June 22, 1954 H. G. ROGERS 2,681,857

PROCESS FOR MAKING A PHOTOGRAPHIC COLOR SCREEN

Filed Sept. 3, 1949

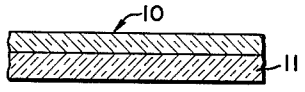


FIG. 1

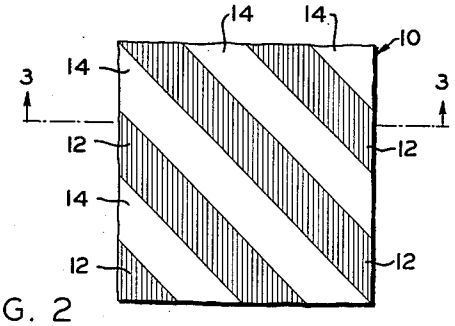


FIG. 2

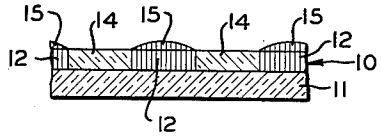


FIG. 3

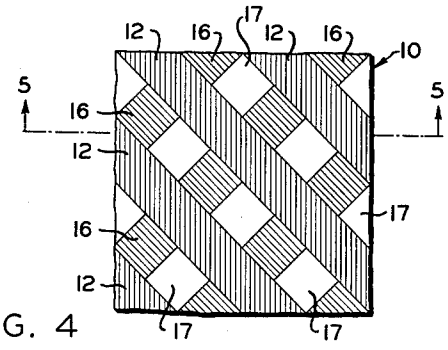


FIG. 4

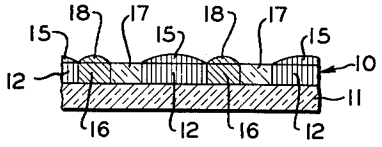


FIG. 5

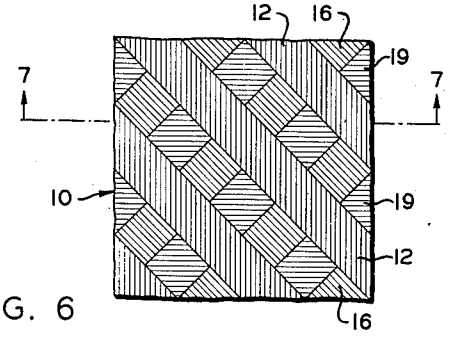


FIG. 6

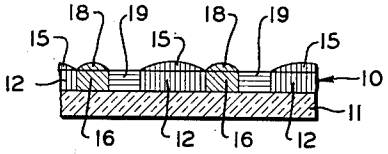


FIG. 7

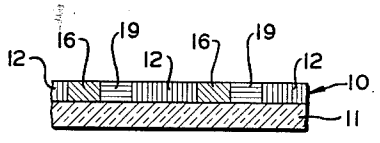


FIG. 8

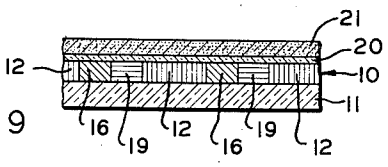


FIG. 9

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PROCESS FOR MAKING A PHOTOGRAPHIC COLOR SCREEN

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Application September 3, 1949, Serial No. 113,994

2 Claims. (Cl. 95—81.5)

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This invention relates to the art of color photography and more especially has reference to color screens useful in said art and to methods for making such screens.

An important object of the invention is the provision of methods for making color screens of the character having a plurality of sets of colored elements providing a screen pattern with the elements of each set being of the same color but different in color from the elements in any other set by practices which greatly reduce the processing steps heretofore required to produce such screens and which provide products of good quality at great simplicity and consequent low cost.

Other objects of the invention are the provision of methods of the character described which comprise successively applying differently colored printing compositions on separated areas of a transparent layer as by printing or flowing said compositions onto said layer to form sets of differently colored screen elements and providing over each area colored by a printing composition, at least with respect to the areas providing the first formed set of screen elements, a protective mask or seal of an agent or material which is relatively impermeable to and which may be nonwettable by subsequently applied printing compositions employed to print the remaining screen elements adapted to complete the screen pattern; and especially to provide processes wherein the printing compositions are colored with dyes, wherein the dyes are penetrated into said layer and wherein the protective agent is contained in the printing composition or the protective agent is applied over a screen element after the formation thereof; as well as to provide color screen forming processes which are simplified by the elimination of dye bleaching steps.

A further object of the invention is the provision of a color screen employing novel materials and especially a color screen having a transparent layer in which the coloring matter of the colored elements is penetrated into the surface of the layer and may extend above the surface of the layer in a material which is relatively impermeable to and which may be nonwettable by various printing compositions useful for forming screen elements of the screen pattern.

These and other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the product possessing the features, properties and the relation of components and the process involving the several steps and the relation and the

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order of one or more of such steps with respect to each of the others which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings wherein:

Figure 1 is a diagrammatic sectional view through a color screen structure or unit which is in an unprinted condition;

Figs. 2 and 3 are, respectively, a diagrammatic plan view, and a diagrammatic sectional view of a color screen structure like that of Fig. 1 after it has been processed to provide a first set of colored elements which form a screen pattern, the section for Fig. 3 being taken on the line 2—2 of Fig. 2;

Figs. 4 and 5 are views, respectively, similar to Figs. 2 and 3 and show the screen structure after it has been processed to provide the second set of colored elements;

Figs. 6 and 7 are views, respectively, similar to Figs. 2 and 3 after the screen structure has been processed to provide the third set of colored elements which make up the screen pattern;

Fig. 8 is a diagrammatic sectional view similar to Fig. 7 but with the residues of printing compositions removed from the surface of the screen layer; and

Fig. 9 is a diagrammatic sectional view showing a photosensitive emulsion mounted on the screen structure of Fig. 8.

One type of additive color photographic process is carried out with a color screen or color plate having a screen pattern formed of a plurality of light-transmitting, colored elements which are each of an individual primary color and which are classifiable into different groups in accordance with color. Thus, a three-color screen has a set or group of red elements, a set of blue elements and a set of green elements. These elements may be arranged in a mosaic or in a geometrical pattern. Color screens heretofore employed either possess certain inherent defects in themselves or in the processing by which they are produced.

For example, the mosaic type of screen or plate, which is well exemplified by the so-called Autochrome plate of Lumière, inherently possesses a spotty appearance created by the presence in relatively large and separated areas of the screen of a predominance of one primary color

over the other primary colors employed in the screen pattern. The mosaic screen is formed of a mixture of light-transmitting but colored granular particles of similar size which are spread over and adhered to the surface of a transparent support in a single layer one particle thick and with the particles in contact with each other. While this mixture may be made up of equal quantities of red particles, blue particles and green particles, it may be statistically demonstrated that many contiguous unit areas formed by the distribution of this mixture over the support surface will all have a preponderance of particles of one color with the obvious result of causing the objectionable spotty appearance just noted and consequent lack of color balance.

It is possible to produce a geometrical screen by ruling or by photographic methods. However, either of these procedures is cumbersome for mass production.

An additive process which has received considerable recognition is the so-called Dufay process. In the Dufay process a geometrical screen pattern of differently colored screen elements is formed on a support by procedures which employ mechanical printing steps. While screens of this character possess good color balance, they inherently require a great number of processing steps to provide the finshed product and possess the relative high cost inevitable to complexity of production. For example, at least nine separate steps are needed to produce a screen of the Dufay type. These steps comprise dyeing a transparent support layer all over with a dye of a desired color, then printing a set of lines on the layer with a greasy ink, following which the layer is bleached and the bleached portions are dyed with a second dye, after which the greasy ink is removed and another set of element lines are printed with another greasy ink, which operation is followed by another bleaching operation and another dyeing operation, and is concluded by removal of the last-printed greasy ink.

The present invention is designed to simplify the art of making color screens while providing products having excellent color balance by practices involving as few as three and not more than from four to six operations for producing a three-color screen. As a concept, the invention intends to form sets of differently colored screen elements to cover the entire surface area of a screen layer or support without gaps between elements and without overlapping of elements by the successive application to the screen layer of differently colored printing compositions or inks. The screen elements may be of any shape, irregular or geometrical.

The printing compositions employed by the invention may be designed to penetrate or carry their color into the screen layer and to leave a residue or deposit on the layer over the surface area which they penetrate. The material which forms such a residue or deposit may be impenetrable, at least, by the next successively applied printing composition whereby the material provides a protective mask. On the other hand, the material of a residue may be penetrable by a subsequently applied printing composition. In the latter event, a protective agent possessing a suitable impenetrability may be coated onto the masking residue.

By this invention one manner of forming a color screen employs a layer of a transparent material which may be penetrated by liquid printing compositions containing coloring matter or dye of a character which is substantive to the material of the layer whereby the colored elements providing the screen pattern may be formed. Organic plastics, especially cellulosic materials, may be employed for the screen layer. Cellulose acetate hydrogen phthalate and cellulose nitrate may be named as preferred plastics for use in forming the screen layer. Basic dyes, a preferred coloring matter for the printing compositions, are highly substantive to the preferred screen layer materials.

The screen layer, if desired, may be carried upon a transparent support which may also comprise a cellulosic material, for example, cellulose acetate of cellulose acetate butyrate. Fig. 1 of the drawings shows the last-mentioned type of the screen structure and comprises a screen layer 10 of cellulose acetate hydrogen phthalate coated on a support 11 of cellulose acetate.

The process of the invention is carried out by printing on the exposed surface of the screen layer 10, i. e., that surface most distant from the support 11, to form a plurality of sets of colored elements. Application of the printing composition is by contact with the surface of screen layer 10. The printing composition may comprise a dye in a carrier, such as a solvent, which is able to penetrate into the screen layer as by permeating into the layer or by swelling the material of said layer. Penetration of the carrier into the screen layer is utilized to carry the dye or other colored substance into the layer and below the contacted surface thereof.

The printing composition is also adapted to contain an agent which will not penetrate the material of the screen layer and which also serves the function of increasing the viscosity of the printing composition whereby to facilitate the application thereof from a printing roll. With such a printing composition, a deposit or residue, comprising the material which has not penetrated into the layer, will be formed upon the screen layer.

A residue-forming material of the character just noted may of itself be relatively impermeable to printing compositions brought into contact with the layer after formation of the residue whereby dye, penetrated into the layer and covered by the residue, is protected against the action of subsequently applied printing compositions. Instead, the material adapted to form the masking residue may also be of such character that subsequently applied printing compositions may penetrate the mask and contact the screen element which this mask covers. In this latter case, an agent to which a later applied printing composition is impermeable may be coated on a masking residue so that adulteration or dilution of a dye thereunder will be prevented. From the standpoint of simplicity of processing, it is of course desirable to include in a printing composition a residue-forming material which is impermeable to subsequently applied printing compositions. In any event, these practices result in providing a protective mask over a surface area through which a dye has penetrated into the screen layer.

Residue-forming materials which are incorporated in the printing compositions are selected from compounds having molecules so large that it is impossible for these molecules to pass into the screen layer material. Long chain plastics meet this requirement as to molecule size and in addition may be selected for their property

of forming a coating or seal which is resistant to other printing compositions used in processing.

These residue-forming materials should be soluble or dispersable, i. e., compatible, in the carrier for the dye or other coloring matter of the printing compositions or they should be soluble in a solvent which is itself compatible with said carrier. The dye or colored substance of a printing composition will be introduced into the screen layer at areas or portions thereof contacted by the printing composition whereas the residue-forming material in said composition will be deposited on the surface of such portions and, upon evaporation or drying of solvent or carrier therefore, will provide the desired deposit which, if suitably impermeable, is in the nature of a protective mask.

A residue-forming material which is also a protective agent, in that it is relatively impermeable to water and to alcohol, is that known under the trade name of Acryloid A–10. This material is an acrylic resin solution containing about 30% solids in 2-ethoxyethyl acetate, commonly known as Cellosolve acetate

$$(CH_3COOCH_2CH_2OC_2H_5)$$

A similar type of residue-forming material and protective agent which is relatively impermeable to simple alcohols is a highly hydrolyzed polyvinyl alcohol. Polyvinyl alcohol suitable for this purpose is around 99% hydrolyzed and one example thereof is that marketed by the R & H Division of E. I. du Pont de Nemours & Company under the designation RH–391.

Acryloid A–10 and polyvinyl alcohol are, respectively, water insoluble and water soluble. Another example of a water soluble residue-forming material which may also be used as a protective agent is sodium carboxymethyl cellulose. Sodium polymethacrylate which is readily soluble in an aqueous solution of an alkali may be added to this group. Gelatin and gum arabic are further examples of residue-forming materials which are water soluble but are penetrable and/or wettable by printing compositions intended for subsequent application and hence must be coated with a protective agent. Other water-insoluble materials which may also be used as protective agents are cellulose acetate, polystyrene, methacrylic polyesters, a wax such as Japan wax, aluminum stearate, calcium stearate, zinc stearate and fatty substances such as tripalmitin. The just-named water-insoluble materials are in general suitable for application as protecting coatings over masking residues which are permeable and/or wettable by subsequently applied printing compositions.

Many of the more common organic solvents provide suitable carriers for the dye of the printing composition. Ethylene glycol monoethyl ether, which is well known by its trade name Cellosolve, and also methanol, are well suited for this purpose. Other solvents of this character comprise xylene, a petroleum fraction and other hydrocarbon compounds. As the coloring material of the printing composition is adapted to be penetrated into a screen layer, it is necessary that the solvent employed with the composition be of such character that it permeates or swells the material of the screen layer whereby the dye may be introduced into the screen layer.

As previously noted, the screen layer 10 may be of any material to which penetrated coloring material of the various printing compositions is substantive. Conversely, any coloring material which displays good substantivity to the material of the screen layer may be used in printing the screen elements. Basic dyes, as a class, are excellent for forming colored printing compositions or inks. Cellulose acetate hydrogen phthalate, a preferred screen layer material, is acid in character and basic dyes show great substantivity thereto. Also basic dyes are highly substantive to cellulose nitrate, which has been given as a preferred screen layer material. While cellulose nitrate is essentially neutral in character, the substantivity of basic dyes thereto may be explained by the fact that the NO_2 group of the cellulose nitrate is a bipolar group and is an electron acceptor whereas basic dyes are electron donors.

A residue-forming material or a protective agent in a printing composition is colored by the coloring matter or dye of said composition. Consequently, the deposit or mask built up on the surface of the screen layer is colored and may be considered as a colored residue resulting from printing composition in excess of that which will penetrate into the layer.

When it is desired to prevent the second printing composition from overlapping the first formed screen lines, a protective agent may be employed which, in addition to being relatively impermeable to another printing composition adapted to be subsequently printed on the screen layer, is also of a nonwettable character with respect to the second printing composition. In the latter case, under suitable conditions, masking residues which are formed on the surface of the screen layer 10, above the portions of the screen layer penetrated by the various printing compositions, may be allowed to remain thereon when the screen is used. Generally speaking however, such residues are removed from the surface of the screen layer without substantially affecting the dyes which are penetrated into the layer. Organic solvents may be used for this purpose as by swabbing or rubbing the surface of the screen layer therewith after formation of the screen pattern. Toluene is excellent in this connection with the printing compositions heretofore mentioned.

With a screen structure of the type shown in Fig. 1 the first set of colored elements may, by a preferred practice, be formed thereon by printing with any conventional type of printing device which may be inked with a composition comprising:

20 cc. of:
- 80 grams Acryloid A–10
- 40 cc. Cellosolve
- 4 grams stearic acid

to which is added a paste comprising:

3 grams of Safranine A, C. I. 841
.5 gram Auramine DO, C. I. 655

in Cellosolve.

The foregoing composition is of an orange-red color.

For the purpose of illustration, the colored elements formed in the screen layer 10 have been shown as each comprising a straight line. These may be formed with the use of an inking roller which is provided with a multiplicity of evenly spaced circumferential lines which are formed on the periphery of the roller, for example, at a ruling of 250 lines to the inch.

Figs. 2 and 3, respectively, show the screen structure of Fig. 1 in plan and in section after

printing with a roller of the character described which is inked with the printing composition noted in the just foregoing to provide red screen elements 12 in the form of lines extending diagonally of the screen layer 10 with spaced intervals or unprinted portions 14 between them. It may be observed in Fig. 3 that the line elements 12 comprise a portion formed of dye which has penetrated into layer 10 and a dyed masking residue or seal 15 of printing composition which is formed or built up on the surface of the screen layer at each printed portion thereof.

In the preceding printing composition, the Cellosolve effects penetration of the dye into the layer 10. The Acryloid A–10 provides a dye protective agent and effects the formation of the mask 15 which, in addition to being relatively impermeable to water and alcohol, is relatively nonwettable thereby. Screen layer 10 is relatively thin, having a thickness of the order of from about .0003 of an inch or less to about .0005 of an inch. Under these circumstances, the dye or other coloring matter will extend from surface to surface of the screen layer 10 substantially without lateral or sidewise diffusion. Factors such as the lack of substantivity of the dye or coloring matter of a printing composition for the material of the support 11, the use of a support material which is relatively impermeable to the printing compositions employed, the quantity of printing composition applied to the screen layer per unit of printed area and the like may be utilized individually or in any combination to prevent coloring or dyeing of the support.

An inking roller, similar to that described, may be used for forming a second set of spaced-apart line elements on the layer 10 which are at right angles to the first set of lines. Since the second and third set of printed screen elements will be provided by broken lines having full portions which should lie entirely between the continuous line elements 12, it is preferable to make the broken lines wider than the continuous lines in order to permit the different colors used for screen formation to be properly balanced. However, for simplicity of illustration all screen elements have been shown as having equal width.

This roller may be inked with a green printing composition which comprises:

15 grams 10% polyvinyl alcohol, RH–391
5 cc. of water

to which is added as a solution:

1.5 grams Victoria Green WB base, C. I. 659
5 cc. Cellosolve

The second inking composition is a water base composition, i. e., the major constituent of the solvent mixture is water. Since the material of the masks 15 of line elements 12 is impermeable to and nonwettable by water, the water base printing composition will not be recorded on the masks 15 but will print or record in the unprinted portions 14 of the screen layer. Thus, when the second or green printing composition is applied to the screen layer 10 with a roller of the character described, spaced apart broken lines 16, which form the second set of colored elements of the screen pattern, will be printed in the unprinted portions 14 of the screen layer substantially without overlapping the continuous line elements 12 formed by the first printing step. In other words, the portions of the screen layer which are printed green by the application of the second ink are interposed between the continuous lines 12 adapted to provide the red elements of the screen. Unprinted portions of the screen layer, which remain after the formation of elements 16, are indicated at 17.

In the second or green printing composition, polyvinyl alcohol is the dye-protective agent and effects the formation of a masking residue 18 on the surface of the screen layer over the portions of the layer into which the dye of the green printing composition has penetrated. Polyvinyl alcohol is relatively impermeable to other alcohols. This permits the third printing composition, i. e., the blue or blue-violet composition, to employ an alcohol such as methanol or isopropanol as the carrier which contains the coloring matter.

After the formation of the first and second color elements, as described, it may be noted that the unprinted portions 17 of the screen layer 10 lie between printed portions 12 and 16 thereof and are themselves symmetrical and provide a series of spaced apart broken lines. Hence, the third set of color elements making up the screen pattern may be formed by merely coloring the unprinted portions 17 as by swabbing the surface of the layer with a suitable printing composition or by dipping the layer in such a printing composition or by the use of a printing roller of the type heretofore mentioned.

A suitable printing composition for forming the third set of elements comprises a 3 to 5% solution of Methyl Violet 2B, C. I. 680 in methanol. This composition is of a violet color.

Application of the third printing composition to the screen layer has been successfully carried out by swabbing the surface of the layer with the composition. The effect of such swabbing is to color the unprinted portions 17 and provide violet colored portions 19 which lie between the already formed colored portions 12 and 16 of the screen layer.

It is to be noted that the third printing composition carries no protective agent for the dye. Consequently, when the third printing composition is applied, there is no masking residue formed on the surface of the screen layer. Also the violet printing composition will not be printed on the masking residues 15 of Acryloid A–10 since these residues are relatively impermeable to methanol which serves as a carrier for the violet dye. The third printing composition is of very low viscosity since it contains no protective agent and although this composition will wet the polyvinyl alcohol residues 18, its ability to color or dye these residues is very slight as polyvinyl alcohol is not swelled by methanol and its dyeing effect will be negligible. Hence, the application of the violet printing composition to the surface of the screen layer will result substantially only in coloring or dyeing the unprinted portions of the layer. Any excess of the third printing composition may be squeezed off.

Under proper circumstances the masking residues 15 and 18 may remain on the surface of the screen layer. This is possible where the residues are formed of materials which are nonwettable by printing compositions applied subsequent to the formation of such residues so that overlapping of screen elements does not occur. On the other hand, it is desirable to remove masking residues in instances where a subsequently applied printing composition wets already formed residues so that screen elements overlap. The masks 15 and 18, formed by the specific printing compositions disclosed, may be removed with an

organic solvent such as toluene substantially without affecting the dyes forming the screen elements. This may be applied by gently rubbing or swabbing the surface of the screen layer therewith. The result of this practice is shown in Fig. 8 wherein both the red and the green dyes remain in the screen layer material, such also being the case of the violet dye. It may be pointed out that the toluene, used for removal of the masking residues, is a solvent for Acryloid A–10 and effects the removal of this material by a solvent action. On the other hand, toluene is not a solvent for polyvinyl alcohol but is effective for loosening the slight bond between the polyvinyl alcohol and the material of the screen layer whereby the polyvinyl alcohol may be mechanically removed.

The order of forming the different sets of colored elements is unrestricted to the red, green and violet printing order heretofore disclosed. Any dye disclosed in connection with any specific printing composition may be substituted for any other dye of any other printing composition.

When the screen pattern has been completed, as shown in Fig. 8, the surface of the screen layer 10 may be coated with a thin varnish layer for protective purposes and as thus finished the screen structure is ready for use in additive processes, such as the Finlay process. In the Finlay process, as is well known to the art, a separate color screen is placed in front of and is maintained in contact with a photosensitive emulsion for taking purposes while a contact print made from the negative is viewed through the same or a similar color screen which is also maintained in contact with the photographic element.

In lieu of this practice, the screen in Fig. 8 may have the upper surface of the screen layer 10 coated with varnish to provide a layer 20, as illustrated in Fig. 9, and this in turn coated with a suitable emulsion 21, for example a panchromatic emulsion. A photosensitive element of the character illustrated in Fig. 9 is well adapted for carrying out the additive process known to the art and heretofore referred to as the Dufay process.

Coating of the finished screen layer with varnish serves several functions. The varnish coating protects the layer from mechanical injury and dirt. Also varnish is substantially insoluble and impenetrable by developer solutions so that in instances where the screen layer comes into contact with such solutions the dyes in the screen layer and the material of the screen layer itself are protected from the action of the developing agent.

While a preferred method of forming a screen pattern upon a screen layer has been described, it is to be understood that variations in the method fall within the scope of the invention.

In this regard, the residue-forming material included in the printing composition may be of a character such that it is penetrated by a subsequently applied printing composition. For example, the first set of colored lines for a screen is printed with a composition comprising a red dye, such as that disclosed, Cellosolve and an aqueous solution of gelatin. The residues formed over areas through which the red dye has penetrated into the screen layer material will comprise gelatin. Consequently, protection for the dye in the screen layer must be provided.

By one practice, this protection is attained by sprinkling a water-insoluble, finely divided powder such as zinc stearate, a talc or a resin, for example shellac, onto the gelatin residues while these residues are still wet. Excess powder is blown or brushed off. This powder is used to form a film by itself over the residues and to protect the printed portions of the screen from contact with dyes used in the subsequent formation of other screen elements. In the case of a resin, formation of a film over the screen elements may, if necessary, be assisted by the application of heat to melt the resin particles.

An advantage of the procedure which applies a protective agent onto residues formed over printed areas of a screen layer resides in the fact that a printing composition similar in type to that described to form the first set of screen elements may be employed in the formation of the second set of elements. For example, if the second set of elements are to be green, a printing composition comprising a green dye, such as that previously described, Cellosolve and an aqueous solution of gelatin may be employed. After formation of the green elements the screen layer may again be treated as described with a finely divided powder, such as zinc stearate, whereby to form a protective coating similar to that of the red elements.

The third set of colored elements, namely the blue-violet elements, may be formed with a methanol dye solution such as that which has been specifically described in the foregoing and which is applied in a manner like that previously set forth, as for example by flowing the solution onto the screen layer. Upon completion of the color screen, the protective agent, i. e., zinc stearate or other similar material, may be removed with a suitable organic solvent without harm to the third set of screen elements which remain unprotected.

By another practice, when the masking residues over the printed screen elements are of a character which are permeable to subsequently applied printing compositions, as the gelatin residues hereinbefore described, the protective agent is applied to the tops of the masking residues by application from a printing roll. After the formation of the first set of screen elements, the masking residues extend above the surface of the screen layer and the tops thereof may be readily coated with a printing roll without danger of contact of the roll with the surface of the screen layer itself. Following formation of the second set of screen elements, the residues thereof are similarly coated by the application of the protective agent from a printing roll. As in the application of the first applied protective agent, the elevation of the tops of the second formed residues above the surface of the screen layer will prevent contact of the printing roll with the surface of the layer. While the second protective coating will also be applied over the first protective coating as well as the second formed residues, this is immaterial since the protective agent employed will either be of a transparent nature or will be removed after completion of the color screen.

As a protective agent for this purpose, mention may be made of a suitable cellulose acetate solution which may be noted as an example of a transparent protective agent. A greasy ink comprising one of the previously mentioned stearates in a hydrocarbon solvent or petroleum fraction may be given as an example of a nontransparent protective agent. Both of these materials may be removed with an organic solvent as will be well understood to the art. Formation of the

third set of screen elements when using the practice of applying a protective agent to the tops of the masking residues by a printing roll may be in the manner heretofore described, i. e., by flowing a methanol dye solution onto the screen layer to color the unprinted portions thereof. Both cellulose acetate and the greasy ink described are substantially impenetrable by a methanol dye solution.

It will be readily appreciated that the preferred method which has been set forth, and indeed all variations thereof, provide a process of extreme simplicity for forming a color screen. In this regard it may be noted that only three printing steps need be carried out to complete the screen pattern, such condition being illustrated in Figs. 6 and 7. By the addition of one other step, making a total of four steps, a highly finished product is provided. This product is illustrated in Fig. 8 wherein the printing composition residues are shown as removed from the surface of the screen layer 10.

The extreme simplicity of this process may be well appreciated by comparison with the heretofore mentioned practices of the prior art for making color screens which, at a minimum, require at least nine processing steps.

While the present invention has been disclosed in connection with three-color photography, it will be well understood that it is equally useful for color work wherein two or four or more colors are employed. Use of this nature is intended to be embraced within the inventive concept.

From the foregoing it will be appreciated that there is provided a novel and simplified procedure for forming color screens as well as a novel product and that the aims and objects of the invention have been attained.

Since certain changes may be made in the above product and process without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a process for forming a color screen of the character having a multiplicity of colored elements arranged in sets according to color and carried by a support in a screen pattern and with all elements in each set having the same color but differing from the color of each element in each other set, the steps of covering spaced-apart portions of an undyed but dyeable transparent layer of an organic plastic with a first set of colored elements while leaving portions of said transparent layer uncovered by applying to spaced-apart portions on a surface of said transparent layer a first printing composition comprising (*a*) a dye of a predetermined color, (*b*) a substantially water- and alcohol-insoluble and impenetrable plastic material which forms on said surface a residue of the character effective to substantially prevent the contact of water as well as the contact of alcohol with the portion of said transparent layer lying under said residue, and (*c*) a liquid carrier comprising an organic solvent, other than alcohol, to which said transparent layer is penetrable and in which said dye and plastic material are soluble and forming across said transparent layer said first set of colored elements each having a dyed portion extending below the surface of said transparent layer and a residue substantially coextensive therewith and extending above said surface and comprising said water- and alcohol-insoluble and impenetrable plastic material; retaining said residues formed on said surface by said first printing composition and covering spaced-apart and undyed portions of said transparent layer with a second set of colored elements while leaving portions of said transparent layer uncovered by applying to a second set of spaced-apart and undyed portions on said surface a second printing composition comprising (*a*) a dye of a second color, (*b*) a substantially alcohol-insoluble and impenetrable but water-soluble plastic material which forms on said surface a residue of a character effective to substantially prevent the contact of alcohol with the portion of said transparent layer lying thereunder, and (*c*) a liquid carrier, comprising water and to which said transparent layer is penetrable and in which said second-mentioned dye and said second-mentioned plastic material are soluble and forming across said transparent layer said second set of colored elements each having a dyed portion extending below the surface of said transparent layer and a residue substantially coextensive therewith and extending above said surface and comprising said substantially alcohol-insoluble and impenetrable but water-soluble plastic material; retaining said residues formed on said surface by said second printing composition and covering the undyed portions of said transparent layer with a third set of colored elements by applying to the undyed portions of said surface a third printing composition comprising (*a*) a dye of a third color, and (*b*) a liquid carrier comprising alcohol and to which said transparent layer is penetrable and in which said third-mentioned dye is soluble and forming, across undyed portions of said transparent layer which are located between dyed portions covered by said residues, said third set of spaced-apart colored elements each having a dyed portion extending below the surface of said layer; and then removing said residues from said surface.

2. A process for forming a color screen as defined in claim 1 wherein said first-mentioned carrier is 2-ethoxyethyl acetate and the plastic material contained in said first-mentioned carrier is an acrylic resin; said second-mentioned carrier is water and the plastic material contained in said second-mentioned carrier is polyvinyl alcohol; and said third-mentioned carrier is a lower alcohol.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
990,247	Fifield	Apr. 25, 1911
1,155,900	Dufay	Oct. 5, 1919
1,390,252	Smith	Sept. 6, 1921
1,877,658	Goldsmith	Sept. 13, 1932
2,007,282	Muller	July 9, 1935
2,030,163	Baker	Feb. 11, 1936
2,061,182	Zeller	Nov. 17, 1936