Nov. 19, 1963 D. A. NEWMAN ETAL 3,111,422

METHODS FOR PREPARING PRESSURE-SENSITIVE TRANSFER ELEMENTS

Filed April 27, 1961

Fig. 1

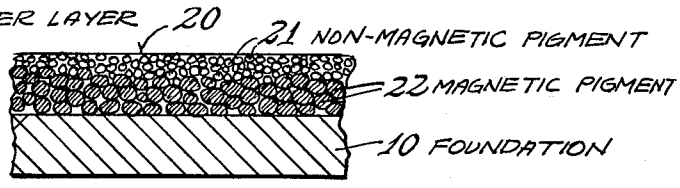


Fig. 2

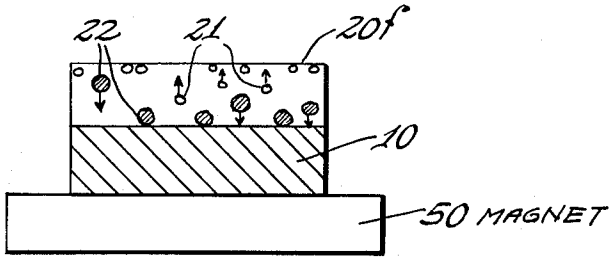


Fig. 3

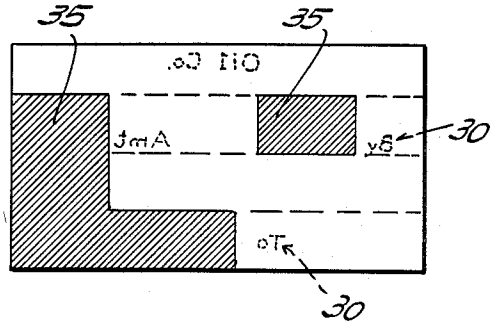
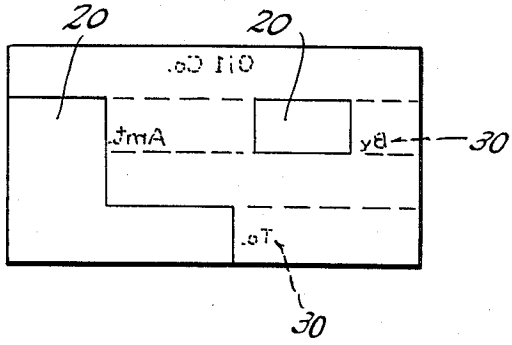


Fig. 4



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United States Patent Office 3,111,422 Patented Nov. 19, 1963

3,111,422

METHODS FOR PREPARING PRESSURE-SENSITIVE TRANSFER ELEMENTS

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Filed Apr. 27, 1961, Ser. No. 105,950
10 Claims. (Cl. 117—36.1)

This invention relates to the method for preparing pressure-sensitive transfer elements having one color but which transfer images of a different color under the effects of imaging pressure.

It has been known in the art for some time to apply transfer compositions to the rear surface of record sheets, either over the entire rear surface or over selected areas thereof in registration with form material printed on the record side of the sheet, as taught for instance by U.S. Patent No. 2,606,775.

Record sheets of this type, either "fully carbonized" or "spot carbonized," find great utility in credit systems such as in the so-called oil ticket field or gasoline credit system wherein the customer signs and retains a top carbonized receipt slip and the oil company retains the bottom carbon copy for billing purposes. The oil ticket field is merely illustrative of the numerous credit systems in operation today and making use of carbonized record sheets.

Although systems which make use of carbonized record-transfer sheets are very economical and effective for producing an original and a carbon copy without the use of a separate carbon paper, nevertheless there are serious disadvantages which have prevented the use of such systems in areas where cleanliness and appearance are important or critical.

Perhaps the most important disadvantage stems from the fact that the record-transfer sheet, which must be retained by the customer as a receipt, has a back surface which is either partly or fully carbonized and which is therefore quite dirty to the touch. Such record sheets have the tendency to stain the hands, clothing, wallet or papers coming in contact therewith, so that they must be carefully handled and stored to prevent the rubbing-off or transfer of the carbon transfer material.

Another disadvantage resides in the poor appearance of such record-transfer sheets, particularly when spot carbonized. The sharp contrast between the large areas of jet black color against the while background is not pleasant appearing and causes many potential users to shy away from record-transfer sheets.

It is an object of the present invention to produce transfer sheets which carry unitary transfer layers which are exceptionally clean to the touch and which therefore find excellent utility as record-transfer carbonized sheets.

It is another object of this invention to produce transfer sheets which carry unitary transfer layers having one color, preferably white, at their surface but producing images of a contrasting color, preferably black, under the effects of imaging pressure.

These and other objects and advantages will be apparent to those skilled in the art in the light of the following disclosure.

In the drawing:

FIGURE 1 represents a diagrammatic cross section, to an enlarged scale, of a transfer sheet according to the present invention containing a mixture of coloring materials.

FIG. 2 represents a diagrammatic cross section, to an enlarged scale, of the transfer sheet of FIG. 1 at an

intermediate stage during its production according to this invention.

FIG. 3 is a rear elevated view of a "spot carbonized" record-transfer sheet of the prior art.

FIG. 4 is a rear elevated view of a "spot carbonized" record-transfer sheet prepared according to the present invention and containing a mixture of coloring materials.

The transfer sheets prepared according to the novel process of the present invention as illustrated by FIG. 1 of the accompanying drawing comprise a suitable flexable foundation sheet **10** such as paper or a plastic film having thereon a pressure-sensitive transfer layer **20** containing a mixture of at least two coloring materials of different particle weight and preferably also of different color, the lighter weight coloring matter particles **21** being preferably a pigment having a white or light color so as to present little or no contrast with the color of the foundation sheet **10** and so as to mask or hide the black or dark color of the heavier pigment particles **22**.

Such transfer sheets are prepared by applying a layer of transfer composition containing the pigment mixture dispersed in a suitable binder material to the foundation sheet and maintaining said layer fluid for a period of time sufficient to allow the lightweight pigment particles **21** to rise or float to the surface while the heavyweight pigment particles sink to the bottom and become masked or hidden by the color of the lighter pigment particles on the surface. It is possible that a small amount of the lighter pigment is dispersed and trapped by the heavier pigment on the bottom of the layer, and vice versa, but in general substantially all of the light pigment **21** overlies the heavier pigment and forms a surface film which is exceptionally clean to the touch, preferably white in color, and substantially completely hides the dark or black color of the heavier particles **22**.

As mentioned above, it is necessary to maintain the applied layer in fluid condition to allow the pigment particles to migrate, and once this is accomplished as evidenced by the substantially complete masking of the dark colored heavy pigment particles, the layer may be set or hardened by cooling or evaporation of solvent depending upon the nature of the binder material used.

FIG. 2 serves to illustrate the preparation of transfer sheets using conventional wax binders. The pigment mixture dispersed in wax is coated by the conventional hot melt method onto a foundation **10** which is placed over a heating device such as hot plate **50** which is maintained at a temperature slightly in excess of the melting temperature of the wax binder used, generally from about 80° C. to about 150° C. The applied layer **20***f* has a dark color which lightens and becomes whitish after a period of about two to twenty seconds or more. Upon attaining this result, the coated sheet is removed from the heated plate and allowed to cool to form a transfer sheet having the hereinbefore-defined advantageous properties. Useful wax binders include carnauba, raw montan, microcrystalline, beeswax, ouricury and the like, as well as mixtures thereof alone or together with lanolin and/or mineral oil.

When using resinous binders rather than waxes, the layer is applied in the cold or at room temperature using coating solvents which dissolve the resinous binder and which are volatile slowly at room temperature. The coated sheet is maintained at room temperature or below, and is kept away from the heat for a period of time sufficient to allow the pigments to migrate in the liquid layer. When the dark colored layer lightens in color and becomes white, then the volatile solvents may be evaporated by maintaining the sheet at room temperature or by applying heat by passing the sheet over hot plate **50**. Suitable resinous binders include ethyl cellulose, vinyl chloride, vinyl acetate and copolymers thereof such as Vinylite VYHH and VYLF, polyvinyl butyrate and polystyrene, chlorinated

polyphenyl resins such as Arochlor 5442 and 5460, rosin modified alkyd resins such as Amberol 750, and similar thermoplastic resinous binders.

According to a preferred embodiment of the present invention, the heavy dark colored pigment particles **22** consist of or comprise magnetic pigment such as magnetic iron oxide, iron filings, iron powder or the like, and migration of the heavy pigment to the bottom of the liquid transfer layer is aided by the use of a conventional permanent magnet or electromagnet. FIG. 2 may be used to illustrate this embodiment wherein number **50** is either a magnetic hot plate (when wax binders are used in layer **20***f*) or just a magnet (when resinous binders are used in layer **20***f*). Pigment particles **22** are iron oxide particles which are attracted by the magnet and thus settle at the bottom of the transfer layer next to the foundaion. Pigmen particles **21** are non-magnetic and remain unaffected by the magnet and mask the color of the black iron oxide.

Suitable materials for use as the lightweight coloring material particles **21** include pigments such as titanium dioxide, zinc oxide, aluminum oxide, calcium oxide, calcium carbonate, graphite, fine carbon black and the so-called lamelliform metallic pigments including powdered aluminum, silver, bronze, zinc, nickel, tin and the like. Likewise dyestuffs may be used in their undissolved crystal particulate state, suitable dyes including crystal violet, methyl violet, magenta, rhodamine, and safranine. However, for simplification purposes, the lightweight coloring material particles will be referred to in the following claims as lightweight pigments since the undissolved dye particles are actually in the physical nature of pigments.

Suitable materials for use as the dark colored heavy pigment particles **22**, in addition to the magnetic pigments mentioned hereinbefore, include heavy carbon black, nigrosine, Bismark brown, chrome yellow, methyl orange and the like.

The following examples are given by way of illustration and should not be considered limitative. The specified amounts are in parts by weight.

Example 1

Carnauba wax	18.5
Raw montan wax	2.5
Beeswax	12.5
Lanolin	10.2
Mineral oil	13.6
Heavy pigment (magnetic iron oxide)	30.5
Light pigment (aluminum powder)	12.2

Example 2

Ethyl cellulose	5.0
Mineral oil	17.6
Lanolin	3.2
Heavy pigment (magnetic iron oxide)	12.2
Light pigment (titanium dioxide)	7.0
Solvent (toluol or the like)	55.0

Example 3

Vinylite VYHH (vinyl chloride-vinyl acetate copolymer)	10.0
Mineral oil	15.3
Rapeseed oil	4.2
Heavy pigment (carbon black)	7.0
Light pigment (silver powder)	3.5
Ethyl acetate	45.0
Toluol	15.0

Example 4

Vinylite XYSG (polyvinyl butyral)	10.0
Lanolin	5.0
Mineral oil	12.4
Heavy pigment (iron powder)	9.2
Light pigment (bronze powder)	3.4
Ethyl acetate	45.0
Toluol	15.0

Example 5

Arochlor resin 5460 (chlorinated polyphenyl resin)	10.0
Beeswax	5.0
Carbon tetrachloride	85.0
Heavy pigment (iron oxide)	20.0
Light pigment (titanium dioxide)	10.0

Example 1 relates to a wax-base transfer composition which is applied to a suitable foundation by any conventional hot melt method and which is heated to a temperature of about 150° C. using a hot plate, heated roller, infrared radiation or the like to allow the pigments to migrate. Since the heavy pigment is iron oxide, a suitable magnet is also preferably used in order to insure faster and more complete migration of the iron oxide to the bottom of the transfer layer.

Examples 2 through 5 relate to resin-base compositions which are applied in the absence of heat as solvent coatings. A suitable magnet is also preferably used in connection with the coatings of Examples 2, 4 and 5 which contain magnetic pigment.

The compositions of the present invention may be applied to the entire side of a suitable foundation sheet to produce transfer sheets which have a pleasant white or metallic colored transfer coating which is exceptionally clean to the touch, or else they may be applied to preselected areas on the back of a record sheet to form spot carbonized sheets as illustrated by FIG. 4 of the drawing. Such record sheets are generally printed with form material on the front side, as illustrated by the broken line material **30** of FIGS. 3 and 4, and then printed with pressure-sensitive composition on the back side in those areas where duplication is desired. FIG. 3 illustrates prior art spot carbonized sheets wherein the pressure-sensitive areas **35** are black in color and dirty to the touch. FIG. 4 illustrates the spot carbonized sheets prepared according to the present invention wherein the pressure-sensitive areas **20** are colored white, metallic or any other desired light shade such as yellow, pink, orange, green, etc., and are exceptionally clean to the touch.

Although the lightweight pigments which have been disclosed are either white or metallic in color, other colors may be used particularly where foundation sheets of different colors are used. To accomplish this result, suitably colored pigments are used or white pigments such as titanium dioxide, calcium carbonate and the like may be tinted with small amounts of non-staining dyestuffs of the desired color prior to their addition to the transfer composition. Also, particularly for ozalid work, the lightweight pigment may be black such as graphite or fine carbon black or other opaque material while the heavy pigment is a brightly colored pigment such as chrome yellow or a similar orange, pink or green colored pigment, etc. Likewise suitably colored dye particles may be used in place of the light pigments.

The pigments which may be used according to the present invention are classified as "lightweight" and "heavyweight" using either the weight of the heavy pigment as a standard, or preferably using the weight of the liquid binder material as the standard. In other words, both pigments may be heavier than the wax or resin binder material in its hot or dissolved state of minimum density but the heavy dark pigment will sink to the bottom more quickly than the light pigment which tends to remain in the liquid in the form of a suspension due to its light weight and small particle size, so that the light pigment forms a submerged masking coating. However, as illustrated by FIGS. 1 and 2 of the drawing, the heavy pigment is preferably heavier and the light pigment lighter than the binder material in its liquid state. Thus the heavy pigment sinks while the light pigment floats, thereby effecting quicker and more complete pigment separation and masking.

It should be understood that the present invention also

contemplates the method of magnetically attracting the magnetic pigment to the surface of the transfer layer to produce a black colored layer which produces white colored images under pressure. Such method may be carried out in the same manner as exemplified by FIG. 2 of the drawing except that the magnet **50** is placed over layer **20***f* and in close proximity thereto so that magnetic particles **22** are attracted to the layer surface while non-magnetic particles **21** remain unaffected.

There is no criticality with respect to the nature of the foundation sheet employed, suitable materials including paper and plastic films such as polyethylene terephthalate (Mylar), cellophane, cellulose acetate, polyvinyl acetate and the like.

The amount of pigment employed in the present transfer sheets may vary greatly depending upon the end use to which the sheet is to be put. However, the heavy pigment is generally present in an amount equal to from about 70% to about 98% of the total weight of the pigment mixture.

Sheets prepared according to the present invention and containing magnetic pigment may be used to prepare duplicate or carbon copies containing magnetizable images which may be automatically sensed in known manner with conventional magnetic data processing equipment.

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

We claim:

1. The method of preparing pressure-sensitive transfer elements carrying a transfer layer having one color but which transfers differently colored images under the effects of imaging pressure, which comprises coating a flexible foundation with a layer of transfer composition comprising a mixture of a lightweight pigment and a heavyweight pigment of a color contrasting with that of the light pigment dispersed in a fluid binder material, maintaining said binder material fluid for a period of time sufficient to allow the heavy pigment to settle and be substantially completely masked by the color of the light pigment, and solidifying said binder material to form said pressure-sensitive transfer element.

2. The method of preparing pressure-sensitive transfer elements carrying a transfer layer having a light color but which transfers dark colored images under the effects of imaging pressure, which comprises coating a flexible foundation with a layer of transfer composition comprising a mixture of a light pigment and a heavy dark pigment dispersed in a heated fluid wax binder, maintaining said wax binder fluid for a period of time sufficient to allow the dark pigment to settle and be substantially completely masked by the color of the light pigment, and cooling said wax binder material to solidify the same and form said pressure-sensitive transfer element.

3. The method of preparing pressure-sensitive transfer elements carrying a transfer layer having a light color but which transfers dark colored images under the effects of imaging pressure, which comprises coating a flexible foundation with a layer of transfer composition comprising a mixture of a light pigment and a heavy dark pigment dispersed in a volatile solvent fluid solution of a resinous binder, maintaining said resinous binder fluid for a period of time sufficient to allow the dark pigment to settle and be substantially completely masked by the color of the light pigment, and evaporating said volatile solvent to solidify said resinous binder and form said pressure-sensitive transfer element.

4. The method of preparing pressure-sensitive transfer elements carrying a transfer layer having one color but which transfers images of a different color under the effects of imaging pressure, which comprises coating a flexible foundation with a layer of transfer composition comprising a mixture of a light colored non-magnetic pigment and a dark colored magnetic pigment dispersed in a fluid binder material, maintaining said binder material fluid and applying a magnetic force to attract the dark pigment and cause it to be substantially completely separated from said light pigment, and solidifying said binder material to form said pressure-sensitive transfer element.

5. The method of preparing pressure-sensitive transfer elements carrying a transfer layer having a light color but which transfers dark colored images under the effects of imaging pressure, which comprises coating a flexible foundation with a layer of transfer composition comprising a mixture of a light pigment and a heavy dark magnetic pigment dispersed in a fluid binder material, maintaining said binder material fluid and applying a magnetic force to cause the dark pigment to settle and be substantially completely masked by the color of the light pigment, and solidifying said binder material to form said pressure-sensitive transfer element.

6. The method of preparing pressure-sensitive transfer elements carrying a transfer layer having a light color but which transfers dark colored images under the effects of imaging pressure, which comprises coating a flexible foundation with a layer of transfer composition comprising a mixture of a light colored non-magnetic pigment and a heavy dark magnetic pigment dispersed in a fluid wax binder material, maintaining said wax binder material fluid and applying a magnetic force to cause the dark pigment to settle and be substantially completely masked by the color of the light pigment, and cooling said wax binder material to solidify the same and form said pressure-sensitive transfer element.

7. The method of preparing pressure-sensitive transfer elements carrying a transfer layer having a light color but which transfers dark colored images under the effects of imaging pressure, which comprises coating a flexible foundation with a layer of transfer composition comprising a mixture of a light colored non-magnetic pigment and a heavy dark magnetic pigment dispersed in a volatile solvent fluid solution of a resinous binder, maintaining said resinous binder fluid and applying a magnetic force to cause the dark pigment to settle and be substantially completely masked by the color of the light pigment, and evaporating said volatile solvent to solidify said resinous binder and form said pressure-sensitive transfer element.

8. The method of preparing pressure-sensitive transfer elements carrying a transfer layer having a light color but which transfers dark colored images under the effects of imaging pressure, which comprises coating a flexible foundation with a layer of transfer composition comprising a fluid binder material having dispersed therein a mixture of a light colored pigment which is lighter in weight than said binder material and a dark colored pigment which is heavier in weight than said binder material, maintaining said binder material fluid for a period of time sufficient to allow the dark pigment to settle and the light pigment to rise thereover and substantially completely mask the color of the dark pigment, and solidifying said binder material to form said pressure-sensitive transfer element.

9. The method of preparing pressure-sensitive transfer elements carrying a transfer layer having a light color but which transfers dark colored images under the effects of imaging pressure, which comprises coating a flexible foundation with a layer of transfer composition comprising a fluid wax binder material having dispersed therein a mixture of a light colored pigment which is lighter in weight than said wax binder material and a dark colored pigment which is heavier in weight than said wax binder material, maintaining said wax binder material fluid for a period of time sufficient to allow the dark pigment to settle and the light pigment to rise thereover and substantially completely mask the color of the dark pigment, and cooling said wax binder material to solidify the same and form said pressure-sensitive transfer element.

10. The method of preparing pressure-sensitive transfer elements carrying a transfer layer having a light color but which transfers dark colored images under the effects of

imaging pressure, which comprises coating a flexible foundation with a layer of transfer composition comprising a volatile solvent fluid solution of a resinous binder having dispersed therein a mixture of a light colored pigment which is lighter in weight than said resinous binder and a dark colored pigment which is heavier in weight than said resinous binder, maintaining said resinous binder fluid for a period of time sufficient to allow the dark pigment to settle and the light pigment to rise thereover and substantially completely mask the color of the dark pigment, and evaporating said volatile solvent to solidify said resinous binder and form said pressure-sensitive transfer element.

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