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PROCESS FOR MAKING A STENCIL SCREEN COATING AND COMPOSITION THEREFOR

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This invention relates to a stencil screen and, more particularly, to a coating for use in filling the voids of a stencil screen whereby portions of the coating are subsequently removed according to photographic methods to form a preselected pattern of voids on the screen. This application is a continuation-in-part of co-pending application Serial No. 721,336, filed March 14, 1958.

In the production of stencil screens, gelatin has been widely used as a coating therefor because of its ready availability and low cost. The gelatin is first dissolved in hot water and a light-sensitizing agent and a coloring dye are added to the solution. The purpose of the dye is to make the composition more visible so that the ultimate user of the screen can readily perceive which portion of the screen is coated therewith. The viscous gelatin solution is then coated onto a fine mesh screen, either by applying the viscous mass with a squeegee, or by immersing the screen while flat in a shallow pan containing some of the composition so that the composition will just penetrate the interstices of the screen so as to surround them and provide a physical bond to the screen.

The light-sensitizing agent enables a photographic process to be used in converting the coated screen into a stencil outlining the desired pattern. A film in the nature of an opaque positive of the desired decoration or printing is placed over the fine mesh screen coated with the light-sensitized composition, and this assembly is exposed to a light source, such as an arc lamp. The arrangement is such that the light issuing therefrom will pass through the negative and contact the coated screen at those areas outlined by the transparent portion of the negative. The light contacted composition is converted to a state of water insolubility, whereas the portion of the composition which is not contacted by light remains water soluble.

The coated screen is then given a mild wash with water to remove the water soluble portion and thereby yield the final stencil which bears a coating outlining the desired decoration or printing. The portion of the screen bearing the water-insoluble coating composition has its interstices filled with this composition so that the decorating material, such as a printing ink, paint, vitreous enamel, glaze, or "color" will not pass therethrough.

Stencil screens so produced are conveniently used to apply color or printing to a substrate such as glassware, e.g., bottles, tumblers, and the like. The stencil held in a frame is brought into contacting relationship with a tumbler or bottle held in a chuck. Decorating medium or color on the screen is then forced through the unfilled interstices of the stencil screen by a squeegee onto the underlying surface in the desired pattern. After either the stencil or the bottle is retracted so as to be separated from contact with the other, the bottle or tumbler passes into an oven for making, in the case of heat-hardenable material.

Heat, of course, is not always necessary, inasmuch as cold colors have been developed which will harden quickly under ambient conditions. The application of the decoration as described is preferably accomplished by automatic equipment. The rigorous service conditions to which the stencils are exposed by such equipment frequently cause the stencil screen to crack, necessitating the shut-down of the machines for substitution of new screens therein. Even if no cracking occurs, the stencil screens wear out due to degradation of the coating.

In an effort to enhance the life of these screens, the art has resorted to several modifications. In one embodiment, the screen which has been coated with the gelatin composition in the desired pattern, and dried (as described above) is dipped into a glycerin bath. The glycerin adheres to the coated stencil screen, and the screen is then again dried. The glycerin overcoat is found to impart a slight increase in strength to the coating and, consequently, slightly longer life to the stencil in the automatic equipment. Another embodiment which has been utilized involves the inclusion of glycerin in the melted gelatin solution. Glycerin, being water soluble, readily goes into solution with the water containing the melted gelatin. It has been found that this also slightly upgrades the coating concentration, thereby increasing the life of the screen formed therefrom. Unfortunately, neither of the above embodiments is so advantageous that it really justifies the expense of the modification. Thus, the coating of the stencil screen with glycerin involves an extra step in the manufacture of the screens and consequently increases the cost. Further, the cost of the glycerin itself adds to the expense of the ultimate screen.

Accordingly, it is an object of the present invention to provide an improved stencil screen masking composition which permits the production of a stencil screen possessed of longer life than those known heretofore.

It is another object of this invention to provide such a stencil screen coating composition which is relatively inexpensive, can be produced by a relatively simple process, and yet yields a stencil screen of improved quality.

It is yet another object of this invention to provide a stencil screen composition which, by reason of its greater strength and consequent longer life, materially reduces the "down" time for the automatic equipment used in applying decorations to a substrate.

It is still another object of this invention to provide a composition which is tougher and less apt to crack under rigorous service conditions encountered with automatic color decorating and printing machines.

The above and many other objects, features, and advantages of the present invention will become apparent to those skilled in the art from the following detailed description and the examples set forth below, in which reference will be had to several preferred embodiments.

Basically, the present invention is predicated upon the discovery that an improved gelatinous stencil screen masking composition may be produced by including in the aqueous solution of gelatin an ester of an aliphatic carboxylic acid including, for example, the alkyl esters of malonic, succinic, glutaric, adipic, pimelic, suberic, azelaic, sebacic, oleic, linoleic, linolenic, and eleostearic acids, wherein the alkyls are straight chain or branched and contain from 2 to 10 carbon atoms. Each carboxyl group of the acid has an alkyl radical attached thereto.

The following examples are merely illustrative of the invention.

Example I

An improved stencil screen composition of the present invention was prepared according to the following formulation:

1000 cc. water
230 grams sheet gelatin
250 cc. (217 grams) butyl oleate (weight calculated using density of 0.868 gm./ml.)
12 grams of a blue paste dye (Monastral—Fast Blue "BFP"
20 grams sodium bichromate

The above ingredients were combined in the following manner: 100 cc. of water at a temperature of 180° F. was poured into a glue pot. The dye and gelatin were added, and the mixture heated to about 175° F. The

heat was maintained until the gelatin had gone into solution (about 30 minutes). Next, the butyl oleate was added to the solution and the mixture stirred. In a separate container, the sodium bichromate was dissolved in 400 cc. of hot water, and this solution was poured into the gelatin solution and mixed until blended. This took about three minutes. Next, hot water was run through a colloid mill to bring the mill up to the same temperature as the previously prepared mixture, e.g., about 175° F. When the mill was thus warmed, the gelatinous mixture was run through the mill five times in order to more or less homogenize the ingredients. The completely mixed composition was then strained through a 165 mesh stainless steel screen into a shallow pan maintained at about 140° F. It was allowed to set for about five minutes to allow air bubbles to rise to the surface of the liquid. The exposed surface of the liquid was then scraped to remove the bubbles so that the screen could be "floated." To float a screen, it is held in a horizontal position and immersed in the composition so that the top surface is just covered by the liquid composition. When it is lifted slowly therefrom, the bottom side of the screen will be found to be more heavily coated than the top side. The composition just penetrates the interstices of the screen as described hereinbefore to insure its being retained thereby. The coated screen was then dried in a darkroom, after which an opaque positive film of the desired design, in which the ultimately desired printing or lettering corresponds to the opaque part of the film and the remaining areas thereof are translucent so as to permit transmission of light therethrough, was placed over the screen, and the assembly exposed for about one minute to light issuing from an arc lamp located on the film side of the assembly. The portion of the composition contacted by light is converted thereby to a cured state which is insoluble in water. The screen was given a mild wash with warm water, whereupon the portion of the coated screen which had not been exposed to light washed away, leaving the stencil screen bearing a water insoluble coating which outlined the desired decoration, printing, or the like. This stencil screen was found to be extremely tough as compared to the conventional gelatin screens or to the gelatin screens which had been modified by overcoating with glycerin or combining glycerin with the melted gelatin in the formulation thereof. The stencil screen was not subject to cracking, and was capable of undergoing a substantially greater number of cycles in automatic decorating equipment without material degradation.

Example II

An improved stencil screen coating composition of the invention was prepared according to the same formulation and in the same manner as described in connection with Example I, except that 250 cc. of di-2 ethylhexyl adipate (242 grams calculated using density of 0.927 gm./ml.) was substituted for the 250 cc. of butyl oleate. It was found that the composition yielded a stencil screen which was possessed of the same desirable qualities as the stencil produced according to Example I, e.g., longer life, tougher, non-cracking, and, at the same time, relatively inexpensive.

Example III

Following the aforesaid procedure, 25 gm. of solid granular gelatin, technical grade, was dissolved in 100 gm. of water. To this was added 1 gm. of solid Monastral Blue dye and 4 gm. of potassium dichromate light sensitizer. This solution was combined with 25 gm. of diethyl adipate and blended for 5 min. The resulting solution was applied to a stencil screen and exposed by an arc lamp. The image produced was clear and sharp, and the stencil screen produced had the same desirable qualities as in Examples I and II.

Example IV

Again following the aforesaid procedure, 25 gms. of solid granular gelatin, technical grade, was dissolved in 100 gm. of water. To this was added 1 gm. of solid Monastral Blue dye and 4 gm. of potassium dichromate light sensitizer. This solution was combined with 25 gm. of di-2-ethylhexyl adipate and blended for 5 min. The resulting solution was applied to a stencil screen and exposed by an arc lamp. The image produced was clear and sharp, and the stencil screen produced had the same desirable qualities as in the aforesaid examples.

In order to achieve the optimum combination of the desirable characteristics mentioned, it is preferred that the aliphatic carboxylic acid ester be present in the composition in about equal weight proportion with respect to the gelatin.

However, tests have shown that the gelatin may be present in amounts of from 33 to 80 parts by weight and the carboxylic acid ester may be present in amounts of from 67 to 20 parts by weight, based upon the combined weight of the gelatin and the ester.

Exactly why the modification of gelatin by the inclusion of an alkyl ester of a carboxylic acid, such as butyl oleate, di-2-ethylhexyl adipate, di-ethyl adipate and the like advantageously improves the properties in the manner described is not known. However, and although it is not intended to be bound by any theory expressed herein, it is possible that these materials, although being water insoluble (whereas glycerin is water soluble), contribute an internal physical plasticization and thus lend to the final composition a resiliency which is reflected in the improved service performance of the stencil screens.

Other light-sensitizing agents than sodium bichromate may, of course, be used in forming the masking compositions of this invention. Thus, any of the conventional light-sensitizing agents (essentially oxidizing materials) may be used, although the dichromates of potassium, sodium, and/or ammonium are preferred.

The composition of this invention may be applied to metallic wire screens or to silk nylon screens with equal facility. Where applied to wire, the composition may be removed by burning it off with flame, thus permitting the wire screen to be salvaged and reused, if desired. For nylon or silk screens, a solution of bleach such as hypochlorite is conveniently used to remove the composition.

While there have been disclosed certain preferred embodiments of the invention, it is not thereby desired or intended to be limited solely thereto, for the precise proportions of the materials utilized may be varied and equivalent chemical materials may be employed, if desired, without departing from the spirit and scope of the invention as defined in the appended claims.

Having fully described the invention, what is claimed is:

1. A stencil screen comprising a screen base and a coating on said screen base, said coating filling the voids of the said stencil screen and wherein subsequently portions of said coating are removed according to photographic methods in order to form a preselected pattern on said screen, said coating comprising an aqueous mixture of (*a*) gelatin, (*b*) a light-sensitizing agent to permit photographic method production of the design pattern, and (*c*) a member selected from the group consisting of the alkyl esters of malonic, succinic, glutaric, adipic, pimelic, suberic, azelaic, sebacic, oleic, linoleic, linolenic and eleostearic acids, said alkyl containing from 2 to 10 carbon atoms, and the amount of (*a*) being from 33 to 80 parts by weight based on the combined weight of (*a*) and (*c*).

2. A stencil screen as defined in claim 1 wherein the alkyl ester is di-2-ethylhexyl adipate.

3. A stencil screen as defined in claim 1 wherein the alkyl ester is butyl oleate.

4. A stencil screen as defined in claim 1 wherein the alkyl ester is diethyl adipate.

5. A stencil screen comprising a screen base and a coating on said base, said coating filling the voids of the

said stencil screen and wherein subsequently portions of the coating are removed according to photographic methods to form a preselected pattern of voids on said screen, said coating composition comprising an aqueous mixture of (*a*) gelatin, (*b*) a light-sensitizing agent to permit photographic method production of the desired pattern, and (*c*) a member selected from the group consisting of the alkyl esters of malonic, succinic, glutaric, adipic, pimelic, suberic, azelaic, sebacic, oleic, linoleic, linolenic and eleostearic acids, said alkyl containing from 2 to 10 carbon atoms, and the amount of alkyl ester to said gelatin being substantially equal by weight.

6. A stencil screen as defined in claim 5 wherein the alkyl ester is di-2-ethylhexyl adipate.

7. The stencil screen as defined in claim 5 wherein the alkyl ester is butyl oleate.

8. The stencil screen as defined in claim 5 wherein the alkyl ester is diethyl adipate.

9. The stencil screen comprising a base and a coating on said base, said coating filling the voids of said stencil screen and wherein subsequently portions of the coating are removed according to photographic methods of production to form a preselected pattern of voids on said screen, said coating comprising:

	G.
Water	1000
Gelatin	230
Butyl oleate	217
Dye	12
Dichromate light-sensitizing agent	20

10. The stencil screen comprising a base and a coating on said base, said coating filling the voids of said stencil screen and wherein subsequently portions of the coating are removed according to photographic methods of production to form a preselected pattern of voids on said screen, said coating comprising:

	G.
Water	1000
Gelatin	230
Di-2-ethylhexyl adipate	242
Dye	12
Dichromate light-sensitizing agent	20

11. In the method of forming a preselected pattern of

voids on a stencil screen comprising the steps of filling the voids of said stencil screen with a coating of an aqueous mixture of gelatin and a light sensitizing agent, drying said coating on said screen, placing an image containing member having transparent and non-transparent portions before said screen, exposing said screen to a light passing through said transparent portion of said image containing member, that portion of the gelatin coating in said voids of said screen contacted by said light being rendered water insoluble, the remainder of said gelatin coating on said screen remaining water soluble, and washing said screen to remove said water soluble portion of said gelatin coating, said voids containing said water insoluble coating thus defining a pattern of the configuration of the transparent portion of said image containing member, the improvement whereby said aqueous mixture of gelatin and a light sensitizing agent contains a member selected from the group consisting of alkyl esters of malonic, succinic, glutaric, adipic, pimelic, suberic, azelaic, sebacic, oleic, linoleic, linolenic, and eleostearic acids, said alkyl containing from 2 to 10 carbon atoms, and the amount of gelatin being from 33 to 80 parts by weight based on the combined weight of gelatin and alkyl ester.

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