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W. V. D. KELLEY

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COLOR PHOTOGRAPHY

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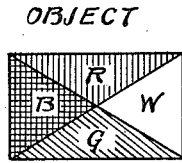


Fig 1

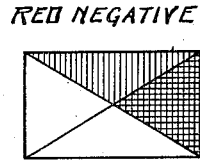


Fig 2

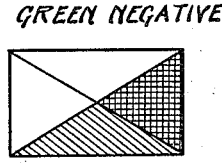


Fig 3

PRINTING NEGATIVES

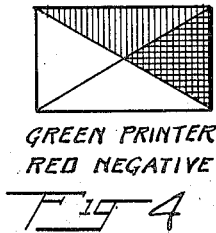


Fig 4

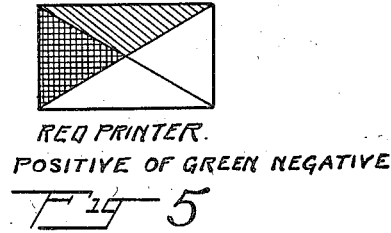


Fig 5

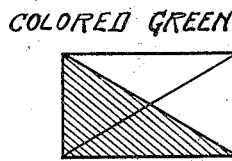


Fig 6

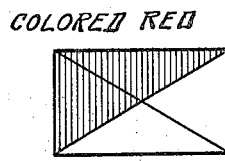


Fig 7

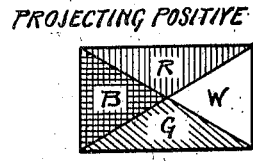


Fig 8



Fig 9



Fig 10

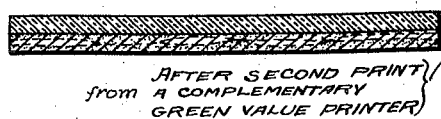


Fig 11

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UNITED STATES PATENT OFFICE

WILLIAM V. D. KELLEY, OF JERSEY CITY, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO MAX B. DU PONT VITACOLOR CORPORATION, OF LOS ANGELES, CALIFORNIA, A CORPORATION OF DELAWARE

COLOR PHOTOGRAPHY

Application filed December 12, 1922, Serial No. 606,369, and in Great Britain August 13, 1921.

This invention relates to color photography and has reference to improvements upon the invention set forth in my previous Patent No. 1,278,161, dated September 10, 1918, whereby the time and expense of producing finished single coated positive is reduced to a minimum.

As described in said patent, the process starts with color selection negatives of complementary colors, and a printing positive or diapositive is prepared from one of the negatives. In the specific embodiment described in said patent, the first print was made in single coated emulsion which was then re-sensitized by bichromating for the second print, with both positive images in dye, giving extreme transparency.

In the accompanying drawings,

Figure 1 represents an object,

Fig. 2 a red color value negative,

Fig. 3 a green color value negative,

Fig. 4 represents the green printer, or red value negative,

Fig. 5 the red value printing positive,

Fig. 6 the green colored positive image,

Fig. 7 the red colored positive image,

Fig. 8 the final projecting positive,

Fig. 9 is a cross-section of the film before printing,

Fig. 10 is a cross-section of the film after the first print, and

Fig. 11 is a similar view after the second print.

In this invention, an improvement is introduced first in the character of positive single coated stock used, and secondly by reason thereof, in the treatments for producing the color images. The positive stock in this invention consists of ordinary emulsion provided with a light retarding fugitive dye, as for example tartrazin, as set forth in my application Ser. No. 383,648, filed May 24, 1920, of which application this application is a continuation in part.

The first print is made, for example, from the red value negative through the transparent support to the inner stratum of the positive emulsion to produce what is hereinafter termed a green value diapositive print without affecting the outer stratum, followed

by a second print hereinafter referred to as the red value dianegative print in register in the outer stratum, from a complementary green value printer positive. The registration method shown in Patent No. 1,350,023, August 17, 1920, will be suitable for contact printing, which is preferred, but the two images can be printed by contact, or optically, or simultaneously if desired. The prints may be successively made if the negatives are on single strip, but if the printing negatives (negative and printer positive) are on separate strips, as will usually result by making the printer positive from one of the original negatives, both prints may be made at the same time. In either case, the emulsion is impregnated with the fugitive dye to prevent printing through, as primarily it is desired that one print be in the stratum of emulsion next the support, and the other print in the outer stratum of emulsion. This leaves an intermediate stratum practically unaffected, except where one negative is thin or is overprinted. Preferably, the bottom or inner print will be made the heavier, so that a slight reduction from the bleach for the outer image will be helpful in clearing the inner image.

Upon first washing out the yellow fugitive dye, and then developing the prints, there results a composite print composed of a diapositive and a dianegative in reduced silver, in different strata of a single layer of emulsion. These prints are not fixed out at this time but may be handled in artificial light, and the unfixed silver salt will act as an aid in judging of the completion of the next operation.

The film is now placed in a bath having the property of hardening the gelatine surrounding the developed silver and at the same time bleaching a silver image. This bath is also characteristically slow enough in penetrating the gelatine as to completely bleach the top dianegative image before acting on the lower or diapositive image next the support. A slight reducing effect of the bleach on the lower image does no harm. The film is submerged in the bleach bath for about thirty seconds, or until the surface image is bleached.

Such a bleach is described in Brit. Jrl. Phot. Supt. p. 36, May 7, 1909. The action of the bleach is to remove the dianegative converted silver image by rendering it invisible and transparent, and at the same time hardening or tanning the gelatine in situ therewith so as to render such image dye repellent to a gelatine dye, whereas the remainder of the gelatine will absorb dye. The bleach also clears the inner image by slight reduction. The progress can be easily watched as the outer image disappears first and the reduction of the inner can be watched and stopped at the right time.

A suitable bath is:

Potassium ferricyanide -----	9 gms.
Potassium bromide -----	14 gms.
Potassium bichromate -----	9 gms.
Glacial acetic acid -----	3 cc.
Potassium alum -----	15 gms.
Water -----	2000 cc.

After washing, the film is fixed out in plain sodium thiosulphate, leaving the surface hardened where the silver of the dianegative previously existed, and an unbleached black silver image representing a diapositive print of the red negative. In other words, only a single record is now discernible, this being the inner one lying next the support. This silver image (the green value diapositive) from the red value negative is now converted to a dye toned green image, or a chemically toned green image, is then fixed out in sodium thiosulphate, and thoroughly dried. The toning baths intensify the inner image.

If the inner image (the green value diapositive) is to be dye toned, it is bleached in a bath that will give a vanadium yellow mordant, as by bleaching in the following bath for about six minutes:

Vanadium oxalate 10% solution--	50 cc.
Oxalic acid -----	10 gms.
Potassium ferricyanide -----	10 gms.
Water -----	2000 cc.

The film is then fixed to remove the products of the bleach, dyed in basic dyes, such as a mixture of chrysoidine and fuchsine, chemically termed the hydrochlorides of the color bases of diphenyl and triphenyl-methane, or other colors, washed and dried.

The film must be thoroughly dried, then placed in a bath containing 12 grammes of red acid dye commonly known as pinatype red D dye, such as used in the pinatype process or similar dyes derived from the salt of a sulphonic base, per 1000 ccs. of water for about three minutes to dye the top negative gelatine image, and washed for two minutes. After drying, the film is ready to project or view. This dye has the characteristic of readily dyeing soft gelatine, while leaving the hardened gelatine unaffected.

Or for the bottom image, the dye-toning

method disclosed in my Patent No. 1,411,968 dated April 4, 1922; may be utilized. In which event after bleaching the inner image (the green value diapositive) as therein described, and after bleaching the outer image (the red value dianegative) as herein described, two dyes of the acid family may be used, wool green S, (sodium salt of tetramethyl-diaminodiphenyl-beta-hydroxynaphthyl-carbinol disulphonic acid anhydride) the salt of a sulphonic base for the inner image, and red acid dye commonly known as pinatype red D dye, such as used in the pinatype process, or a dye, derived from a similar salt for the outer image.

The bottom image (the green value diapositive) may be toned in uranium by using a bath such as the following, which mordants basic red dyes to enrich the color. In this case, green dyes are used for the surface image (the red value dianegative).

Water -----	48000 cc.
Uranium nitrate -----	288 gms.
Potassium oxalate -----	96 gms.
Hydrochloric acid -----	672 cc.

The color schemes are therefore reversible.

As an aid to the surface hardening of the surface image a pyro developing bath may be used composed of:

Pyrogallic acid -----	5 gms.
Sodium sulphite -----	20 gms.
Sodium carbonate -----	25 gms.
Potassium bromide -----	1 gm.
Distilled water -----	1000 cc.

This bath has the same characteristics as the bleach mentioned for removing the surface image, viz: of hardening the gelatine in proportion to the amount of reduced silver present. The two baths, that is the pyro developer plus the bichromate bleach bath assure hardness in the desired places. Time of development is about three minutes at 65° F. If an amidol (diamidophenol) developer is used, prints are utilized that develop satisfactorily in two minutes.

The step of using a preliminary bath for removing the fugitive dye is of advantage and should be by washing in water at a temperature of 65° which will cause the gelatine to swell, and increase the separation between the bottom and top images.

By utilizing a diapositive image on the top and totally removing the silver without depending on a silver image as a means for mordanting or toning a color, there is a condition present particularly favorable to the production of outer print for the reason that should the initial bleaching affect the bottom image, it can do no harm by degrading it. The lower image could be entirely ruined for the purpose of this invention if the bleaching is carried too far, without disadvantage as it would be removed upon fixing. A slight

action on the lower image does no more than reduce its intensity.

If it is desired to chemically tone the bottom image blue, the film is immersed for four minutes in:

Potassium oxalate -----	12	gms.
Ferric nitrate -----	11	gms.
Potassium ferricyanide -----	10	gms.
Hydrochloric acid -----	6	cc.
Water -----	2000	cc.

After using the bichromate bleach bath for the first image, a bath for three minutes in a .5% ammonia solution may be given as an aid to removing the bichromate.

In the drawings, the object in Fig. 1, from which the negatives of Figs. 2 and 3 are made, is composed of black, red, green and white sections B, R, G, W. Figs. 4 and 5 show the printer negatives, Fig. 5 being a positive of Fig. 3. Figs. 6 and 7 show the respective colored prints from Figs. 4 and 5, and Fig. 8 the finished positive.

In this process, the finished print at the time of coloring has only one silver record. There are two silver records immediately after development, but when the silver that has not been light affected is fixed out, there is only one silver image to control or color. All of the operations can consequently be simple tank operations under complete supervision.

By toning is meant broadly the coloring of an image, while by chemical toning is meant coloring by a salt of a metal whether subsequently intensified by a dye or not, and by dyeing or dye toning is meant coloring of a treated image with soluble dye.

I claim:

1. Process of producing two differently colored prints in a single silver halid emulsion consisting in printing a diapositive and a dianegative image of the same subject in registration in different strata of the emulsion, developing the respective prints, rendering the dianegative print invisible, and differently coloring the respective prints.

2. Process of producing two differently colored prints in a single silver halid emulsion consisting in printing a diapositive and a dianegative image of the same subject in registration in different strata of the emulsion, developing the respective prints, removing the dianegative print, and differently coloring the respective prints.

3. Process of producing two complementary prints in a single silver halid emulsion, consisting in forming in registration, a diapositive and a dianegative silver print in different strata of the emulsion from complementary color value images of the same subject, treating the stratum carrying the dianegative print to render the silver image transparent and dye repellent while retain-

ing dye absorptiveness in the remainder of said stratum, dyeing such remaining portion to form one color print, and coloring the other print in the other stratum.

4. Process of producing two complementary prints in a single silver halid emulsion, consisting in forming in registration a diapositive and a dianegative silver print in different strata of the emulsion from complementary color value images of the same subject, bleaching the dianegative print and hardening the gelatine in situ therewith to render the image transparent and repellent to a gelatine dye, dyeing the remaining gelatine diapositive image, and coloring the positive silver image in the other stratum.

5. Process of producing two complementary colored images in the same emulsion, which consists in printing a diapositive and a dianegative in a single emulsion, hardening and removing the dianegative surface record, toning the silver image, and dyeing the soft gelatine of the surface.

6. The process consisting in printing in a light retarding sensitive emulsion complementary diapositive and dianegative images respectively in the inner and outer strata, bleaching the outer dianegative image and dyeing the adjacent silver free gelatine to form one image, and coloring the inner diapositive image with a complementary color.

7. The process consisting in forming in separated strata of a single silver halid emulsion a diapositive and a dianegative silver print, removing the diapositive image while rendering the gelatine in situ therewith repellent to dye without affecting the receptivity to dye of the remaining gelatine in the same stratum, dyeing such gelatine to form one diapositive dye image, coloring the other image with a complementary color, and fixing both images.

8. Process of producing two differently colored prints in a single silver halid emulsion consisting in printing a diapositive and a dianegative image of the same subject in different strata of a single emulsion, bleaching the dianegative and reducing the diapositive images, toning the diapositive image to one color, and dyeing the image in the other stratum to another color.

9. Process of producing two differently colored prints in a single silver halid emulsion consisting in printing a diapositive and a dianegative image of the same subject in different strata of a single emulsion, bleaching the dianegative and reducing the diapositive images, fixing, chemically toning the diapositive image to one color, and dyeing the image in the other stratum to another color.

10. Process of producing two differently colored prints in a single silver halid emul-

- sion consisting in printing a diapositive in the inner stratum of the emulsion and a dianegative in the outer stratum, bleaching the dianegative and reducing the diapositive images, chemically toning the diapositive image to one color and dyeing the image in the other stratum to another color.
11. Method of producing a color photograph by blending differently colored images within the same emulsion and comprising printing and then developing silver images in different strata of said carrier from color value negatives, differently converting both images for coloring, and fixing different color images by the agency of said differently converted images.
12. A color transparency in a single colloid layer comprising in one stratum a diapositive silver print colored, and in the other stratum a print having a transparent bleached dianegative portion and a gelatine dyed positive portion.
13. A color transparency in a single colloid layer comprising in the inner stratum adjacent the support, a diapositive colored color value image, and in the outer stratum an invisible uncolored dianegative and a dye positive complementary in color and value with the first image.
14. A color transparency in a single colloid layer comprising in the inner stratum adjacent the support a diapositive colored color value image, and in the outer stratum an invisible uncolored dianegative and a dye positive complementary in color and value with the first image, both said diapositive and dianegative being derived from sensitive silver salt originally contained in the emulsion.
15. A color transparency comprising in a single layer of colloid emulsion having in one stratum a silver print, and in the other stratum a dianegative silver print of the same subject.
16. A color transparency comprising in a single layer of colloid emulsion having in one stratum a silver print, and in the other stratum a dianegative silver print of the same subject in registration.
17. A color transparency comprising in a single layer of colloid emulsion having in the inner stratum a silver print, and in the outer stratum a dianegative silver print of the same subject.
18. A color transparency comprising a single layer of colloid emulsion having in the inner stratum next the transparent support a partially reduced diapositive silver print and in the outer stratum a positive image capable of taking dye.
19. A color transparency comprising a single layer of colloid emulsion having in the inner stratum next the transparent support a partially reduced diapositive silver print
- and in the outer stratum a positive image capable of taking dye associated with a dye repellent dianegative transparent image.
- Signed at New York, in the county of New York and State of New York, this 2nd day of December, A. D. 1922.
- WILLIAM V. D. KELLEY.

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