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[54] DONOR-RECEPTOR COPY PAPER

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[51] **Int. Cl.**.....**B41m 5/10**
[58] **Field of Search**.....117/36.3

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[57] **ABSTRACT**

A pressure-responsive image transfer system of the donor-receptor manifold variety comprising a web-carried donor coating composed of an aqueous dispersion of a major weight proportion of kaolin or aluminum silicate, a minor proportion of carbon black and/or nominal amounts of a water-soluble dye and a dispersing agent admixed with a binder consisting of a dispersion of polyethylene in an aqueous solution of polyvinyl alcohol for use in combination with a juxtaposed web-carried receptor coating such as a hot-melt mixture of a major weight proportion of paraffin and a minor proportion of ethylene vinyl acetate copolymer or an aqueous dispersion of a major weight proportion of polyethylene and a minor weight proportion of ethylene vinyl acetate copolymer.

4 Claims, No Drawings

DONOR-RECEPTOR COPY PAPER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a manifold system of coated papers or substrates having transferable coatings on one surface thereof capable of being transferred to a receiving surface by the selective application of pressure such as by a ballpoint pen, stylus, pencil, typewrite key, printing plate or the like in the localized areas to which the pressure is so applied. In the multiple-copy manifold system, the paper or other substrate carrying the coatings and upon which the copies are to be made is provided with said coatings in such a manner that the transferable or donor coating on one substrate is superimposed upon the receiving or receptor coating of the adjacent substrate whereby the transfer of the donor-receptor image from one substrate to the next takes place upon the application of a single transferring pressure.

DESCRIPTION OF THE PRIOR ART

Donor-receptor manifold systems of the type above described have been sought to avoid the necessity for using transfer or copy sheets such as carbon paper interleaved between the substrates upon which the copies are to be made. Until the present invention, however, the principal properties desired in the donor and receptor films and particularly in the former, have appeared to be mutually exclusive. For example, in order to obtain a clearly legible transferred image, the donor coating has had to be friable and capable of quick and complete separation from the remainder of the film and from the substrate by which it is carried, upon the application of the localized force. On the other hand, where the donor coating has been sufficiently friable to afford this ready separation, it has been found that it smudges and mars the appearance of the adjoining substrate.

It was primarily to solve this particular dilemma that the prior art resorted to the use of receptor coatings which are characterized by some degree of affinity for the donor coating and therefore promote a legible transfer therefrom even though the donor coating itself is smudge-resistant to the extent that normal transferability is somewhat impaired. While this donor-receptor approach to manifold copy systems is believed to be sound in theory and has achieved some degree of success in certain specific applications, the introduction of the receptor film has been attended by a variety of new technical problems which have not been satisfactorily solved. By way of example, the receptor coatings, while they may have improved the affinity of the copy substrate for the transferred image, have been lipophilic to the extent that they do not readily accept printing inks or ink from a writing instrument such as a pen or stylus. Additionally, it has been found that the images produced in such systems have not been easily and cleanly erasable, and only a small number of copies have been attainable. Beyond this, the ingredients and procedures required for the preparation of the prior art donor-receptor papers have been costly, and the increased manufacturing costs have been compounded by additional costs of control and inventory maintenance resulting from the fact that a particular donor coating has heretofore generally required a particular receptor coating for optimum results.

SUMMARY OF THE INVENTION

It is accordingly an object of the present invention to provide a new and improved web-carried image transfer coating for use in donor-receptor manifold copy systems.

Yet another object of the invention is to provide such a donor coating which is adaptable for use with the two principal varieties of receptor coatings; viz, the so-called "hot-melt" coatings and the water-based coating.

Yet another object of the invention is the provision of a donor coating which can provide a large number of copies wherein the transferred image is characterized by high pigment density, clear and sharp character edge definition and generally improved legibility and darkness.

Still another object of the invention is to provide an improved donor coating composed of relatively inexpensive ingredients and capable of being inexpensively prepared and applied to a variety of substrates.

To achieve these and other objects and advantages, this invention provides a donor coating composition which comprises a first, so-called "master batch" component which is an aqueous dispersion of pigments consisting principally of a major weight proportion of aluminum silicate clay or kaolin and nominal amounts of other pigments to give coloring or shading such as carbon black; e.g., SRF Carbon Black, with good water dispersion characteristics and a water-soluble dye. The clay represents on the order of 94 weight percent of the total of such pigments, the carbon black on the order of 5 weight percent, and the dye on the order of 1.0 weight percent. The clay comprises from 90 to 92 weight percent of all of the solids (including the binder solids) in the total donor coating. Critical to the obtaining of the improved results of the present invention are the shape characteristics and size distribution of the particles in the aluminum silicate clay or kaolin. The shape of such particles must be that of thin flat plates having a length-to-thickness ratio of at least 10 to 1, and the particle size must be such that at least 90 percent of the particles are less than 2 microns in largest dimension and the distribution of particle sizes follows a normal pattern around an average size of from 0.5 to 0.55 microns in largest dimension. In the binder dispersion, the polyvinyl alcohol solids represent from 0.26 to 0.32 weight percent of the total solids in the donor coating and the polyethylene represents from 2.10 to 2.50 weight percent thereof. In addition to the basic ingredients of the master batch and the binder, the donor coating may also comprise nominal amounts of processing aids such as a dispersant such as sodium tripolyphosphate representing on the order of 0.2 weight percent and a leveling or antifoaming agent such as trisbutoxyethyl phosphate of on the order of 0.02 weight percent based upon the total solids in the donor coating.

In the preparation of the donor coating, the binder component is formed by the solution of the polyvinyl alcohol in water to obtain on the order of a 20 weight percent solution, and this solution is then admixed with the aqueous polyethylene emulsion. The dry ingredients of the master batch are also placed in solution by the admixture thereof with a sufficient amount of water that, when the solution of the master batch ingredients is admixed with the binder solution, the total mixture achieves a viscosity which is workable for the purposes of applying a coating to the substrate as by spraying, roller, blade, gravure, reverse roll or the like. The desired viscosity varies depending upon the method of intended application and the desired thickness of the dry coating. In a typical blade application, the coating thickness may be in the range of from 0.0001 to 0.0003 inches, and the preferred viscosity of the total water-based system is within the range of from 10 to 2000 centipoises.

In the manner established for the series of superimposed sheets or other substrates involved in conventional donor-receptor manifold copy systems, the donor coating is applied to the verso or underside of the uppermost sheet which is that upon which the original printing impression will be made and to the underside of all of the sheets or leaves therebelow with the exception of the lowermost. The receptor coating is thereupon applied to the upwardly disposed surface of the sheet immediately underlying the topmost sheet and to the corresponding surface of all of the underlying sheets. In such an arrangement, the pressure applied in the original imprinting of the topmost sheet is transferred downwardly through all of the sheets. Thus the portions of the donor coating in the localized areas of the application of such pressure separates from the overall donor coating on each of the sheets and is received and held by the opposed receptor coating of each underlying sheet.

Although nominal variations in the quality of the transferred image are encountered with the use of different types of receptor coatings, one of the important advantages of the

present invention is that the donor coating above described has been found capable of providing greatly improved copies in high ply form sets from the standpoint of the quality and legibility when it is employed in combination with a variety of different receptor coatings including both of the principal basic types thereof; viz, the so-called "hot-melt" system involving a paraffin or other wax with a melting point of on the order of 130° F. or above and the water-based system involving aqueous dispersions of polymeric materials such as polyethylene and ethylene vinyl acetate. Since the hot-melt receptor coatings are generally preferred over water-based coatings because of their lower cost, stability and ease of coating, the fact that the donor coating of the present invention is compatible with such receptors, even though the donor is itself water-based, represents an additional advantage in that economies may be thereby achieved even in addition to the fact that the donor coating is itself less costly than prior art donors of either the hot-melt or water-based variety.

Experimentation has demonstrated that only slight variations from the donor composition generally described above can be tolerated without adversely affecting the product quality. While the substitution of similar alternate materials such as equivalent dyes and dispersing agents and different grades of polyvinyl alcohol can be tolerated, the presence and proportions and particulate configuration of the aluminum silicate or kaolin, the proportions of the polyvinyl alcohol and, to a lesser extent, of the carbon black are extremely critical and do not admit of substitution or variation without a serious loss in product quality. Alternative clays and other fillers, for example, fail to produce the highly desirable character sharpness and edge definition obtainable where the preferred grade and type of aluminum silicate clay is employed. Similarly, the replacement of the polyvinyl alcohol by any of the film-forming constituents of the prior art such as cellulose acetate, polyvinylacetate, cellulose nitrate, polyacrylonitrile and the like substantially impairs the transferability of the donor film, regardless of the receptor employed, to the extent that the quality of the transferred image is rendered unacceptable. Moreover, the proportion of the binder component in the donor coating is highly critical in that an increase thereof above the stated range destroys legibility, especially in form sets requiring a large number of copies, and a reduction thereof causes flaking of the coating and excessive dirtiness and smudging.

DESCRIPTION OF PREFERRED EMBODIMENTS

One specific preferred embodiment of the donor-receptor system above generally described comprises a donor coating wherein the binder is composed of "Valspex N-123," which is a 32 percent solids nonionic, aqueous emulsion of soft, low molecular weight polyethylene containing an emulsifier in a solids-to-emulsifier ratio of 30 to 1, manufactured and sold under that proprietary designation by the Valchem Chemical Division of United Merchants and Manufacturers of New York, N.Y., and of "Elvanol 51-05," which is a 20 weight percent aqueous solution of polyvinyl alcohol manufactures and sold under that proprietary name by the E. I. DuPont DeNemours Company of Wilmington, Del. The master batch component of this preferred donor comprises "ASP 200" which is an aluminum silicate clay manufactured and sold under that proprietary designation by Engelhard Minerals and Chemicals of Menlo Park, N.J., "Regal SRF-S" carbon black which is a semireinforcing furnace carbon black manufactured and sold by the Cabot Corporation of Boston, Mass., "-Calcocid Naphthol Blue Black Extra Concentrated Dye" manufactured and sold by American Cyanamid Corporation, Dies and Textile Chemicals Department, Bound Brook, N.J., a dispersant such as sodium tripolyphosphate and a leveling or antifoaming agent, such as trisbutoxyethyl phosphate, which is manufactured and sold by Aldridge Chemical Company of Milwaukee, Wis. In this preferred embodiment, said ingredients are employed in proportions according to the following table of weight percentages of the total donor composition, considered first from the standpoint of the solid materials only and second from the standpoint of the total mixture including the water solvent:

Ingredient	Weight Percent of Total Solids	Weight Percent of Total Mixture
Binder Component:		
Polyvinyl alcohol	0.3	0.8
Polyethylene	2.3	4.0
Master Batch:		
Aluminum silicate	91.4	50.6
Carbon black	4.9	2.7
Dye	0.9	0.5
Sodium Tripolyphosphate	0.2	0.1
Trisbutoxyethylphosphate	0.02	0.01
Water	—	41.3

In the processing of the above composition, all of the dry ingredients of the master batch including the sodium tripolyphosphate dispersant and the trisbutoxyethylphosphate antifoaming agent are dissolved in the water, and the resultant solution is then admixed with the previously mixed binder components which are themselves in solution. The resultant formulation is then applied to one side of a suitable web ultimately to form the appropriate leaves or sheets in the multiple copy manifold system as by a blade method of application, whereupon the substrate is allowed to dry to leave a continuous donor film approximately 0.00025 inches in thickness. A specific substrate to be so employed may be a highly filled carbonizing bond paper.

The weight percentage of the polyvinyl alcohol solids in the above recipe has been found to be variable within the range of from 0.26 to 0.32 weight percent without substantially altering the desired properties of the finished donor coating. Similarly, the polyethylene solids in said above given recipe may vary within the range of from 2.10 to 2.50 weight percent. It can be seen therefore that these binder components can represent from 2.36 to 2.82 weight percent of the total donor coating solids with the master batch component solids (including the nominal amounts of the processing agent such as the antifoaming agent and the dispersing agent) representing from 97.18 to 97.64 weight percent of the total solids. In other embodiments of the invention, the "ASP 200" aluminum silicate clay can be replaced by equal weight proportions of the kaolin known as "Lustra" which is a fine-particle-sized kaolin produced and sold under that proprietary name by Freeport Kaolin Company, Division of Freeport Sulphur Company, New York, N.Y. Both the "ASP 200" and the "Lustra" are characterized by platelet particles having a length to thickness ratio of at least 10 to 1, and the particle size is such that 92 percent of the particles are less than 2 microns in the largest dimension and the distribution follows a normal pattern around an average size of 0.5 microns in largest dimension.

A specific "hot melt" receptor to be applied to the opposite sides of the substrates coated with the donor as above described comprises a mixture of from 80 to 90 weight percent of a 130 degree F. melting point paraffin, such as "Gulf Wax 33" manufactured and sold under that proprietary designation by Gulf Oil Corporation of Houston, Tex., and from 10 to 20 weight percent of an ethylene vinyl acetate copolymer such as that manufactured and sold by the E. I. DuPont DeNemours Company of Wilmington, Del., under the brand name "Elvax 210." The paraffin is melted and the ethylene vinyl acetate copolymer is added by stirring at 230° F. to form a hot-melt dispersion. This dispersion is then coated upon the reverse side of the donor-coated paper by the above described usual methods for applying the donor coating such as roller, gravure, blade and reverse roll applications.

A water base receptor that may be similarly employed in combination with the above-described donor coating consists of a mixture of the above-described "Valspex N123" polyethylene emulsion and an aqueous dispersion of ethylene

vinyl acetate, such as a 42 percent solids dispersion of the type known as "Flexbond 150," which is manufactured and sold under that name by Airco of New York, N.Y. In one preferred embodiment, the Valspex N123 represents 75 weight percent of the total mixture and the ethylene vinyl acetate dispersion represents five percent of the total mixture; and the resultant solids ratio of the polyethylene to the ethylene vinyl acetate is 93.5 to 6.5. Such a water-based receptor may also be applied by the above-described conventional means for applying either the donor or the hot-melt receptor coatings.

The invention having thus been described the following is claimed:

1. A pressure-responsive image transfer system of the donor-receptor manifold type comprising a plurality of superimposed sheets, one surface of a sheet being coated with an aqueous donor coating of transferable material and one surface of a sheet being coated with a receptor coating for receiving the transferred material, said sheets being arranged with the donor coating of one sheet in contact with the receptor coating of an adjoining sheet, wherein said donor coating comprises a master batch and a binder, the master batch consisting of an aluminum silicate clay in an amount within the range of 90 to 92 weight percent of the solids in said donor coating characterized by platelet particles having a length-to-thickness ratio of at least 10 to 1 and wherein the particle size is such that 90 percent of the particles are less than 2 microns in the largest dimension and the distribution follows a normal pattern around an average size of 0.5 micron in largest dimension and a minor proportion of coloring pigmentation, and the binder consisting of a mixture of soft low molecular weight polyethylene in an amount of 2.10 to 2.50 weight percent of the solids in said donor coating and polyvinyl alcohol in an amount of 0.26 to 0.32 weight percent of the solids in said donor coating, and wherein said receptor coating is one of the class consisting of a hot-melt mixture and a water-based mixture.

2. A system of claim 1 wherein said coloring pigmentation consists of a major weight proportion of carbon black and a minor weight proportion of dye and said receptor coating consists essentially of a major weight proportion of paraffin and a minor weight proportion of ethylene vinyl acetate copolymer or a major weight proportion of soft low molecular weight polyethylene and a minor weight proportion of ethylene vinyl acetate copolymer.

3. A pressure-responsive image transfer sheet of the donor-receptor type comprising one surface of the sheet being coated with an aqueous dispersion donor coating of transferable material and the other surface being coated with a receptor coating for receiving transferred material from another sheet, wherein said donor coating comprises a master batch and a binder, said master batch consisting of an aluminum silicate clay in an amount of 90 to 92 weight percent of the solids in said donor coating characterized by platelet particles having a length-to-thickness ratio of at least 10 to 1 and wherein the particle size is such that at least ninety percent of the particles are less than 2 microns in the largest dimension and the distribution follows a normal pattern around an average size of 0.5 microns in largest dimension and a minor weight proportion of coloring pigmentation, and the binder consisting of a mixture of soft low molecular weight polyethylene in an amount of 2.10 to 2.50 weight percent of the solids in said donor coating and polyvinyl alcohol in an amount of 0.26 to 0.32 weight percent of the solids in said donor coating, and wherein said receptor coating is one of the class consisting of a hot-melt mixture and a water-based mixture.

4. A sheet of claim 3 wherein said coloring pigmentation consists of a major weight proportion of carbon black and a minor weight proportion of dye and said receptor coating consists essentially of a major weight proportion of paraffin and a minor weight proportion of ethylene vinyl acetate copolymer or a major weight proportion of soft low molecular weight polyethylene and a minor weight proportion of ethylene vinyl acetate copolymer.

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