in order to make more efficient use of the organo-silicon as an agent intimately in contact with the fibers of the base sheet. The organo-silicon compound may be combined with the fibers by dispersion in the slurry used to form the paper base sheet but it is preferred to introduce the organo-silicon by treatment of the finished sheet as by impregnation, dip coating, flow coating, spray coating or other conventional sheet treating means.

The improvement in copy quality is secured when the base sheet is treated with a composition containing from about 0.5-10 percent by weight of the organo-silicon compound therein. When applied alone as a pretreatment or as an after treatment to the sensitizing composition, appli-

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cation may be made from a solvent solution in ethyl acetate or the like solvent medium or from aqueous dispersion. When applied as an ingredient with the sensitizing composition, the organo-silicon may be dispersed in amounts within the range of 1-10 percent by weight in the aqueous medium wherein the other ingredients are dissolved. While amounts greater than that supplied from a 10 percent solution or dispersion may be used, the application of additional amounts is not necessary to secure the desired results and since the organo-silicon materials are rather expensive, use of greater amounts would be impractical from the standpoint of cost. It is preferred, in fact, to incorporate the organo-silicon materials in concentrations equivalent to an amount which can be applied from a 1-4 percent solution or dispersion since such concentrations give almost complete elimination of burn-out and facilitate the production of copy of excellent quality.

As the organo-silicon compound use is made of the organo-silicon polymers, often referred to in the trade as polysiloxanes, and preferably the organo-silicon fluids of low molecular weight, such as dimethyl polysiloxane (DC 200 fluid) of 100 centistokes viscosity, marketed by The Dow Chemical Company of Midland, Michigan, diethyl polysiloxane (DC 400 fluid), phenyl methyl siloxane copolymer (DC 550 fluid), phenyl methyl polysiloxane (DC 710 fluid). Though not as desirable, use may also be made of the polysiloxanes of higher molecular weight having waxy or resinous characteristics such as the copolymer of phenyl methyl-phenyl and methyl siloxanes (DC 803), the copolymer of dimethyl, phenyl and methyl siloxanes (DC 260) and the like.

The following examples will illustrate the practice of this invention:

Example 1

For a system of the type described and claimed in copending application, Serial No. 280,161, filed April 2, 1952, a low basis weight paper, such as 4½-pound Washington Linen, is first coated with a 2 percent solution of dimethyl polysiloxane (DC 200 fluid) dissolved in ethyl acetate. After drying at room temperature and preferably at an elevated temperature within the range of 150-300° F., the paper is coated with a heat sensitizing composition having the following formulation:

6 grams lead acetate
5 grams thio-urea
0.5 gram glacial acetic acid
100 grams water

In systems of the type described in Example 1, thio-urea is combined with a bivalent metal salt of a low aliphatic acid such as the nickel, copper, cobalt formates, acetates, propionates, lactates and the like, alone or in various combinations. Improved results are secured when materials such as ammonium, sodium and potassium acetates or other salts of the alkali metals are used with the base substances to provide for the development of copy by reaction at lower temperature levels and to reduce the amount of background color which may form in the treated base sheet. In such systems, the coating compositions may be formulated with 3-10 percent by weight of the metal salt and 1-10 percent by weight thio-urea with the alkali metal salts being present in amounts ranging from slightly less than the total thio-urea and metal salt to about three times the amount thereof.

By way of illustration a further example of a sensitizing composition based upon the described system may comprise the following:

Example 2

5 grams nickel acetate
6 grams thio-urea
10 grams sodium acetate
100 grams water

The base sheet may be treated in advance of the application of the coating composition with a 3 percent solution of diethyl polysiloxane (DC 400 fluid).

Example 3

A low basis weight paper may be treated with a 1.5 percent solution of diphenyl polysiloxane fluid in suitable solvent. After drying the treated base paper is coated with a heat sensitizing composition of the type described in the copending application of Clarence J. Shoemaker, filed on May 3, 1952, represented by the following formula:

5 grams nickel acetate
6 grams thio-urea
10 grams sodium acetate
1 gram magnesium chloride
100 grams water

As in the previously described system, suitable sensitizing compositions are formulated with the described ratios of thio-urea, polyvalent metal salt with or without the alkali metal salts to lower the reaction temperature and eliminate background color. The further addition of inorganic bivalent metal salts such as magnesium chloride, nickel chloride, magnesium sulphate and the like incorporated in the system described in the above mentioned application further improves the characteristics of the sensitized base sheet when such inorganic salts are present in amounts less than 2 percent by weight of the treating composition or less than 20 percent by weight of the total of thio-urea and organo-metallic salts in the base materials.

Example 4

A thin copy sheet formed of cellulose fibers may be sensitized in accordance with the practice of this invention with a composition based upon the following formulation:

5 grams cobalt acetate
5 grams thio-urea
20 grams sodium acetate
100 grams water

Two grams of dimethyl polysiloxane are dispersed in the above coating composition and the material applied to the base sheet and then dried at a temperature of about 175° F.

Example 5

A paper base tissue is coated with a solution containing 5 grams nickel acetate, 5 grams thio-urea, 2 grams glacial acetic acid, 87 grams water and sodium hydroxide in amounts sufficient to adjust the pH to about 7.2 to 7.5. After the coating has dried, the coated sheet is subsequently treated with a 2 percent solution of dimethyl, phenyl ethyl polysiloxane in ethyl acetate. The coating may be air dried or dried at a temperature of about 150° F.

In use, for the production of copy by thermographic technique wherein heat is generated by infra red the sensitized copy sheet is positioned in surface contact with an original having the image or printed portion to be duplicated formed thereon of infra red ray absorbing substance. When the desired contacting relation has been established, radiations rich in infra red are directed onto the original and absorbed in material forming the letter outlines and then converted into heat. The radiations are of sufficient intensity instantaneously to generate a heat pattern having a temperature sufficient upon transfer to the copy sheet to effect the desired thermal reaction to form intense black copy in the heated areas.

When the sensitized copy sheet contains organo-silicon materials of the type described in the desired concentrations, lateral spread of the heat pattern is apparently reduced and the fibers adjacent the heat pattern appear better able to resist deterioration with the result that sharp copy of intense black quality is produced without any burn-out of the loop letters or the like.

It will be understood that the concepts of this invention are applicable also to other sensitizing compositions relying upon heat for the development of copy and that changes may be made with respect to the application and treatment of the organo-silicon substance to the copy sheet without departing from the spirit of the invention, especially as defined in the following claims.

We claim:

1. A copy sheet of the type described comprising a paper base sheet containing a sensitizing composition which produces a visible color change at elevated temperature and a polysiloxane distributed throughout the sheet.

2. A copy sheet for thermographic duplication comprising a paper base sheet, a polysiloxane fluid coating the fibers of the base sheet, and a thermo-sensitive composition distributed throughout the base sheet to provide a color change by thermal reaction at elevated temperature to produce copy.

3. A copy sheet as claimed in claim 2 in which the amount of polysiloxane in the copy sheet corresponds to that deposited from a composition containing 0.5 to 10 percent by weight thereof.

4. A copy sheet as claimed in claim 2 in which the sensitizing composition is based upon the combination of thio-urea and a metal salt capable of forming a colored reaction product therewith at elevated temperature.

5. A copy sheet as claimed in claim 1 in which the polysiloxane comprises an organo-silicon fluid of low molecular weight.

6. In the method of producing a sensitized copy sheet for thermographic duplication, the step of treating a paper base sheet with a composition containing from 0.5 to 10 percent by weight of a polysiloxane fluid, and impregnating the sheet with a composition containing materials which produce a color change by thermal reaction at elevated temperature.

7. The method as claimed in claim 6 in which the organo-silicon compound is applied to the base sheet in advance of the sensitizing composition.

8. The method as claimed in claim 6 in which the polysiloxane is applied as a component of the sensitizing composition.

9. The method as claimed in claim 6 in which the polysiloxane is applied subsequent to the sensitizing composition.

10. The method as claimed in claim 6 in which the sensitizing composition is based upon the combination of thio-urea and a polyvalent metal salt capable of forming a colored reaction product at elevated temperature.

11. In the method of producing a sensitized copy sheet for thermographic duplication, the steps of incorporating a polysiloxane with the cellulosic fibers of the copy sheet and subsequently sensitizing the copy sheet with a composition which provides a color change by thermal reaction at elevated temperature to produce copy.

12. The method as claimed in claim 11 in which the polysiloxane comprises an organo-silicon fluid of low molecular weight.

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