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PROCESS FOR EXPOSURE AND COPYING OF PHOTOGRAPHS AND
CINEMATOGRAPHIC RECORDS IN NATURAL COLORS
Filed Sept. 12, 1931

1,904,600

Fig. 1.

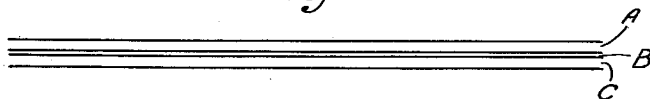


Fig. 2.

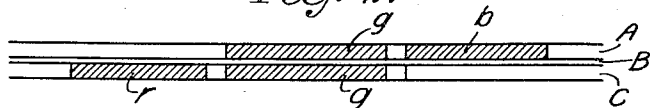


Fig. 3.

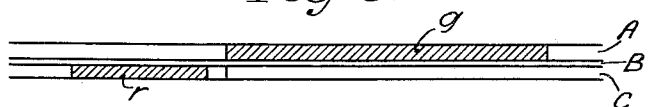


Fig. 4.

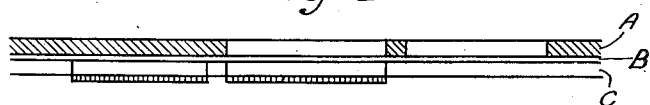
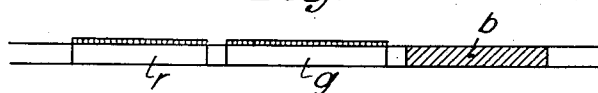


Fig. 5.



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PROCESS FOR EXPOSURE AND COPYING OF PHOTOGRAPHS AND CINEMATOGRAPHIC RECORDS IN NATURAL COLORS

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The present invention relates to processes for producing natural or multi-color photographs.

Briefly stated, the process comprises forming a negative film or plate having image values in both the orthochromatic and panchromatic coatings of said film or plate with at least one of the image values in the panchromatic coating covered with a film of a transparent fatty substance, impressing the sensitized face of a positive against said film covered surface of the negative film so as to transfer the fatty substance to the positive, exposing the positive through the negative, developing the uncovered area of the positive, and differentially coloring the positive.

In the drawing, Fig. 1 shows the unexposed negative film; Fig. 2 shows the film of Fig. 1 exposed and developed; Fig. 3 shows a modification of Fig. 2; Fig. 4 shows the film of Fig. 2 with the grease applied; and Fig. 5 shows the positive film.

In carrying out the process for producing three-color photographs according to the present invention, a negative film is prepared as illustrated in Figure 1. A coating A, consisting of an orthochromatic light-sensitive bromide of silver emulsion which is non-sensitive to the red rays of light is applied to one side of a celluloid base B. On the opposite face of the base B is applied a coating C consisting of a panchromatic emulsion, the light sensitivity of such emulsion being more rapid than that of the emulsion of coating A. The coating A includes a yellow-filter color substance which retains all of the blue rays of light, such filter substance being incorporated in the emulsion of coating A or applied to the base B so that it lies intermediate the coating A and base B.

The negative film thus prepared is turned with the coating A facing the lens and is then exposed. The blue rays of light act upon the coating A and are prevented from passing through the base B into the coating C by the color filter substance which is present in the coating A.

The yellow rays of light act upon the coating A, then penetrate through the base

B into the coating C and in turn act upon the said last named coating. The red rays of light pass through coating A, base B, into coating C and act only upon said last named coating because coating A is non-sensitive to the action of the red rays of light.

The exposed negative film is then developed and treated in a known manner as by baths, whereby the silver is converted into other metallic compounds, the layer of gelatin encircling the silver particles at the same time hardened, and a relief produced in that the untanned gelatine swells and remains so as to be ready to absorb a red color substance as will later be explained, while the tanned gelatine remains unaltered in size. In order to render the developed film transparent it is subjected to the action of a bleaching agent. The bleaching of the film may be effected either simultaneously with the development as by adding sodium thiosulphate to the developing bath or subsequently to the development as by subjecting the developed film to the action of sodium thiosulphate. This bleaching results in the removal of the metal compounds and consequently makes the film transparent.

The developed negative film thus described contains three image values as best illustrated in Figure 2. In said figure the cross-hatched field represented by the letter *b* indicates the image value of coating A obtained by the action of the blue rays of light; the letter *g* indicates the image value of both coatings A and C obtained by the action of the yellow rays of light; and the letter *r* indicates the image value of coating C obtained by the action of the red rays of light.

The surface of the coating A of the developed negative film illustrated in Figure 2 is treated with a red color substance which is absorbed by only the non-hardened parts of the gelatin of coating A, thus resulting in the dyeing of such non-hardened parts and causing the film to acquire the character of a positive. At the same time a coating of a transparent fatty substance like grease is applied to the surface of coating C as by pass-

ing a greased roll over the surface of said coating. The passage of the greased roll over the surface of coating C causes a thin film of transparent grease to be deposited on the tanned portions of the coating, that is, the image values in coating C obtained by the action of the yellow and red rays of light, in a manner similar to that in the bromoil process.

Figure 4 illustrates a section of the developed negative film after the surface of the coatings A and C have been treated in the manner just described. In Figure 4, the slating cross-hatching in coating A represents the non-hardened parts of the gelatin of coating A which have been colored by the absorbed color substance or dye while the vertical cross-hatching in coating C represents the image values obtained by the action of the yellow and red rays of light which are covered with a film of transparent grease, the image value obtained by the action of yellow rays of light being in the middle of coating C and that value obtained by the action of red rays of light being to the left of the yellow ray image value.

The negative film of Figure 4 is next placed in contact with a positive, either a simple emulsion coated film or a piece of printing paper, in a dark room with the surface of coating C facing the positive and then firmly pressed against the same.

The pressing of coating C of the negative against the positive causes the film of transparent grease which covers those image values obtained by the action of the yellow and red rays of light to be transferred to the corresponding parts of the positive. The positive is now exposed through the negative. The fatty substance deposited on the negative is transferred to the copy (the layers of grease correspond to the red and yellow parts of the image), at the same time the positive is exposed through the transparent parts of A, which correspond to the yellow and blue parts of the image. The copy is now separated from the negative, and is then developed. Owing to the layer of grease the places on which the grease has been deposited, can now neither be developed nor fixed, while the other parts of the copy will either be fixed out or developed as black silver.

After exposure the positive is separated from the negative, and developed. In developing the positive, only those parts of the image which are not covered by the film of transparent grease are fixed or developed as black silver. As illustrated in Figure 5, the developed positive contains the exposed and developed image *b* corresponding to the image value of the negative obtained by the action of the blue rays of light, the exposed but non-developed image *g* corresponding to the image value of the negative obtained by the action of the yellow rays of light, and the non-exposed and non-developed

image *r* corresponding to the image value of the negative obtained by the action of the red rays of light. In other words, image *b* corresponds to the blue part, image *g* to the yellow part, and image *r* to the red part, the blue being represented by reduced metallic silver, yellow as exposed, and red as unexposed bromide of silver.

The respective parts of the positive illustrated in Figure 5 are next converted into the different colors desired. This may be effected by first dyeing or coloring the developed image *b* blue, then removing the layer of grease and developing the images *g* and *r* whereby *g* is converted into silver subbromide and *r* is converted silverbromide. Thereafter *g* is dyed or colored yellow which does not affect or take on *r*, and *r* is dyed or colored red which does not affect or take on *g*. For example, image *b* may be converted into Prussian blue by means of ferric citrate of potassium, image *g* into chrome or lead yellow, and image *r* into red uranyl ferrous cyanide. Any of these metallic color compounds may further be used in connection with diachromy in which the silver is removed from the positive simultaneously with the entrance of organic color substances. This results in the formation of a positive having an image thereon in natural colors.

To produce two color photographs according to the process of the present invention a negative film as illustrated in Figure 1 is prepared in the same manner as previously described except that the coating A is made to contain a filter color substance which allows only the red rays of light to pass there-through in place of a yellow filter color substance.

The negative film thus formed is turned with the coating A facing the lens, and is then exposed. The blue-green rays of light act upon the coating A, and are prevented from penetrating to the coating C by the filter color substance which is present in coating A. The red rays of light pass through coating A, base B, into coating C, and act upon said last named coating.

The exposed negative is then developed and treated in a known manner as by baths, whereby the silver is converted into other metallic compounds, the layer of gelatin surrounding the silver particles at the same time hardened, and a relief produced. To render the developed film transparent it is subjected to the action of a bleaching agent.

The developed negative thus prepared contains two image values as illustrated in Figure 3, wherein the cross-hatched field represented by the letter *g* indicates the image value of coating A obtained by the action of the blue-green rays of light, and the cross-hatched field represented by the letter *r* indicates the image value of coating C obtained by the action of the red rays of light.

The surface of the coating A of the developed negative film illustrated in Figure 3 is treated with a red color substance which is adsorbed by only the non-hardened parts of the gelatin of coating A, thus resulting in the dyeing of such non-hardened parts and causing the film to acquire the character of a positive. At the same time a thin film of a transparent fatty substance like grease, is applied to the surface of coating C so as to cover the tanned portion of the coating, that is, the image value of coating C obtained by the action of the red rays of light, in the same manner as previously described in connection with the process for making three-color photographs.

The negative film is next placed in contact with a positive in a dark room with the surface of coating C facing the positive and then firmly pressed against the same. The pressing of the coating C of the negative against the positive causes the film of transparent grease which covers the image value obtained by the action of the red rays of light to be transferred to the corresponding parts of the positive.

The positive is now exposed through the negative. During the exposure only those parts of the positive corresponding to the transparent parts of coating A of the negative, that is, those transparent parts which correspond to the image value obtained by the action of the blue-green rays of light are acted upon by the light while that part of the positive covered by the film of transparent grease which corresponds to the image value of the negative obtained by the red rays of light, is not acted upon by the light.

After exposure the positive is separated from the negative, and developed. In developing the positive only those parts of the image which are not protected by the film of grease are developed, or fixed as black silver. The black silver of the developed part of the positive is converted into a green color whereupon the film of grease is removed from the positive, and that portion of the positive converted into a red color by the diachromy method.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. The process for producing multi-color photographs which comprises forming a negative plate having an orthochromatic coating on the front face and a panchromatic coating on the back face thereof, exposing said negative to form image values in both of said coatings, developing the exposed negative, applying a film of a transparent fatty substance to the image values of the panchromatic coating, impressing the sensitized face of a positive against said film covered surface of the negative plate so as to transfer the fatty substance to the corre-

sponding parts of the positive, exposing the positive through the negative plate, developing the uncovered area of the positive, and differentially coloring the positive.

2. The process for producing multi-color photographs which comprises forming a negative plate having an orthochromatic coating on the front face and a panchromatic coating on the back face thereof, exposing said negative to form image values in both of said coatings, developing the exposed negative, applying a film of a transparent fatty substance to the image values of the panchromatic coating, impressing the sensitized face of a positive against said film covered surface of the negative plate so as to transfer the fatty substance to the corresponding parts of the positive, exposing the positive through the negative plate, developing the uncovered area of the positive, removing the film of fatty substance, and coloring the area of the positive from which the film of fatty substance has been removed.

3. The process for producing multi-color photographs which comprises forming a negative having an orthochromatic coating on the front face and a panchromatic coating on the back face thereof, exposing the negative to form image values in both the orthochromatic and panchromatic coatings, developing the exposed negative, applying a film of a transparent fatty substance to the image values of the panchromatic coating, impressing the sensitized face of a positive against said film covered surface of the negative plate so as to transfer the fatty substance to the corresponding parts of the positive, exposing the positive through the negative plate, developing the uncovered area of the positive, and differentially coloring the positive.

4. The process for producing multi-color photographs which comprises forming a negative having an orthochromatic coating on the front face and a panchromatic coating on the back face thereof, exposing the negative to form image values in both the orthochromatic and panchromatic coatings, developing the exposed negative, applying a film of a transparent fatty substance to the image values of the panchromatic coating, impressing the sensitized face of a positive against said film covered surface of the negative plate so as to transfer the fatty substance to the corresponding parts of the positive, exposing the positive through the negative plate, developing and coloring the uncovered area of the positive, removing the film of fatty substance, and coloring the area of the positive from which the film of fatty substance has been removed.

5. The process for producing multi-color photographs which comprises forming a negative having an orthochromatic coating on the front face and a panchromatic coating

on the back face thereof, exposing the negative to form image values in both the orthochromatic and panchromatic coatings, developing and bleaching the exposed negative, coloring the non-hardened parts of the developed gelatin of the orthochromatic coating, applying a film of a transparent fatty substance to the image values of the panchromatic coating, impressing the sensitized face of a positive against said film covered surface of the negative plate so as to transfer the fatty substance to the corresponding parts of the positive, exposing the positive through the negative plate, developing the uncovered area of the positive, and differentially coloring the positive.

6. The process for producing multi-color photographs which comprises forming a negative having an orthochromatic coating on the front face and a panchromatic coating on the back face thereof, exposing the negative to form image values in both the orthochromatic and panchromatic coatings, developing and bleaching the exposed negative, coloring the non-hardened parts of the developed gelatin of the orthochromatic coating, applying a film of a transparent fatty substance to the image values of the panchromatic coating, impressing the sensitized face of a positive against said film covered surface of the negative plate so as to transfer the fatty substance to the corresponding parts of the positive, exposing the positive through the negative plate, developing and coloring the uncovered area of the positive, removing the film of fatty substance, and coloring the area of the positive from which the film of fatty substance has been removed.

7. The process for producing multi-color photographs which comprises forming a negative having an orthochromatic coating non-sensitive to red rays of light including a blue-green color filter substance on the front face and a panchromatic coating on the back face thereof, exposing the negative to form a green image value in the orthochromatic coating and a red image value in the panchromatic coating, developing and bleaching the exposed negative, coloring the non-hardened parts of the developed gelatin of the orthochromatic coating, applying a thin film of transparent fatty substance to the red image value of the panchromatic coating, impressing the sensitized face of a positive against said film covered surface of the negative plate so as to transfer the fatty substance to the corresponding part of the positive, exposing the positive through the negative, developing the uncovered area of the positive, coloring the thus developed area with the desired color, removing the film of fatty substance from the red image area of the positive, and coloring the red image area with the desired color.

8. The process for producing multi-color

photographs which comprises forming a negative having an orthochromatic coating non-sensitive to red rays of light including a yellow color filter substance on the front face and a panchromatic coating on the back face thereof, exposing the negative to form blue and yellow image values in the orthochromatic coating and yellow and red image values in the panchromatic coating, developing and bleaching the exposed negative, coloring the non-hardened parts of the developed gelatin of the orthochromatic coating, applying a film of transparent fatty substance to the yellow and red image values of the panchromatic coating, impressing the sensitized face of a positive against said film covered surface of the negative plate so as to transfer the fatty substance to the corresponding parts of the positive, exposing the positive through the negative, developing the uncovered area of the positive, coloring the thus developed area with the desired color, removing the film of fatty substance from the yellow image area of the positive, developing the latent image of said yellow area, coloring the image of said yellow area with the desired color, removing the film of fatty substance from the red image area of the positive, and coloring the red image area with the desired color.

In testimony whereof I affix my signature.

POUL SMITH RASTRUP ANDERSEN.