

March 20, 1951

A. E. DAVIS ET AL
MATERIAL SUITABLE FOR DECORATION BY
STAMPING AND PROCESS OF MAKING SAME
Filed Oct. 3, 1946

2,545,918

Fig. 1.

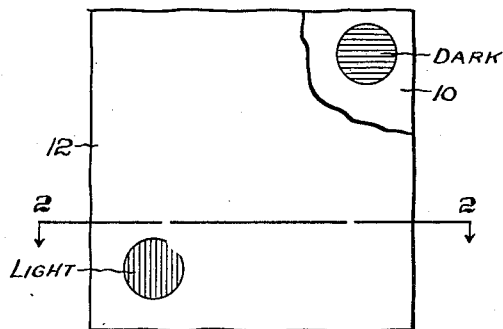


Fig. 2



Fig. 3.

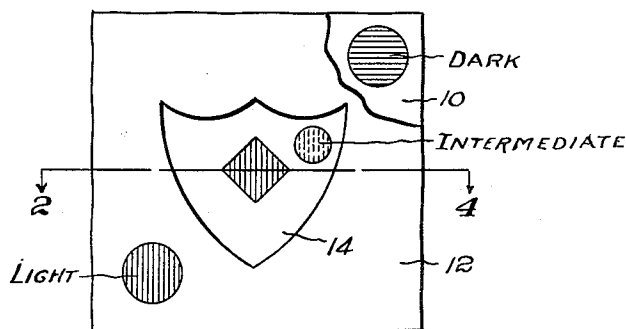


Fig. 4.



Inventors:
Austin E. Davis.
Lloyd M. Perry.
by Emory Booth, Townsend, Miller & Weidner.
Attys.

UNITED STATES PATENT OFFICE

2,545,918

MATERIAL SUITABLE FOR DECORATION BY
STAMPING AND PROCESS OF MAKING
SAMEAustin E. Davis and Lloyd M. Perry, Nashua, N. H.,
assignors to Nashua Gummed and Coated Paper
Company, Nashua, N. H., a corporation of
Massachusetts

Application October 3, 1946, Serial No. 701,042

10 Claims. (Cl. 117—16)

1

This invention relates to a material which, when operated on by what may be termed a stamping tool, such as a heated die or an embossing roll or plate, will give two-tone effects with clear definition of the impressed design and more pronounced color contrast than has hitherto been possible.

Many uncoated papers and certain pigment coated papers undergo such localized changes of texture when treated by embossing or hot stamping as to provide a noticeable degree of contrast in tone apart from the intaglio effect produced by actual impression of the die in the material with resultant localized offsetting of its surface throughout the areas of the impressed design. Manufacturers of photograph albums and binders of catalogs and advertising brochures produce attractive cover designs in this manner. The degree of contrast, however, is slight and insufficient for marked effect. Hitherto paper coaters have increased the possibility of contrast by adding to aqueous coating compositions containing the usual inorganic, infusible pigments of the coating art emulsions of wax, such, for example, as paraffin. The wax liquefies under the heat of the embossing or stamping operation and coats or partially coats the pigment particles, thus rendering the mass more transparent and consequently darker. The optical phenomenon is like that exhibited by a grease spot on paper. The effect is further enhanced by the compression which the coating undergoes in the stamped area. Best results are usually had with pigment of low refractive index. Attractive contrast effects are obtained in this manner but there is considerable demand for a higher order of contrast than has hitherto been achieved.

Such higher orders of contrast are made possible by the present invention and in fact it is possible literally to obtain the ultimate contrast of black and white.

The invention will be explained with the aid of illustrative examples in the accompanying specification. To this specification are annexed drawings which, as will be well understood, are of a quite unrealistic and diagrammatic nature and probably will be of use chiefly as a sort of graphical memorandum of the subject matter for the convenience of those who may have occasion hereafter to make use of the patent. In these drawings—

Fig. 1 is a plan view of a coated sheet of paper;

Fig. 2 is a section on the line 2—2 of Fig. 1; and

Figs. 3 and 4 are views corresponding to Figs. 1 and 2, respectively, after the stamping operation.

2

It is believed that an understanding of the invention will be facilitated by a brief sketch at this point, which should not be understood either as a complete exposition thereof or as a definition of its scope, the former being provided by the specification as a whole and the latter by the annexed claims when read and understood in the light of the specification. Briefly it may be said that a suitable base material which usually will be thin sheet material such as paper is provided with a coating ordinarily of such film-like thinness as usual in coated paper, which coating comprises a pigment, either alone or combined in significant proportion with infusible pigments of the type conventional in the arts, which because of its presence in fine discrete particles will have marked hiding power, but which, as a result of the stamping operation, will soften with resultant coalescence of the particles to provide a relatively translucent film at the areas affected.

The characteristic pigment used may in general be most advantageously selected from the field of resins, natural or synthetic. Certain materials commonly termed waxes have somewhat similar physical properties and, as distinguished from such soft waxes as paraffin, are of adequate hardness to permit their mechanical fracture into sufficiently fine discrete particles to permit their use in accordance with the principles of the invention, either alone or in combination with resins, although when used alone perhaps not so completely realizing its advantages and potentialities as the resins of which examples will herein be given.

While the improved degree of color contrast is readily appreciated by comparison of the embodiments of the invention such as those here given as examples with embodiments of the prior art as already referred to, to permit the improvement to be apprehended from a merely verbal description, such as the present specification, and for purposes of definiteness it is desirable to define procedures for determining with reasonable scientific accuracy for a given coating material the properties of significance in attaining the improved results and for evaluating them numerically. For this purpose measurements may be effected by means of a known scientific instrument for measuring the diffusive light reflectance of a given specimen in its dominant hue. The instrument utilized in obtaining the figures hereinafter given is known as a "Photovolt reflectance meter," distributed by the Will Corporation of Rochester, New York, Model 610. The reflectance in light screened in turn through red, green and blue color filters is referred to that of magnesium

oxide in similarly screened light. The "dominant hue" of a given specimen is broadly indicated by the color filter which yields the highest value for the specimen. By means of this instrument we may determine values for brightness, opacity and contrast as now to be defined.

Brightness.—This term denotes the diffusive light reflectance of a given specimen in its "dominant hue." It is expressed as the reflectance value of a specimen in light through that filter (red, green or blue) which yields the highest value, referred to the value of magnesium oxide in similarly filtered light as 100.

Opacity.—This term is expressive of the hiding value of a given composition and is measured by determining the brightness of the given composition when coated on black paper in reference to the brightness of the same composition when coated on white paper. The specific procedure in accordance with which the figures herein given were determined was the following. 85 parts (dry basis) of a given composition are mixed with 15 parts (dry basis) of binder and coated in an amount corresponding approximately to 10 pounds per ream (24" by 36"—500 sheets) (a) on black paper having a brightness of approximately 6.0 and (b) on white paper having a brightness of approximately 85.0. "Opacity" is expressed as the brightness value (a) in relation to the brightness value (b) when a value of 100 is assigned for (b).

Contrast.—This term means the relation of the brightness value of a coated specimen (a) in its areas not subjected to the stamping operation to the brightness value (b) in areas which have been so subjected. "Contrast" is expressed as the brightness value (a) in relation to the brightness value (b) when a value of 1.0 is assigned for (b).

To indicate the significance of some of the values which will be given and as a basis of comparison there is given below data on certain inorganic pigments commonly employed in paper coating:

	Bright-ness	Opac-ity
English china clay.....	58	72
Precipitated whiting.....	24.5	32.0
Yellow iron oxide.....	54.5	100

To provide a further basis of comparison, figures for brightness and contrast are given as determined from commercially obtained samples of paper designed for stamping and having colored coatings as specified on dark gray stock:

	Bright-ness	Contrast
Red.....	38.5	2.1
Green.....	12.5	1.9
Brown.....	14.5	1.9

As will appear, in accordance with the invention an opacity reasonably comparable to or better than that of English china clay may be obtained in accordance with the principles of the invention and with contrast values markedly increased as compared to the commercial examples of the prior art just referred to.

As an initial example of the invention the use of a hard wax, specifically carnauba wax, as a pigment will be described. This is not given first place because it is considered the most preferable

material, as will hereinafter appear, but because, being nominally a wax, it well illustrates the nature of the invention in contrast with the use of emulsions of soft wax in connection with the inorganic pigment coatings of the prior art. The carnauba wax herein referred to in the example was a commercial grade known as No. 3 North Country Carnauba Wax.

Example 1

	Parts by weight
Carnauba wax	100
Oxidized rosin dispersant	5
Water	150

Oxidized rosin dispersant is prepared from gum rosin which has been oxidized in a manner similar to that described by Schaal in United States Patent 698,741. The oxidized rosin is then dissolved in ammonia and water to yield a solution of approximately 43.8 solids and a pH value of approximately 9.0. The dry carnauba wax is first preliminarily ground to a fine powder and then mixed with the other ingredients and ground in a ball mill until of acceptable fineness and opacity. A product acceptable for some purposes may be obtained with about sixteen hours' grinding but continued grinding improves the product and a product of excellent fineness and opacity is obtained by grinding for five days, which represents about the optimum period. After grinding is completed, an ammoniacal solution of casein is added for a binder, which may be prepared as follows:

	Parts by weight
Lactic casein	100
Ammonia (26° Bé.)	16
Water	550

The coating material thus prepared is coated on a paper base in accordance with the usual practices of the coating art.

The following values were obtained:

Brightness	50.2
Opacity	59.7
Contrast	10.9

Referring now to the drawing, 10 represents a foundation material, such as a sheet of dark paper, and 12 a coating such as that described rendered opaque by the fine discrete particles of fusible pigment indicated in Fig. 2 by the stippling of the layer 12. Figs. 3 and 4 show a design 14 impressed thereon and the absence of stippling in the area 14 in Fig. 4 indicates the softening of the discrete particles in that area and their coalescence into a substantially amorphous film producing a contrast in color with the unchanged body of the light colored coating 4, as indicated by the legend "Intermediate" on Fig. 3 of the drawing. The change in color in such case is due partly to the altered light reflectance of the portion 14 of the coating layer itself and in part to the disclosure of the backing layer 10 because that area is now less opaque than the unaltered portion of the layer 12. The conventional lining of portions of the figures for blue, red and purple may be considered as merely indicating dark, light and intermediate shades and is not intended to represent otherwise the particular example just discussed. Such a color effect, however, is possible in accordance with the invention, as will hereinafter appear.

It will be noted that the value for opacity given in the example is due to the hiding power of the discrete particles of the wax themselves which

5

serve as the only pigment present. The case is to be distinguished from a paper having a coating formed from inorganic pigments providing a hiding power like that obtained from similar coatings in ordinary coated paper and to which a minor proportion of wax was added in emulsion form, the addition of the wax being intended not substantially to diminish such hiding power until liquefied in the stamping operation and absorbed by the infusible pigment. Moreover, emulsions prepared in accordance with the usual processes of the art do not provide in the deposited coating discrete particles of the emulsified phase of the kind herein discussed and having significant hiding power. Paraffin is of such softness that it could not be mechanically fractured to the discrete particle form effective to give opacity. At ordinary temperatures particles tend to lump together and coalesce. Commercial paraffins, moreover, being separated from the petroleum residue by crystallization, approximate pure crystalline compounds and exhibit a rather sharp melting point or short range of plastic softness.

Example 2

As another example of hard wax, figures are given which are similarly determined from a coating prepared in a similar manner from a commercial synthetic wax termed Acrawax. This is the commercial name of a modified fatty acid ester in the nature of a high melting hard wax. The particular product used was obtained from Glyco Products Company and was of the grade termed "C" by that company. Further description is not here necessary as it is offered merely as a further example of the utilization for the purposes of the invention of material which would be popularly and commercially known as wax but having sufficient hardness for the purposes of the invention. The figures are:

Brightness ----- 55.5
Opacity ----- 60.3
Contrast ----- 10.4

While useful products may be produced, as the examples given show, from substances commonly and commercially known as waxes if sufficiently hard, in general even such waxes are less desirable, at least as the sole pigment ingredient of the coating film. The temperature range wherein they are plastic may be relatively short and they approach the case of pure crystalline compounds having a definite melting point and which pass abruptly from solid to liquid phase. The purpose here is to provide a pigment having good hiding power but which under the correlative influences of the heat and pressure of the stamping tool will soften locally and coalesce into a substantially amorphous film, as manifested by greatly reduced reflectance. This may be termed a fusible material. On the other hand, if the material were meltable in the sense that it liquefied in the process, unless as in the prior art it were utilized merely as a minor ingredient subsidiary to a major proportion of infusible pigment, into the mass of which it was absorbed on melting, adequate definition of the design between the heated and unheated areas would not be obtained in commercial practice.

For this reason it is preferable to utilize either completely or in a significant proportion fusible pigments derived from materials which are commonly termed resins and which do not become sharply fluid when heated to a point of adequate softness but have a relatively wide temperature

6

range between the hard solid state and the liquid state. Such resinous materials may be chosen from those resins which can be reduced to adequate fineness and which are hard enough at room temperature so that they will not tend to re-coalesce when ground. Below are data on brightness, opacity and contrast of some typical resinous materials prepared in the manner already described with 10-pound coatings on standard black paper, with opacity reference on standard white paper:

Examples 3, 4 and 5

		Bright- ness	Opacity	Contrast
15				
3	Pentalyn G.....	61.0	74.4	11.5
4	Aroclor 5460.....	54.0	66	10.8
5	Nevindene.....	63.0	73.2	12.0

Pentalyn G is a pentaerythritol-abietate resin; Aroclor 5460 is a chlorinated diphenyl resin, and Nevindene is an indene resin. The commercial names are given not only because more convenient, but because the figures given are based on the particular commercial products so identified. As resins are not pure crystalline compounds, clearly coatings prepared from substantially similar resins of different commercial origin might yield specifically different figures although of like general magnitude. The examples indicate the general range of results to be obtained from a resin judiciously chose in the light of the present specification.

The value of such fusible pigments in securing opacity is dependent on their being suitably ground. For instance, Nevindene R3, ground 24 hours, has an opacity of 59.0. When grinding is continued to 144 hours, as in Example 5, this opacity is increased to 73.2, by grinding for 168 hours to 76.3. Similarly, Pentalyn G, ground 16 hours, has a opacity of 45.8; with grinding continued to 144 hours it has an opacity of 74.4

Darker colored resinous materials and dark waxes may be usefully employed. For instance, black montan wax may be prepared as in Example 1 and produces in the unheated coated areas a gray tan shade. Vinsol resin (a pine wood resin having an acid number of 92, a drop melting point of 119° C., a saponification value of 150 and 6.5% of unsaponifiable matter) yields a light yellow shade. This latter is prepared by grinding in a dilute aqueous solution of methyl cellulose since the resin is soluble in ammonia. Supplemental amounts of methyl cellulose may be added as required for adequate binding of the dried coating. Below are data on brightness, opacity and contrast for these two materials:

Examples 6 and 7

		Bright- ness	Opacity	Contrast
60				
6	Black montan wax.....	33.5	64.5	6.1
7	Vinsol resin.....	44.5	72.7	8.0

The fusible resinous pigments of Examples 3, 4 and 5 are light in color, generally white in the coated areas that have not been heated or compressed. To provide darker tints or full colors coloring material may be added. Infusible pigments of the types used in paper coating may be used and in considerable proportion providing a substantial proportion of the total pigment particles present are of the fusible type herein de-

scribed. By that proportion in which opaque fusible pigment replaces infusible pigment will the resultant contrast be improved since, on embossing or stamping, this opaque fusible pigment portion is rendered translucent to diminish, according to its proportion, the opacity of the entire coating in the embossed or stamped area. A significant proportion may be considered twenty-five percent of the total pigment present which would permit tone variation desirable in some applications. In general the proportion of fusible particles is desirably greater and for commercial purposes they preferably constitute the major portion of the pigment present. Full colors as well as tints may be produced in the unheated or uncompressed coated areas with the employment of 90% or more of the pigment which consists of fusible particles as herein described. While a wide range of colored non-fusible pigments may be effectively employed with this high proportion of fusible pigments when tints are desired, organic pigments of the so-called toner strength are most effective in producing full colors. Below are given examples for red, blue and green colors:

Example 8 (Red)

	Parts by weight
Lithol Red toner (color)	5.0
Pentalyn G resin (resinous fusible pigment)	52.0
Acrawax C (waxy fusible pigment)	20.0
Lactic casein (binder)	23.0

Toner, Pentalyn G and Acrawax C, dry ground, are mixed with five parts of 43.8% "oxidized rosin dispersant" and 116 parts of water. Ammonia is added to maintain a pH of approximately 9.0 and the composition is then ground for four days in a ball mill. The 23 dry parts of casein, prepared as a 15% ammoniacal solution with a pH of approximately 9.0, are then added to the ball mill ground dispersion. The proportion of casein is greater than hitherto indicated to render the strongly colored composition more resistant to bleeding in water when coated.

Example 9 (Green)

	Parts by weight
Hansa Yellow toner (color)	2.0
Monastral Blue toner (color)	2.5
Black iron oxide (non-fusible pigment)	0.5
Pentalyn G resin (resinous fusible pigment)	52
Acrawax C (waxy fusible pigment)	20
Lactic casein (binder)	23

This composition is prepared in a manner similar to that of Example 8.

Example 10 (Brown)

	Parts by weight
Lithol Red toner (color)	1.4
Hansa Yellow toner (color)	2.8
Black iron oxide (color)	2.1
Pentalyn G resin (resinous fusible pigment)	51.2
Acrawax C (waxy fusible pigment)	19.5
Lactic casein (binder)	23.0

This composition is prepared in a manner similar to that of Example 8.

Brightness, opacity and contrast data, with coated specimens prepared in a manner similar

to those of Example 1, except for the higher proportion of binder employed, are here given:

	Brightness	Opacity	Contrast
Example 8 (Red)	51.5	67.3	6.9
Example 9 (Green)	14.0	82.3	3.1
Example 10 (Brown)	29.0	100	5.3

These figures may be compared with those above given for commercial red, green and brown coatings of the prior art.

In Examples 8, 9 and 10 the pigment, apart from the small amount of color-giving material, consists of two fusible components each of which initially exists in independent, finely divided form, the two being in intimate mechanical mixture and each component being significant in its contribution to hiding power. In the stamping operation they merge and coalesce into a substantially amorphous film of low reflectance. Whether the individual particles are superficially softened and weld together or whether a merger occurs or both phenomena are present, it is unnecessary to speculate. The individuality of the particles is to such an extent lost that their hiding power is substantially eliminated and a film of low reflectance takes their place. The heterogeneous mixture acts for the purposes of the invention as a material exhibiting a wide range of plastic softening without objectionable liquefaction which would interfere with proper definition of the design or development of objectionable stickiness either during the stamping operation or in the finished work.

Reference has been made to opacity as due to fineness of the discrete pigment particles to be secured by adequate grinding. In a sense the opacity of the coating measures the fineness of the particles. In general the opacity should be as good as that of a coating of similar weight of precipitated whiting which may be considered as a standard of substantial opacity as referred to in the claims. As the examples show, greater opacity, of the order of that provided by English china clay, may be obtained and is to be recommended. An opacity of less than 50 as determined by the procedures herein described should, except for special applications, be considered an unnecessarily inefficient application of the principles of the invention.

An important feature of the invention is the uniformity with which coatings of a desired character may be prepared. It therefore finds a desirable application even when the contrasts desired are not so great as here described. A formula being established, material may be prepared therefrom at any time from the same materials under easily controlled identical conditions to produce uniformly like results in use.

In referring to the particles of fusible pigment as "hard," reference is made to the fact that they retain their form and individuality without any substantial tendency to re-coalesce during their preparation or at ordinary temperatures to which the product is subjected during shipment or storage, while reference to a resin or wax as "hard" implies the possibility of reducing it to such hard discrete particles by mechanical fracture.

The reference to the material as "hard" indicates also that it is not plastically responsive at room temperatures in the absence of substantial pressure and that its melting point is ade-

quately high. On the other hand, it should have a plastic response permitting coalescence of the particles under practical values for the correlative temperature and pressure of the stamping tool. Obviously if the coating is on paper a red hot iron which would burn the paper would not be used.

The paper or similar base may itself be dyed or filled or a first colored coating with infusible pigments may be applied thereto. Such materials as textile fabrics, metal foil, organic foils, glassine paper and the like are equivalent to paper and such thin base materials may be mounted on press board or the like, the mounted material being stamped as a unit as in the production of book covers.

Reference has been made to the stamped design as a decoration which will be understood to include designs such as printed letters or other characters having primarily an intellectual rather than a purely aesthetic appeal.

We claim:

1. As a new article of manufacture a material for decoration by stamping to produce two tone effects comprising a base material having adherent thereover a pigmented film of substantial opacity, at least a quarter of the pigment therein consisting of hard discrete particles of comminuted material which is fusible in the sense that it will plastically respond to the heat and pressure of the stamping tool with resultant localized coalescence of the softened particles to provide diminished reflectance in the treated area.

2. As a new article of manufacture a material for decoration by stamping to produce two tone effects comprising a base material having adherent thereover a pigmented film of substantial opacity, the major portion of the pigment therein consisting of hard discrete particles of comminuted material which is fusible in the sense that it will plastically respond to the heat and pressure of the stamping tool with resultant localized coalescence of the softened particles to provide diminished reflectance in the treated area.

3. As a new article of manufacture a material for decoration by stamping to produce two tone effects comprising a base material having adherent thereover a film containing fine discrete particles providing substantial opacity and including a significant proportion of hard comminuted resin which is fusible in the sense that it will plastically respond to the heat and pressure of the stamping tool with resultant localized coalescence of the resin particles to provide diminished reflectance in the treated area.

4. As a new article of manufacture a material for decoration by stamping to produce two tone effects comprising a base material having adherent thereover a film containing fine discrete particles providing substantial opacity and including a significant proportion of hard comminuted wax which is fusible in the sense that it will plastically respond to the heat and pressure of the stamping tool with resultant localized coalescence of the wax particles to provide diminished reflectance in the treated area.

5. As a new article of manufacture a material for decoration by stamping to produce two tone effects comprising a base material having adherent thereover a film containing fine discrete particles providing substantial opacity and comprising in major proportion an intimate mixture of two fusible components, one of which is a hard comminuted resin, the heterogeneous mixture softening without apparent liquefaction through-

out a wide temperature range under the correlative heat and pressure of the stamping tool substantially to merge the individuality of the particles into a coherent film of markedly reduced reflectance corresponding to the treated area.

6. As a new article of manufacture a material for decoration by stamping to produce two tone effects comprising a base material having adherent thereover a film containing fine discrete particles providing substantial opacity and comprising in major proportion an intimate mixture of two fusible components, one of which is a hard comminuted resin and the other a hard comminuted wax, the mixture softening under the correlative heat and pressure of the stamping tool substantially to merge the particles with loss of individuality into a coherent film of markedly reduced reflectance corresponding to the treated area.

7. As a new article of manufacture a material for decoration by stamping to produce two tone effects comprising a base material having adherent thereover a film containing fine discrete particles providing substantial opacity and comprising infusible pigment particles zero to 25%, the balance of the discrete particles comprising comminuted hard resin 10% to 100% of said balance and any remainder comminuted hard wax, the wax and resin being of a fusible character as manifested by their plastic response to the correlative heat and pressure of the stamping tool with resultant localized coalescence of the fusible particles to provide diminished reflectance in the treated area without apparent liquefaction or development of stickiness.

8. As a new article of manufacture a material for decoration by stamping to produce two tone effects comprising a base material having adherent thereover a film containing fine discrete particles providing substantial opacity and comprising infusible pigment particles zero to 25%, the balance of the discrete particles comprising a significant proportion of comminuted hard resin and the rest hard fusible material which together with the resin softens without apparent liquefaction throughout a wide temperature range under the correlative heat and pressure of the stamping tool substantially to merge the individuality of the particles into a coherent film of markedly reduced reflectance corresponding to the treated area.

9. The process of manufacturing a material for decoration by stamping to produce two tone effects which comprises mechanically grinding into discrete particles of a predetermined order of fineness effective to lend substantial opacity to the film hereinafter referred to as hard pigment which is fusible in the sense that it will respond plastically to the heat and pressure of a stamping with resultant localized coalescence of adjacent particles, incorporating such pigment particles in a pigmented coating composition in which they represent at least a quarter of the pigment present and coating the mixture as a thin film on a base material.

10. The process of manufacturing a material for decoration by stamping to produce two tone effects which comprises mechanically grinding into discrete particles of a predetermined order of fineness effective to lend substantial opacity to the film hereinafter referred to at least two hard pigments, one of which is a hard resin, and which have the characterizing property of softening without apparent liquefaction throughout a wide temperature range under the correlative

11

heat and pressure of the stamping tool substantially to merge the individuality of the particles into a coherent film of markedly reduced reflectance, incorporating such pigment particles in intimate mixture in a pigmented coating composition in which they represent at least 25% of the pigment present and coating the mixture as a thin film on a base material.

AUSTIN E. DAVIS.

LLOYD M. PERRY. 10

REFERENCES CITED

The following references are of record in the file of this patent:

12

UNITED STATES PATENTS

Number	Name	Date
221,277	Birnbaum	Nov. 4, 1879
2,059,465	Kress et al.	Nov. 3, 1936
2,065,925	Overton et al.	Dec. 29, 1936
2,117,256	Rafton	May 10, 1938
2,158,560	Bezenberger	May 16, 1939
2,190,843	Mitter	Feb. 20, 1940
2,281,837	Ford	May 5, 1942
2,292,518	Helfrich	Aug. 11, 1942