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METHOD OF OBTAINING COLOR PHOTOGRAPHS

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Fig. 1.

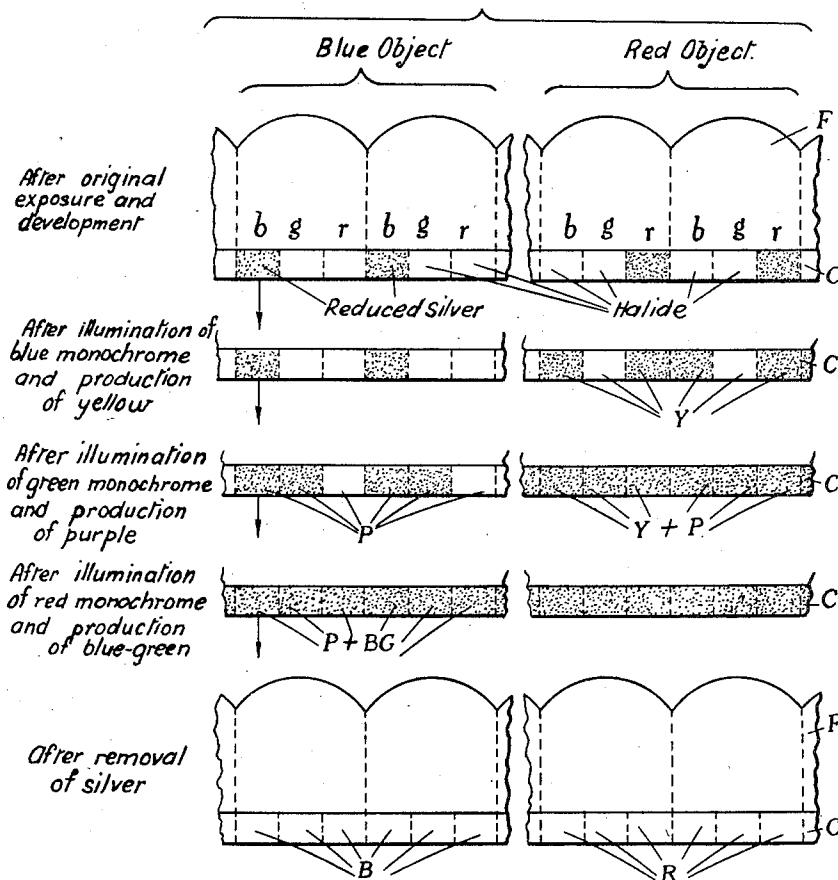
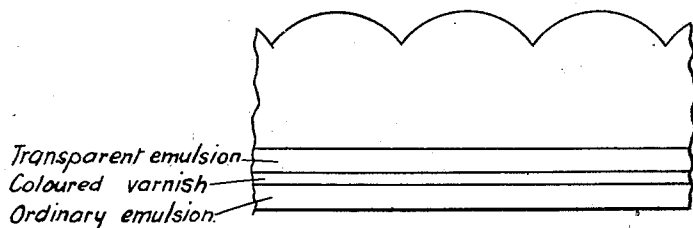


Fig. 2.



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METHOD OF OBTAINING COLOR
PHOTOGRAPHSAnne Henri Jacques de Lassus Saint Genies,
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6 Claims. (Cl. 95—2)

The present invention relates to improvements in the methods of coloring photographs on lenticular supports described in my copending application Serial No. 118,123 filed December 29, 1936. The colored photographs obtained can be observed or projected without any filter.

In the above-mentioned application there have been described operative processes leading either to purely additive synthesis or else to an intermediate case of additive synthesis accomplished with complementary colors generally employed in subtractive synthesis.

The present invention accomplishes, on the contrary, purely subtractive synthesis and offers the advantage of producing images which are more transparent and of more homogeneous coloration.

It consists essentially in applying to the photographs to be colored, as in the above-mentioned application, a method similar to that of the "second exposure", by effecting the second exposure in several separate operations through the lenticulations of the support, but by then treating the photograph in such a manner that each illumination of a monochrome component is followed by its coloring and, by diffusion, by the coloring of the other monochrome components (in the parts where, on the microscopic scale, they are adjacent to the monochrome component under consideration) in a color complementary to that which is to be obtained in the said monochrome component, the intensity of this coloration being substantially proportional to the quantities of silver reduced at the different places of the image during the second development.

The invention will be described with reference to the accompanying drawing, in which

Fig. 1 indicates diagrammatically one complete process for carrying out the invention, and

Fig. 2 shows a film used in carrying out a modified process.

Referring to Fig. 1 the lenticular film F to be colored comprises the emulsion C in which there has been recorded in the usual manner, according to additive analysis, a negative image of an object in color.

This image is developed, preferably by a developer which contains in the known manner an halide solvent. On the left-hand part of the film shown in the drawing there has been recorded a blue object, and the parts *b* of the emulsion, which correspond to the blue zone of the view-taking filter, contain, after such a development, reduced silver and little or no silver halide, while the parts *g* and *r*, which correspond

respectively to the green and red, contain little or no reduced silver and halide in the main part.

In the right-hand part of the film shown in the drawing, there has been recorded a red object, and it is the parts *r* of the emulsion which contain, contrary to the foregoing and in the known manner, reduced silver and but little halide after the first development.

The photograph is then exposed, in a second, selective exposure, to the action of the light through the lenticulations, by directing the luminous rays, according to the above-mentioned co-pending application, in such a manner that, for example, only the parts *b* of the emulsion are illuminated, and the image is developed in a developer which produces the coloring of the image in a color complementary to blue, that is, in yellow. To this end, a developer may be employed which liberates, with the products of oxidation of the developer and consequently in the presence of the nascent reduced silver, a colloidal yellow colorant, the quantity of which is substantially proportional to the quantity of this reduced silver. This developer may be, for example, pyrogalllic acid or pyrocatechin.

In the left-hand part of the photograph illustrated in the drawing, this illumination and selective development produces no effect, as the parts *b* of the emulsion no longer contain any halide. On the other hand, in the right-hand part, where the parts *b* were virgin, the yellow colorant, designated by the letter *y*, is fully manifested, and imparts to the gelatin a color which, by diffusion, penetrates into the parts *g* and *r*. It will be understood that the required diffusion may be obtained by the proper selection of the colorant, thickness of the emulsion, method of development and other well understood factors.

The next step consists in the illumination of the parts *g*, which correspond to the green, and in their development. Both to the right and to the left of the drawing, a large amount of metallic silver is reduced by the developer which, in order to produce the purple colorant, contains a substance such as, for example, thio-indoxyl. This colorant, designated on the drawing by *P*, is distributed by diffusion in the adjacent parts *b* and *r*.

The final step consists in illumination of the parts *r*, which correspond to the red, and in their development in a developer which contains a substance such as, for example, non-methylated dinaphthol liberating a blue-green colorant. In the left-hand part of the drawing, this colorant,

designated by BG, is liberated normally and penetrates into the adjacent parts *g* and *b*, while at the right it is not liberated, given that the parts *r*, completely blackened during the first development of the negative image, no longer give rise to the reduction of silver and, consequently, to the oxidation of the developer.

If the silver reduced during the successive operations is now dissolved, there is obtained, to the left, the mixture of the colorants purple P and blue-green BG, given that P allows the blue and red to pass, while BG allows the blue and green to pass, only the blue passes. To the right, the mixture of the purple P and yellow Y is obtained, which allows only the red to pass. It is seen, therefore, that the correct coloring is thus obtained over the whole extent of the film where the color under consideration must appear.

It is seen that if none of the parts *g*, *b*, *r* is blackened during the first development, all the colors P, BG, Y are liberated during the second developments and that their mixture produces black. If, on the contrary, all three parts *b*, *g*, *r* are blackened during the first development, none of the colors P, BG, Y is liberated and, after the dissolution of the reduced silver, a non-colored transparent gelatin is obtained corresponding to the whites of the subject.

According to a modified mode of working, it is possible, instead of effecting the coloring during the development, to introduce into the gelatin before each selective operation, a colorant which is destroyed by the nascent silver during the development.

Thus, before selectively developing the parts *b*, there is introduced into the emulsion a yellow colorant such as, for example, an azo colorant.

Before developing the parts *g* which correspond to the green, there is introduced into the emulsion a purple colorant, and before developing the parts *r* (corresponding to the red) a blue-green colorant is introduced.

After each of these partial developments, it may be useful to stabilise the corresponding colorants which remain in the gelatine in order that they shall not be affected by the subsequent treatments.

After having thus colored all the partial images, it is necessary to dissolve the silver entirely reduced at the end of treatment; it is possible again to dissolve the silver partly destroyed after each partial operation.

During the successive operations of partial illumination and development which have just been described, a more or less complete desensitisation of the emulsion is often ascertained; it is particularly pronounced when use is made of developers which contain halide solvents. The result of this is that, to effect the coloring of the various partial images, recorded on a photograph, the translucent support of which has been goffered, it may be obligatory to regenerate, that is, re-sensitise its emulsion, which complicates the operations.

This drawback may be avoided and the quality of the color photographs may be improved by providing on the lenticular translucent supports of photographs of this kind, intended to be colored, two suitable photo-sensitive layers, superposed on the smooth side of the support, instead of a single layer. Such a film is illustrated in Fig. 2.

The first layer, which is in contact with the lenticular support, should preferably be transparent and similar from this point of view to

certain emulsions of diapositives for example; the second may be similar to the ordinary non-translucent emulsions.

According to a preferred form of execution of this modification, the second layer of a colorant is impregnated, or alternatively the two layers are separated by a varnish colored in a color which is inactive for the second layer, the colorant being, in each of these cases, preferably soluble in the first treating bath.

An image is produced on the first layer only by the luminous rays during the recording thereon of the primary image, negative for example; in effect, the colorant which impregnates the second layer or which separates the second layer from the first protects the second layer perfectly from the direct action of the luminous rays during the recording of the said primary image. When this image is developed by a developer containing a solvent which is generally ammonia, this solvent partly dissolves the silver halide, but only in the vicinity of the silver image and in proportion to the reduction in silver of this halide by the developer. Consequently, this solvent does not affect the halide of the second layer, and an image is correctly developed in the first layer only, the second retaining its normal sensitivity.

During this first development, the colorant impregnating the second layer or simply separating the two layers disappears; the second layer is then enabled, as the first layer, to have an image produced thereon by the light during the partial illuminations through the first, transparent, emulsion. In the present case, as has been seen, the emulsion of the second layer has not been weakened.

The successive colorations of the different monochrome components may then be effected in accordance with one of the known methods. They are produced in the first layer, for the small part of halide which it contains and which may again be brought into play in each of the successive operations, and especially in the second layer by reason of the quantity of halide which it contains, which is bound to be sufficient for the purpose.

The use of two suitable sensitive layers without introducing changes into the method of coloring described above gives several advantages. Besides avoiding with certainty the re-sensitisation of the emulsion, this method permits a much easier dosing of the coloring operations, for example, for the purpose of giving a certain opacity to each colorant. In effect, in the case of a single emulsion layer, if it has not been possible to regenerate it suitably, there is a risk, in the second or third coloring operation, of there being a deficiency in opacity in the colorant; this risk does not exist in the case foreseen by the present invention.

It is comprehensible that another, equally simple, mode of separation of the successive impressions in the two emulsion layers may consist in rendering these zones and in making use of suitably colored sources in order to obtain the impression of the first layer alone, by ensuring the isolation of the second layer without interposition of any colored varnish between the two layers in intimate contact with one another.

I claim:

1. Method of obtaining a photograph in color which consists in first obtaining by the lenticular process of photography a primary image in black and white composed of a plurality of monochrome components, and then subjecting without fixing

of the sensitive salts each monochrome component of said primary image successively to treatment including an exposure made selective by the lenticular support and a development associated with a diffusive coloring operation producing a color complementary to that which is finally to be obtained in the particular monochrome component treated, the coloration extending over the microscopic elements adjacent the elements of each monochrome component treated and giving a density substantially proportional to the quantity of silver reduced in each partial development, and finally removing the reduced silver from the photograph.

2. Method of obtaining a photograph in color starting from a black and white photograph comprising a plurality of monochrome components on a lenticular support, which consists in subjecting without fixing of the sensitive salts each monochrome component successively to a treatment including an exposure made selective by the lenticulations of said support and a development associated with a diffusive coloring operation producing a color complementary to that which is finally to be obtained in the particular monochrome component treated such that the color extends adjacent the elements of the monochrome component treated, and finally removing the reduced silver from the photograph.

3. Method of obtaining a photograph in color starting from a black and white photograph comprising a plurality of monochrome components on a lenticular support, which consists in subjecting without fixing of the sensitive salts each monochrome component successively to a treatment including an exposure made selective by the lenticulations of the film and a development containing a color-forming material which colors the film in a color complementary to the particular monochrome treated and in the microscopic elements affected by the light during said selective exposure and by diffusion in adjacent microscopic elements, and finally removing the reduced silver from the photograph.

4. Method of obtaining a photograph in color starting from a black and white photograph comprising a plurality of monochrome components on a lenticular film, which consists in subjecting without fixing of the sensitive salts each monochrome component successively to a treatment including introducing into the emulsion of the film a colorant complementary to that which is finally to be obtained in the particular monochrome treated and which is destroyed by the

action of nascent silver, subjecting the monochrome component to an exposure which is made selective by the lenticulations of the film and developing the film to destroy the colorant in monochrome exposed, and finally removing the silver reduced by said treatments.

5. Method of obtaining a photography in color using a lenticular film comprising two sensitive layers separated by a transparent intermediate layer colored in a color which shields the second layer, which consists in forming on the first layer adjacent the lenticular support a primary image in black and white composed of a plurality of monochrome components whilst removing the color from said intermediate layer, and subjecting the film without fixing of the sensitive salts to a plurality of successive treatments, one for each monochrome component, each treatment including an exposure made selective by the lenticulations of said support and a development associated with a diffusive coloring operation producing a color complementary to that which is finally to be obtained in the particular monochrome treated such that the color extends by diffusion over the microscopic elements adjacent the elements of the monochrome components treated, and finally removing the reduced silver from the photograph.

6. Method of obtaining a photograph in color using a lenticular film comprising two sensitive layers, the first layer adjacent the lenticular support being transparent and the second layer beyond said first layer being impregnated with a color which renders it inactive, which consists in forming on the first layer adjacent the lenticular support a primary image in black and white composed of a plurality of monochrome components whilst removing the color from the second layer, and subjecting the film without fixing of the sensitive salts to a plurality of successive treatments, one for each monochrome component, each treatment including an exposure made selective by the lenticulations of said support and a development associated with a diffusive coloring operation producing a color complementary to that which is finally to be obtained in the particular monochrome treated such that the color extends by diffusion over the microscopic elements adjacent the elements of the monochrome component treated, and finally removing the reduced silver from the photograph.

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