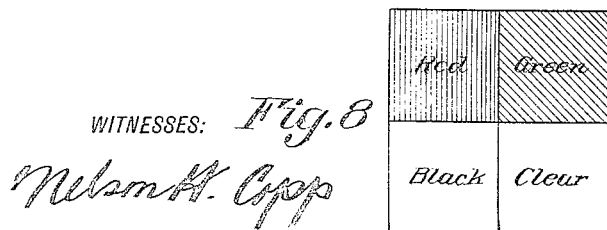
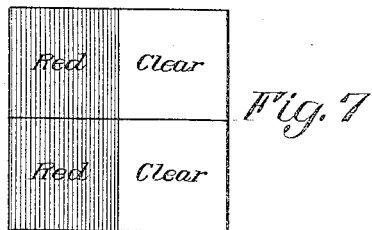
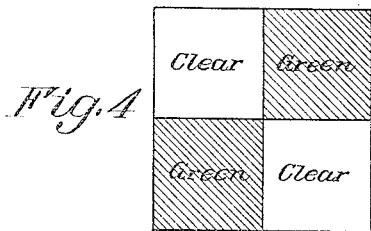
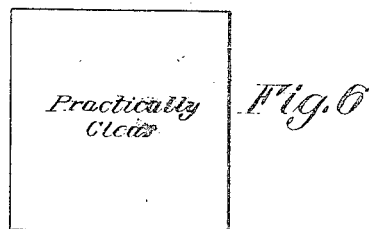
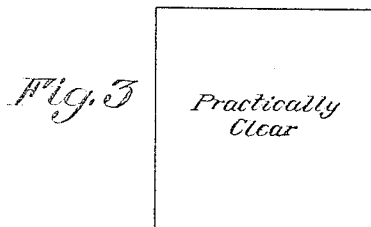
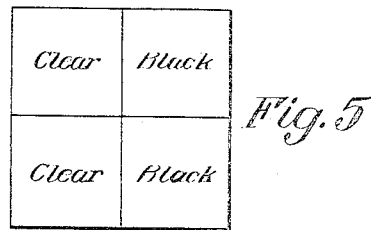
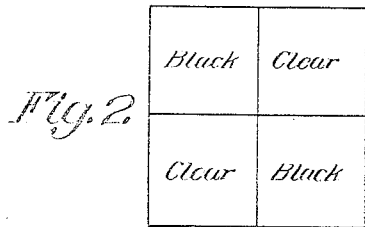
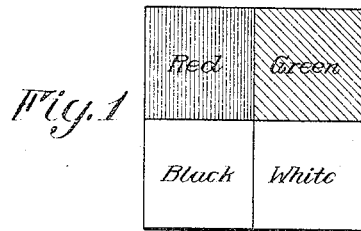


J. G. CAPSTAFF.
 PHOTOGRAPHS IN COLOR AND METHOD OF MAKING THE SAME.
 APPLICATION FILED SEPT. 21, 1914.

1,196,080.

Patented Aug. 29, 1916.



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UNITED STATES PATENT OFFICE.

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PHOTOGRAPHS IN COLOR AND METHOD OF MAKING THE SAME.

1,196,080.

Specification of Letters Patent.

Patented Aug. 29, 1916.

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To all whom it may concern:

Be it known that I, JOHN G. CAPSTAFF, of Rochester, in the county of Monroe and State of New York, have invented certain
5 new and useful Improvements in Photographs in Color and Methods of Making the Same; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of
10 this specification, and to the reference-numerals marked thereon.

My present invention relates to photography and more particularly to the production of photographs in color and it has for its object to provide a simple and convenient method of making photographic transparencies in two or more colors, which method may be successfully practised with the skill
15 of the ordinary photographer and without the use of special taking apparatus or a specially prepared sensitized medium, the plates and cameras already in general use being adequate for the purpose. Features
20 of novelty reside, further, in the article itself resulting from the carrying out of my process and it, therefore, is also part of the present invention.

To these and other ends the invention consists in certain improvements and combinations of parts all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the
30 specification.

To first give a general idea of the lines along which my invention proceeds, it may be stated preliminarily that I utilize the idea of treating a plurality of different color sensation records of a given subject in such
40 manner that when subjected to certain dye solutions, they will each partly absorb and partly repel the particular dye applied according to the sensations they have recorded and thus while constituting substantial
45 duplicates of each other in image outline they will constitute complements of each other in the matter of color and intensity. Their composite effect, therefore, when superposed and viewed by transmitted light, will
50 show instances of predominance of each color as well as the predominance of neither due to their neutralizing effect upon each other, and the absence of both, the last named conditions supplying the light and
55 shade values.

I shall first describe my method in connection with the production of two color pictures, say in red and green, as this is its simplest form and gives a very pleasing
60 result.

In practising my invention I first obtain two negatives of the subject to be reproduced upon sensitive films, the sensitive body being composed of panchromatic silver bromiodid suspended in a suitable vehicle such
65 as gelatin, hereinafter termed sensitized gelatin films. I prefer to do this by successive exposures through the same lens with the ordinary apparatus or one modified only to the extent of adapting it for the reduction to a minimum of the time interval
70 between exposures, but it is obvious that the components may be obtained in other ways. By "film" I mean the word in its original sense, that is, a light sensitive salt suspended
75 in a colloid such as gelatin whether upon a base of glass or a flexible support. One negative is made mainly by the green light reflected by the subject and the other mainly
80 by the red light, preferably through the use of red and green filters applied to the lens. The two negatives are developed and washed as usual. I then submit the negatives to a bleaching and tanning bath which
85 converts the free silver into a salt of silver which is subsequently removed in a hypobath, and leaves the films practically clear, transparent and almost colorless except for a faint brownish trace of the original image. The bath preferably consists of the following
90 solution:

A. Potassium ferricyanid	37.5	gms.
" bromid	56.25	"
" bichromate.	37.5	"
Acetic (or similar) acid	10	cc.
Water	1,000	cc.
B. Potassium alum	5	%

For use take equal parts of A and B. The solution may be diluted by adding water. 100

The bath may be applied at ordinary temperatures and the solution washed back and forth across the film by rocking the tray as usual in photographic manipulations until the results quoted are obtained. Aside from
105 the conversion of the silver into its salt, the bleaching step brings about another rather more important change. Peculiar chemical reactions that set in have the effect of tanning or similarly affecting the gelatin in the
110

immediate neighborhood of each silver particle attacked so that what were the black portions of the original negative film are rendered substantially impenetrable to the dye that is next applied, substantially in proportion to the amount of silver originally present, while what were the light portions of the original negative that lack the free silver remain unchanged in this respect or substantially so and are still in condition to be permeated by the coloring matter. Before dyeing, however, it is important for perfect results that the films be dried thoroughly. Otherwise, the dye intrudes upon those parts that ought to remain clear.

An acid dye, (preferably a salt of a sulfonic acid) is used and in the two color method being followed, two baths are provided; one an orange-red and the other a blue-green. The red sensation record, that is, the film exposed through the red filter, is, by submersion, dyed green, while the green sensation record exposed through the green filter is similarly dyed red. The distribution of the silver particles and hence of the tanned or otherwise affected portions on the two films is diversified according to the different color values they respectively record and hence the dye takes effect partly at the same and partly at different relative points. At this point, the films may be rinsed again in water to remove the superfluous dye and quickly dried with the aid of preliminary blotting or squeegeeing to prevent lateral diffusion of the dye and a resulting lack of good definition, but more preferably they are treated with dilute acid which has the effect of what may be termed "fixing" the dye with even better results. In fact, the acid treatment is greatly preferable particularly where this invention is practised for the production of cinematograph film in color where, from their very nature, it is difficult to conveniently and quickly handle for drying, the great lengths of film while any lack of definition in the small pictures is, of course, greatly, aggravated when they appear on the projecting screen.

When the two dried films are superposed upon each other with the images in exact register and the combination is viewed by transmitted light, it will be seen that a positive reproduction of the subject with the black, white, red, green and various intermediate values of its color scheme reproduced will result. Since the green filter absorbs red light, all red portions of the original subject produced little or no effect upon the sensitive film emulsion; hence these remained substantially untanned and subsequently absorbed red dye. The red filter, however, transmitted the red light and in consequence, the red objects were recorded

fully on the red sensation negative, became strongly tanned, and repelled the green dye; the resultant effect of the superimposed films thus showing red only at these parts. In other words, where the subject was red in color, the green filter made it appear black (to the eye) and hence recorded it light on the one film. This light portion not being tanned by the bleaching, subsequently absorbed deeply the red dye. The red filter made it appear light (to the eye) and hence recorded it dark or silvered on the other film which portion being tanned did not absorb the green dye but remained clear. The superposition would therefore allow the red to show through unobstructed and to predominate the area of the positive image corresponding to the red of the subject. The reverse would be true with the green color in the subject. In the same way, the reproduction of the black and white of the subject with black and white to correspond in the finished picture can be traced, the black resulting from an opacity due to the neutralizing effect of deep red and deep green superposed and the whites and grays from a total lack of the predominance of either.

In the accompanying drawing I have shown diagrammatic views illustrating roughly the steps of the method in making a picture of a colored object containing only the two colors, red and green, and also white and black areas, and have indicated by the conventional shading and by words, the coloring or lack of color the respective parts are given or assume after the treatments indicated thereon. Figure 1 indicating the object; Fig. 2 a diagram of the negative formed when exposed through the red filter; Fig. 3 a diagram of the same negative after bleaching and fixing; Fig. 4 a diagram of the same after dyeing in the green bath; Fig. 5 a diagram of the negative made through the green filter; Fig. 6 a diagram of the negative after bleaching and fixing; Fig. 7 a diagram of the same after dyeing in the red bath; Fig. 8 a diagram of the composite image when the parts shown in Figs. 4 and 7 are superposed and viewed by transmitted light.

The fixing of the two films to remove the silver salts, preceded and followed, of course, by washing, preferably occurs immediately after the bleaching step, for while the films may be fixed after the development, as usual, and before the bleaching, such fixing constitutes a really unnecessary step at that point for the reason that the bleaching solution, in dissolving the silver, re-precipitates it in the form of silver bromid and fixing must therefore follow the bleaching anyway, while it is immaterial to the action of the bleach whether the developed film has been previously fixed or not. Where a third color is desired, a tri-color

process is worked in the same way, a third color sensation negative being produced, bleached and suitably dyed and the dye image superimposed upon the other two. preferably the gelatin film of this third component is stripped from its support so as not to produce too great a separation of the images. A more pleasing and truthful appearance results when the finished transparency in two colors only is viewed before an incandescent artificial light as such light contains less blue than daylight and approximates closely to that transmitted by the taking filters.

One of the practical advantages of my method is that by it a positive dye image or picture is obtained directly from the black and white negative without first converting the latter into a positive although, obviously, if master positives are made, any desired number of duplicate color positives may be printed therefrom.

In practising my invention, care should be exercised, in the first place, in obtaining good negatives, particularly avoiding over-exposure, and the drying step before dyeing is an important one, as previously pointed out.

The behavior of the sensitive film when gelatin is used as the vehicle for the silver, under treatment in the bleaching and tanning bath is characteristic to some extent of other substances of the colloid group, but I recommend the use of gelatin, alone.

I claim as my invention:

1. The method of making photographs in color, which consists in preparing two photographic negative images of the subject on gelatin light sensitive films by the action of differently colored lights, said negatives being otherwise duplicates of each other, bleaching and differentially tanning the gelatin of each according to the light gradations it has recorded, subjecting each of the two films to the action of a different dye, said films having been fixed at some stage after bleaching and superposing the films with the images in register, whereby when said films are viewed by transmitted light in such superposed registering relationship, their combined color effects are made apparent.

2. The method of making photographic reproductions in colors which consists in preparing two photographic negative images of the subject on sensitized gelatin films, one through a red screen or filter and the other through a green screen or filter, said negatives being otherwise duplicates of each other, developing the images, bleaching and differentially tanning the gelatin of each according to the light gradations it has recorded, dyeing the film exposed through the green filter red and the film exposed through the red filter green, fixing the films at some

stage after bleaching, and finally placing them in superposed registering relationship whereby their combined color effects may be viewed by transmitted light.

3. The method of making photographic reproductions in colors which consists in preparing two photographic negative images of the subject on gelatin light sensitive films by the action of differently colored lights, said negatives being otherwise duplicates of each other, developing the images, treating the films before they are fixed to bleach and differentially tan the gelatin of each according to the light gradations it has recorded, dyeing the films different colors appropriate to their respective tanned color values, fixing the dyes in the films and finally placing the films in superposed registering relationship whereby their combined color effects may be viewed by transmitted light.

4. The method of making photographic reproductions in colors which consists in preparing two photographic negative images of the subject on gelatin light sensitive films by the action of differently colored lights, said negatives being otherwise duplicates of each other, developing the films, bleaching and differentially tanning the gelatin of each according to the light gradations it has recorded, fixing the films, washing and drying the films, dyeing the films different colors appropriate to their respective tanned color values after such drying, fixing the dyes in the films and finally placing the films in superposed registering relationship whereby their combined color effects may be viewed by transmitted light.

5. The method of making photographic reproductions in colors which consists in preparing two photographic negative images of the subject on gelatin light sensitive films by the action of differently colored lights, said negatives being otherwise duplicates of each other, developing the films, bleaching the films in a solution composed of potassium ferricyanid, potassium bromid, potassium bichromate, acetic acid and potassium alum substantially as described, thereby tanning the gelatin of each according to the light gradation it has recorded, fixing the films, dyeing the films different colors appropriate to their respective tanned color values, fixing the dyes in the films and finally placing the films in superposed registering relationship whereby their combined color effects may be viewed by transmitted light.

6. The method of making photographic reproductions in colors which consists in preparing two photographic negative images of the subject on gelatin light sensitive films by the action of differently colored lights, said negatives being otherwise duplicates of each other, developing the films, bleaching

and differentially tanning the gelatin of each according to the light gradations it has recorded, dyeing the untanned portions of the films different colors appropriate to their
5 respective tanned color values, fixing the color in the dyed films against diffusion by means of an acid bath, and finally placing them in superposed registering relationship whereby their combined color effects may be
10 viewed by transmitted light.

7. The method of making photographs in colors which consists in preparing two photographic negative images of the subject on gelatin films sensitized by silver bromo-
15 iodid of silver, and each having recorded thereon the action of a different but complementary colored light, said negatives being otherwise duplicates of each other, subjecting each film to the action of a bleaching and
20 tanning bath substantially such as described, fixing the film to remove the silver salts, subjecting each film to the action of a dye, the

dyes for each film being complementary in color to the light recorded on the original negative, and superposing the film with the
25 images in register.

8. As an article of manufacture, a photographic reproduction in colors consisting of a transparency formed of two superposed
30 duplicate images in gelatin constituting different but approximately complementary color sensation records of the same object, which records contain no free silver and are
35 respectively impregnated with dyes of different but approximately complementary colors that are distributed as to density in each instance in inverse proportion to the density of the silver deposit originally obtained in each negative.

JOHN G. CAPSTAFF.

Witnesses:

RUSSELL B. GRIFFITH,
HARRIET T. VAY.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents,
Washington, D. C."