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P. GLAFKIDES

2,293,816

METHOD OF MAKING COLOR SEPARATION NEGATIVES

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FIG. 1.

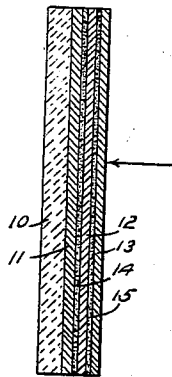


FIG. 2.

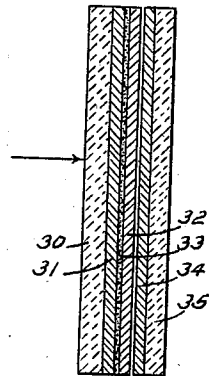
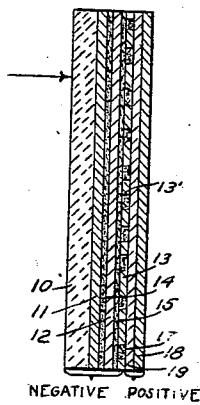
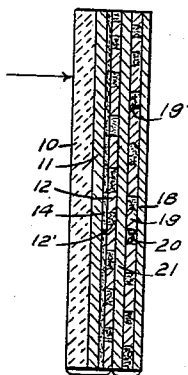


FIG. 3.



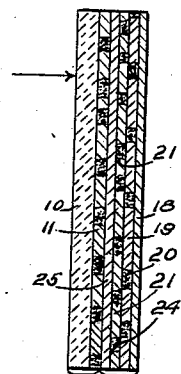
NEGATIVE POSITIVE

FIG. 4.



NEGATIVE POSITIVE

FIG. 5.



NEGATIVE POSITIVE

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METHOD OF MAKING COLOR SEPARATION
NEGATIVES

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1 Claim. (Cl. 95—2)

This invention relates to the art of color photography and relates more particularly to an improved method of making a plurality of color separation negatives from a single negative element comprising a plurality of emulsion layers superimposed on a single base.

The present application constitutes a continuation-in-part of my copending application Ser. No. 221,480, filed July 27, 1938.

The principal object of the present invention is the provision of an improved method for making color separation negatives on separate bases from a negative material of the type described in my co-pending application, such material comprising a plurality of photographic emulsions superimposed on a base, said emulsion layers being separated from each other by intermediate insulating layers.

Another object of the present invention is the provision of an improved method of developing the three emulsions, one at a time, so as to keep their several operations separate and without any coloring process. The invention further provides a method of individually removing or attacking each of the several deposited layers, one at a time, without acting on the other layers. Also, the present invention includes the method of selectively printing each emulsion after it has been developed, without exposing the remaining emulsions.

The method which constitutes the present invention is carried out with a composite negative material which has a base composed of the usual material and three emulsions separated by two thin films of varnish. The light sensitive emulsion deposited on the base is a panchromatic emulsion sensitive to all three colors but designed to receive the red image only. A thin film of varnish, insoluble in any developing agent but easily soluble in a solvent or capable of being attacked by a chemical reagent, is deposited on the first emulsion, the film covering the surface of the emulsion. A second emulsion is deposited on the first film of varnish which is sensitive to the green and blue colors, designed to record the green only. A second film of varnish similar to the first is deposited on the second film. The third emulsion is deposited on the second varnish film and is sensitized for the blue color only and is designed to record that color.

The first film of varnish, between the red and green sensitive emulsions, is colored red so that only red light passes through the same. The second film of varnish, between the green and blue sensitive emulsions, is colored a light yellow

and passes both red and green light. The second and third emulsions as well as the separating films are of such character, as will be described more in detail hereinafter, as to permit the major portion of the light to pass through and thus present clear images to the first and second emulsions.

The exposure is made as follows: The film is placed in the camera, emulsion side towards the lens as usual, and the exposure is made. The third emulsion records the blue because it is sensitive only to the blue rays. The remainder of the light passes through the second varnish, and because of its color only the red and green rays are transmitted. The second emulsion is sensitized to the green and blue rays but receives only red and green light; hence the green rays are recorded. The first film of varnish passes only the red light in the image and it exposes the first emulsion which is sensitive to all the rays.

As an alternate method, the filtering actions of the two varnish films may be incorporated in the emulsions themselves or a combination method may be used.

After the laminated negative has been placed in the camera and exposed to the image, it is then developed in an ordinary developer, fixed, washed and allowed to dry. Inasmuch as the internal emulsions are protected by the insulating layers, only the external or top emulsion is developed in black and white in this first operation.

The laminated negative cannot, however, be exposed to light as yet, since the first and second emulsions are still undeveloped. In the event, however, that the insulating layers are dyed as filters, and if the negative material is backed by an anti-halation coating impervious to light, the laminated negative material may afterward be handled in violet light.

The external image, which has thus been developed, is then printed through the remaining emulsions and upon a positive material, and for this purpose a light source of a type which has no action upon such remaining emulsions must be employed. If said remaining emulsions are the ortho and panchromatic ones, the printing must be carried out with an infra-red light source upon a copying emulsion sensitized to infra-red rays.

The printing may be done by either the contact or projection method, the projection printing avoiding the diffusion phenomena entirely, which phenomena might occur by virtue of print-

ing through the emulsions. In contact printing, on the other hand, the use of infra-red light tends to minimize diffusion effects, and when a perfect contact is obtained between the negative and the copying material, diffusion is reduced to a minimum.

The print thus obtained is either developed normally or is developed and reversed, and accordingly gives a duplicate of one of the color separation negatives.

In a normally coated negative material, the first duplicate is the duplicate of the blue violet record. If, however, the base is coated reversely and exposed with its back toward the lens, the first duplicate is that of the red record. In this instance, the printing of this first copy may be made with red light instead of infra-red light inasmuch as the remaining emulsions are not, then, sensitive to red.

The third gelatine layer which bears the first image to be printed is then removed in a manner which will hereafter be described in detail, in order to permit the second emulsion to be developed.

The second varnish film must be removed or attacked. Any solution which acts on the varnish but not the gelatine emulsion may be used. This leaves the second emulsion film exposed and it may be developed, washed, fixed and printed in the same manner as the third emulsion.

The second emulsion and the first varnish film are removed in the same manner as described above, after which the first emulsion bearing the red latent image remains. This may be developed and fixed in the ordinary manner, after which it may be used as a color separation negative and printed on a positive film or paper with ordinary light since no undeveloped emulsion remains. The three separation prints are used in any of the usual positive processes.

For the purpose of better illustrating the method employed in carrying out the present invention, the accompanying drawing shows a number of sectional views of the laminated material.

In the drawing:

Fig. 1 shows a negative base provided with three superimposed emulsion layers which are separated from each other by insulating layers;

Fig. 2 shows a modified type of negative material wherein two bases are provided;

Figs. 3, 4 and 5 illustrate the several steps in the printing operation from the exposed laminated negative material.

As previously stated, the improved negative material comprises a single base and a plurality of layers of emulsion thereon. In Fig. 1 the base may be made from plate glass, cellulose nitrate, cellulose acetate or other suitable materials. On one side of the base a plurality of layers of emulsion 11, 12 and 13, respectively, are formed, such layers being separated from each other by insulating layers 14 and 15. The emulsion 11 in contact with the base is panchromatic and sensitive to red, green and blue light although only the red light reaches this emulsion.

The second layer of emulsion 12 is orthochromatic and is sensitive to green and blue, and the third emulsion 13 is sensitive to blue violet only and is accordingly an ordinary emulsion.

Such a negative is to be exposed, through the medium of a camera, with the emulsion side

towards the lens. If, however, the layer in contact with the base is sensitive to blue violet only, and the top layer is a panchromatic emulsion, the material is then exposed with the base towards the lens.

The insulating layers 14 and 15 are used to separate the emulsion layers from each other. The texture of the insulating layer may be either non-porous or porous, and the procedure of application will vary accordingly. In the event that the insulating layer has a porous texture, the pores must be sufficiently small as to stop the molecules of all chemical agents, other than water, in aqueous solution. Such an insulating layer is similar to a semi-permeable membrane presenting osmotic pressure, and can be compared to a net, the meshes of which permit molecules of predetermined size only to pass therethrough. This porous insulating agent must also be of such character as to be capable of having the pores enlarged, by the use of a suitable chemical reagent, in order to permit larger molecules to pass therethrough.

After the negative material has been exposed and the third emulsion layer developed and the positive print made therefrom, the gelatine layer constituting this third emulsion is now removed in order to allow the second emulsion to be developed. This gelatine layer may be dissolved in an aqueous solution of one of the following chemicals:

- Sodium hypochlorite
- Sodium hydroxide
- Sulfochromic acid
- Sodium iodide concentrated
- Sodium bromide concentrated
- Lithium chloride concentrated

In this connection it has been found that sodium hypochlorite solution gives the best results. In view of the particular composition of the emulsion layer, sodium may be substituted for any other alkaline metal. The concentration of the bath and the time of the immersion will, of course, vary according to the degree of softness of the gelatine, its thickness, and the extent of agitation employed. It will be appreciated, however, that other methods may be followed for eliminating the image layer.

The next step is to attack or dissolve the insulating layer. In cases where the insulating layer is porous like a semi-permeable membrane, it is desirable to enlarge its pores so that the molecules of the developing agents may pass freely therethrough. To this end solvents are employed, but not in sufficient quantities to dissolve the layer. A chemical agent may be employed for this purpose, which agent tends to slow down or counteract the dissolving action. In the case of cellulose nitrate layers, the negative material may be immersed in a mixture containing two parts by volume of amyl acetate and one part by volume of ether. This same negative material is then allowed to dry and, on the varnish so treated, a thin layer of a solution of methyl alcohol and acetone in equal parts by volume is applied to such surface. No part of the semi-permeable layer is removed by dissolution in this operation.

It must be noted that the pores of the insulating layer are enlarged after the external emulsion layer has been totally removed. This same insulating layer has become an external protective layer and is not an intermediate layer any more.

Furthermore, said semi-permeable layer is not rendered permeable to treatment liquids but to chemical agents only, since it was already permeable to water before processing. If the insulating varnish has an impermeable, non-porous or uniform texture, it is totally dissolved with a solvent of such a type as not to cause injury to the emulsion lying immediately therebeneath. For instance, in the case of a resin; caustic soda in aqueous solution may be used. In the event that there is a tendency for the reagent to dissolve or attack the base, the negative material is allowed to remain in contact with the solvent by its emulsion side only, or, in other words, to be floated on the solution.

In reproducing the colored picture from the negative, a plurality of separate color separation negatives may be formed, or a colored positive consisting of a base and a plurality of superimposed colored images may be printed directly from the negative. Only the latter method is illustrated in the drawing, and in Fig. 3 the combined laminated negative and positive material are shown together with the exterior surface of the emulsion 13 of the negative material in meeting engagement with the positive emulsion 19 on the printing material 18. The outer or third emulsion layer 13 has been developed in the manner previously described, and there is accordingly formed in this layer an image designated as 13'. Inasmuch as the first and second emulsions are not as yet developed, and accordingly should not be subjected to ordinary light, infra-red light is used for the purpose of printing the images from this third emulsion layer onto the positive emulsion 19. The positive and negative elements occupy the position shown when contact printing is employed. Somewhat better results are obtained, however, by projection printing.

The image 13' in the layer 13 is, of course, not in color, and when a direct colored positive is made the positive emulsion 19 on the printing material is dyed to produce the desired color for such image, which, in the case of the printing emulsion 19, is yellow. When this positive emulsion 19 is developed, an image 19' will be visible thereon corresponding to the blue record on the negative. The negative image layer 13 is now removed in the manner previously described, and the second insulating layer 15 is also removed, and the second emulsion layer developed, thereby producing the image 12' in such layer, such image corresponding to the green record. The positive material is now given a second positive emulsion 21, the image of which in the instance shown will be dyed magenta, and such layer on the positive material is placed in meeting engagement with the external surface of the second emulsion layer 12 having the image 12' thereon. Infra-red light is also used to print this image 12' on the positive emulsion 21 superimposed on the base 18. Thus, the image 21' is printed on this second layer on the positive material, and the second emulsion layer and its adjacent insulating layer is then removed and the process continued. The positive material is then given a third sensitized layer 25, and for the purpose of printing the image from the first emulsion layer 11 white light may be used.

In the event that separate color separation negatives are to be prepared from the laminated exposed negative, the positive material 18 having the sensitized positive emulsion 19 thereon,

shown in Fig. 3, may, when developed, be used for producing the first color separation negative, and after the third emulsion layer 13 and its adjacent insulating layer 15 have been removed and the image on the second emulsion layer developed, this image may be printed again on positive material having a single positive emulsion thereon, and a second color separation negative made from this second positive. The step may be repeated for the third layer of emulsion, although after the second emulsion layer and its adjacent insulating layer have been removed, the developed image on the first emulsion layer and the supporting base 10 may be used as a negative.

A modification in the construction of the foregoing laminated negative material is shown in Fig. 2 and comprises a base 30 having superimposed emulsion layers 31 and 32 thereon, such layers being separated by an insulating layer 33. A third emulsion layer 34 is positioned upon a second base 35. The external faces of the emulsion layers 32 and 34 are placed in face to face engagement, and the two films placed together in an ordinary camera. In the relation shown in Fig. 2 the light from the image follows the direction of the arrow, and the first emulsion layer 31 is desirably for recording the blue record. The second emulsion layer 32 preferably records the green, and the third emulsion layer 34, which is in physical contact with the second emulsion layer, is for recording the red.

It will be appreciated, of course, that the positions of the several emulsions may be reversed, thereby having the ordinary emulsion at 34 and the emulsion for the red record at 31.

Through the specification the term "emulsion" or "emulsion layer" is deemed to mean either a simple emulsion layer or a combination of superimposed layers of emulsion having similar chromatic characteristics. It may be substituted by any other kind of photo-sensitive material, as will be appreciated. Likewise, an insulating layer may be one layer or several superimposed layers of similar material, and in some instances one of such layers may consist of a clear varnish and the second layer may be colored to act as a filter for the light. Also, the filtering material may be incorporated within the emulsion layers rather than in the insulating layers. The term "impermeable layer" as used in the appended claim may be defined as a layer impermeable both to water and to molecules of chemical agents in aqueous solution, and the term "semi-permeable layer" may be defined as a layer having the character of a semi-permeable membrane, i. e. impermeable to molecules of chemical agents but permeable to water at all times. Such layer has a finely porous structure. A gelatine (or other colloid) layer is considered a permeable layer being permeable to both water and chemical agents.

What I claim is:

The method of enlarging the pores of a semi-permeable cellulose nitrate layer of a photographic element, which consists in first treating the surface thereof with a mixture of approximately two parts by volume of amyl acetate and one part by volume of ether and then treating such surface with a mixture of approximately equal parts by volume of methyl alcohol and acetone.

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