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[54] **THERMOGRAPHIC TRANSFER SHEETS**

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[51] **Int. Cl.** **B41c 1/06**

[58] **Field of Search** 117/36.1, 1.7, 3.4, 13, 117/21, 35.6; 156/234

[56] **References Cited**

UNITED STATES PATENTS

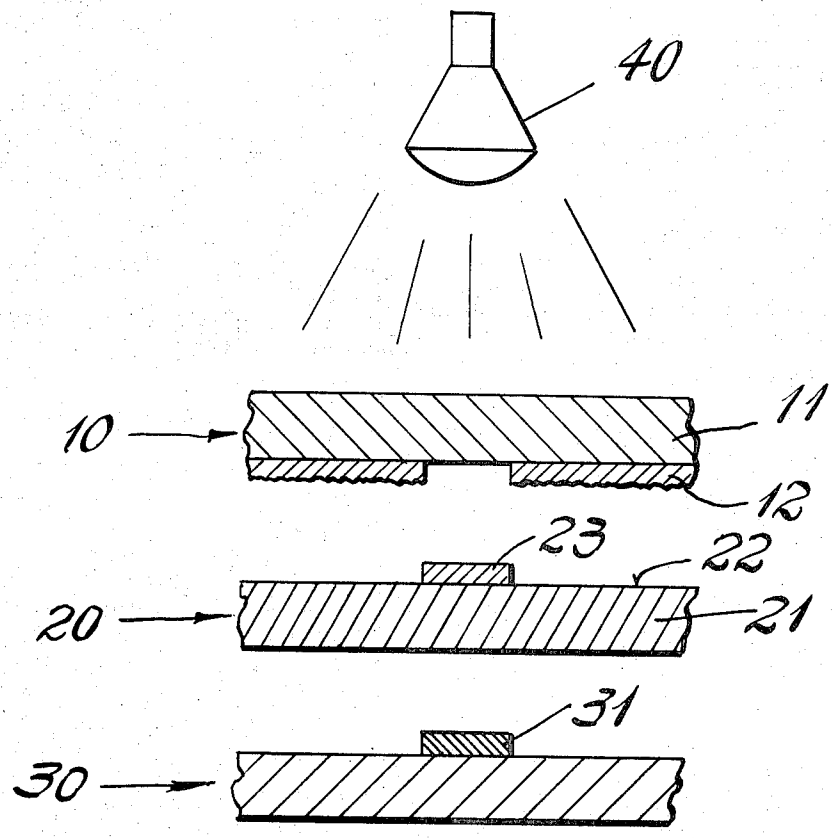
3,289,579	12/1966	Block	101/473 X
3,537,872	11/1970	Kojima et al.	117/1.7
3,558,881	1/1971	Gold	250/65

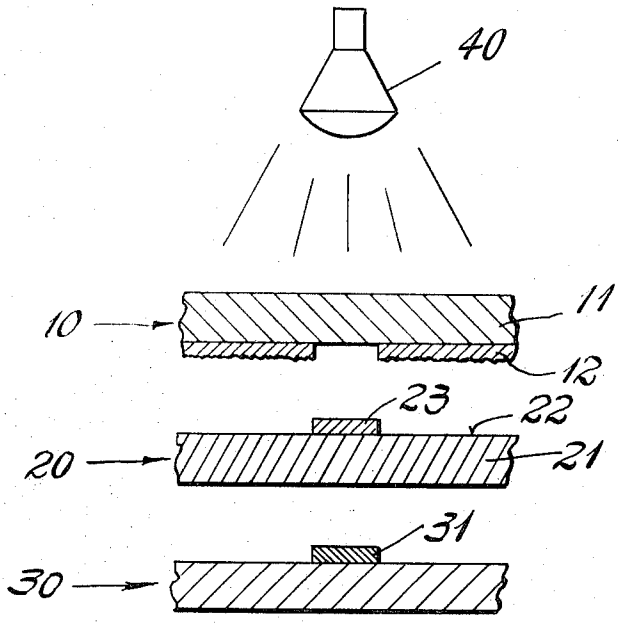
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[57] **ABSTRACT**

Thermographic transfer sheets having a heat-transferable layer comprising discrete particles which are capable of softening and adhering to a copy sheet at thermographic temperatures, said particles being separated by an interface and air voids which provide a thermal insulation and weakened severing points between heated and unheated particles.

4 Claims, 1 Drawing Figure




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THERMOGRAPHIC TRANSFER SHEETS

This application is a division of parent application Ser. No. 109,132, filed Jan. 25, 1971, now U.S. Pat. No. 3,751,318.

The thermographic transfer duplication process is in current commercial use for the imaging of single copies, hectograph masters and planographic printing plates corresponding to an imaged original sheet by means of infrared radiation and a thermographic transfer layer. The original images become heated by the infrared and the heat melts corresponding areas of the transfer layer to cause it to wet and adhere to the receptive sheet to produce the desired copy, master or plate.

One important disadvantage of the known thermographic transfer sheets and processes is their inability to produce imaged copies, masters or plates (hereinafter referred to collectively as copy sheets) which are as sharp and clear as the original images on the original sheet. Hot melt wax thermographic transfer layers have a certain narrow threshold temperature range below which they will not transfer and above which they flow excessively. However even within the limits of the narrow threshold temperature range, a wax transfer layer conducts heat laterally as well as through the thickness of the layer and such lateral conduction causes broadening of the imagewise heat pattern. Thus the wax layer softens and melts in an area which is slightly broader than the dimensions of the original image, whereby the image transferred to the copy sheet is not as sharp or clear as the original. The defects in the copy are magnified in cases where the copy sheet is a master or plate from which hundreds of duplicate copies are made in the spirit or planographic processes, thus reducing the number of acceptable duplicate copies that can be made.

Conventional solvent-applied resinous thermographic transfer layers resist liquefaction at thermographic temperatures but also have cohesive properties which resist sharp separation between the heated and unheated areas during transfer. Such layers also generally have higher softening temperatures than wax layers, and are as heat-conductive as wax layers, so that heat spreads from the image areas to adjacent areas to cause broadening of the imagewise heat pattern.

Another important disadvantage of prior known thermographic transfer sheets, leading to the production of imperfect thermographic copies, is due to the nature of the process itself. During thermal exposure the thermographic transfer layer becomes imagewise welded to the copy sheet. After exposure and cooling, the transfer sheet and copy sheet must be stripped apart whereby the areas of the transfer layer which are welded to the copy sheet are torn from the remainder of the transfer layer. This often results in the welded areas pulling over to the copy sheet adjacent non-welded areas of the transfer layer which have rebonded to the heated areas of the transfer layer during cooling. This is commonly evidenced by the formation of filled-in characters and occurs with both conventional wax and resinous thermographic transfer layers.

It is the principal object of the present invention to provide novel thermographic transfer layers which produce sharper and more perfect thermographic copies than heretofore possible.

It is another object of this invention to provide an improved thermographic transfer sheet which simplifies the final step of separating the transfer sheet and the copy sheet to avoid the transfer of unheated areas of the transfer layer.

These and other objects and advantages of this invention will be clear to those skilled in the art in the light of the present disclosure.

The accompanying drawing illustrates the use of the present transfer sheets in one embodiment of the thermographic copying process.

The present invention involves the discovery that improved thermographic transfer layers can be produced by formulating the transfer composition as a dispersion in a volatile vehicle, applying the dispersion to a receptive flexible foundation and evaporating the vehicle to provide a discontinuous layer of discrete solid heat-softenable particles.

I have discovered that such a discontinuous layer of discrete particles has at least two critical properties which give rise to an unexpected improvement in the thermographic transfer process. First, the discontinuous nature of the transfer layer provides a multiplicity of discrete particles, each separated at least partially from the next by means of an interface and air voids. The air voids provide an insulation between particles and reduce substantially the thermal transfer between particles, whereby the ability of heat to spread laterally across the transfer layer is substantially reduced.

Second, the discontinuous structure of the transfer layer enables the heated, coalesced portions of the transfer layer to separate sharply from the unheated areas. The air voids and interfaces provide weakened severing points between heated and unheated areas whereby the heated areas, bonded to the copy sheet, break easily and sharply from the unheated areas. This facilitates the separating of the transfer sheet and the imaged copy sheet and substantially reduces the ability of the portions of the transfer layer welded to the copy sheet to pull adjacent portions of unheated transfer composition from the transfer sheet.

The transfer compositions of the present invention comprise a major amount by weight of a waxy binder material and a minor amount by weight of a resinous binder material and, in most cases, softeners or plasticizers and coloring matter. The waxy binder material may be a conventional wax such as carnauba, ouricury, microcrystalline, beeswax, montan wax, or a mixture thereof. Other waxy materials having the properties of wax are also suitable alone or mixed with waxes. These include the lower molecular weight polyethylenes such as A-C Polyethylene 400, solid Carbowaxes, polyvinyl stearate, and the like. In addition, a minor amount of resinous film-forming binder material having a higher melting temperature than the wax is included as part of the binder material in order to increase the melting temperature of the dispersion and to render the heated areas more adhesive with respect to the copy sheet. Suitable film-formers include cellulose materials such as ethyl cellulose, vinyls such as polyvinyl butyrate, polybutene resins, and the like. The film-forming binder may be used in amounts ranging from about 5 percent up to about 35 percent of the total weight of the binder material.

Resinous dispersions are also suitable and these generally contain compatible oil softeners or plasticizers to provide resinous particles having the desired softening

point within the thermographic temperature range of from about 150° F up to about 220° F. Preferred resins include polyvinyl acetate, polystyrene, styrene-butadiene copolymers, cellulose esters and ethers such as ethyl cellulose and cellulose acetate-butyrate, and acrylic resins such as methyl methacrylate and ethyl acrylate and copolymers of each. Suitable plasticizers and compatible oils vary from resin to resin and the selection of appropriate materials and amounts to provide the required softening temperature is within the skill of the art.

The coloring matter, if present, must be one which does not absorb infrared radiation to any substantial extent. The preferred materials are the crystal violet dyes which are used in small dissolved amounts in the case of making single copies, and in large undissolved amounts in the case of making hectograph masters. Conventional colorless color-forming reactive chemicals also can be used. In the case of imaging planographic plates, no imaging material is necessary since the wax binder is oleophilic, although a small amount of dissolved dye is preferably included for proofreading purposes.

The transfer composition is applied to a receptive flexible foundation such as thin paper or plastic film as a dispersion in a volatile vehicle, the dispersion comprising from about 3 percent to about 10 percent solids. The vehicle may be water or a volatile organic solvent such as alcohol, toluol, mineral spirits, or the like. The dispersion may be produced in any known manner such as by grinding and agitating the binder material and coloring matter in the vehicle. Preferably the waxy material is melted with the coloring matter and is poured slowly in the vehicle, which is chilled, to form the dispersion.

The dispersion is applied as a thin layer having a dry weight of from about 1 to 4 pounds per ream of 3,300 square feet. The vehicle is evaporated at a moderately low temperature, below the softening temperature of the particles. The waxy particles generally have a softening and melting temperature within the range of from about 150° F to 200° F.

The following example is given as an illustration of one embodiment of this invention.

Eighty grams of carnauba wax and twenty grams of ethyl cellulose are melted together at a temperature of 200° F. The ethyl cellulose apparently dissolves in the molten carnauba wax rather than melting, but the melt is homogeneous. Next the melt is slowly poured into 1,900 grams of ethyl alcohol chilled to a temperature of 20° F. The alcohol is agitated during pouring and a fine milky dispersion of the melt is formed having a solids content of about 5 percent.

Next the dispersion is applied as a uniformly thin layer to a film of ½ mil Mylar polyethylene terephthalate and the alcohol is evaporated to leave a deposit of about 2½ pounds of the dry dispersion per 3,300 square feet of film. The alcohol gives the dispersion an affinity for the Mylar. Drying of the layer occurs at slightly elevated temperatures, well below the melting temperature of the dispersed particles, and the formed layer has a whitish, beady appearance and is translucent. Referring to the drawing, the formed transfer sheet **10** comprises the film foundation **11** and the dispersion transfer layer **12.**

The transfer sheet is used to produce sharp, clear oleophilic images on a thermal planographic printing plate corresponding to images present on an imaged original sheet in the manner illustrated by the drawing. The plate **20** comprises a film foundation **21** having a planographic surface **22.** The original sheet **30** may be any sheet carrying infrared radiationabsorbing images **31.** The sheets are superposed in the order shown and are exposed to an infrared source **40.** The infrared penetrates through to the original image **31** where it is absorbed to generate an imagewise heat pattern which is conducted back to soften a corresponding area of the particulate layer **12.** The softened area adheres to the surface **22** of the plate **20** and transfers thereto in the form of a non-particulate, oleophilic image **23** when the sheets are separated. Image **23** separates sharply and easily from the adjacent areas of transfer layer **12** since the adjacent areas are particulate and are not strongly bonded to the portion which was heated and transferred to produce image **23.**

Variations and modifications may be made within the scope of the claims and portions of the improvements may be used without others.

I claim:

1. Thermographic transfer sheet comprising a flexible foundation carrying a uniform thin volatile-liquid-applied imaging layer of discrete particles which soften at a temperature within the range of from about 150° F to 220° F comprising a major amount by weight of wax and a minor amount by weight of resinous film-former having a higher melting point than the wax, the particles being separated, at least partially, by an interface and air avoids to form areas which are transferable to a copy sheet, the said air voids and interfaces providing a thermal insulation and weakened severing points between heated and unheated particles.

2. Transfer sheet according to claim **1** in which the particles comprise a low molecular weight polyethylene.

3. Transfer sheet according to claim **1** in which the imaging layer is present in a weight within the range of from about 1 to 4 pounds per 3,300 square feet of foundation.

4. Transfer sheet according to claim **1** in which the imaging layer contains a minor amount by weight of coloring matter.

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