N° 13,429 A.D. 1915

(*Under International Convention.*)

Date claimed for Patent under Patents and Designs Act, 1907, being date of first Foreign Application (in the United States), 21st Sept., 1914

Date of Application (in the United Kingdom), 21st Sept., 1915

At the expiration of twelve months from the date of the first Foreign Application, the provision of Section 91 (3) (a) of the Patents and Designs Act, 1907, as to inspection of Specification, became operative

Accepted, 15th June, 1916

COMPLETE SPECIFICATION.

Improvements in or relating to the Production of Photographs in Colours.

I, JOHN GEORGE CAPSTAFF, Physicist, of 16, Electric Avenue, Rochester, State of New York, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to photography and more particularly to the production of photographs in colours and it has for its object to provide a simple and convenient method of making photographic transparencies in two or more colours, which method may be successfully practised with the skill 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.

The invention relates more particularly to processes for the production of photographs in colours of the kind in which two or more negative colour sensation records taken through appropriate colour screens are converted into dye-positives and are then placed in superimposed registering relationship in order to be viewed by transmitted light the resulting picture reproducing approximately the natural colours of the particular subject.

Various methods of treating the negative images to convert them into dye-positives have been proposed but the primary feature of the present invention is that the negative image before dyeing is bleached and differentially tanned in such a manner that a substantially transparent and substantially colourless body is obtained for treatment in the dye bath subsequently applied. The obtainment of this substantially transparent and colourless body greatly facilitates the process as it enables the depth of the colour to which the image is afterwards dyed to be estimated with accuracy and obviously the truth of the final picture must necessarily depend not only upon the colours used for dyeing the separate images but also upon the depth or intensity of the colours in those images.

[*Price* 6*d.*]

The method according to this invention will first be described in connection with the production of two colour pictures, say in red and green, as this is its simplest form and gives a very pleasing result.

In practising the invention, two negatives of the subject to be reproduced are first obtained upon sensitive films, each composed of panchromatic silver bromo-iodide suspended in a suitable vehicle such as gelatine, hereinafter termed sensitized gelatine films. This is preferably done by successive exposures through the same lens with the ordinary apparatus or apparatus modified only to the extent of adapting it for the reduction to a minimum of the time interval between exposures, but it is obvious that the components may be obtained in other ways. By "film" is meant the word in its original sense, that is, a light-sensitive salt suspended in a colloid such as gelatine 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 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.

The negatives are then submitted to a bleaching and tanning bath which converts the free silver into a salt of silver which is subsequently removed in a hypo bath, and leaves the films practically clear, transparent and almost colourless except for a faint brownish trace of the original image. The bath preferably consists of the following solution:—

A. Potassium ferricyanide	37.5	gms.
,, bromide	56.25	,,
,, bichromate	37.5	,,
Acetic (or similar) acid	10	cc.
Water	1000	cc.
B. Potassium alum	5%	

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

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. Apart from the conversion of the silver into its salt, the bleaching step brings about another and more important change. Peculiar chemical re-actions that set in have the effect of tanning or similarly affecting the gelatine in the immediate neighbourhood 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 colouring 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 sulphonic acid) is used and in the two-colour 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 colour 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 squegeeing 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 colour where, from their very nature, it is difficult to handle conveniently and quickly for drying, the great lengths of film while any lack of definition in the small pictures is, 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 colour 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 colour, 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 colour 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.

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 bromide 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 colour is desired a tri-colour process is worked in the same way, a third colour sensation negative being produced, bleached and suitably dyed and the dye image superimposed upon the other two. Preferably the gelatine 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 colours 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 the improved 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 colour positives may be printed therefrom.

In practising the 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 behaviour of the sensitive film when gelatine is used as a 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 gelatine alone.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A process for making transparent photographs in colours of the kind in which two or more negative images after being converted into dye-positives are placed in superimposed registering relationship, characterised by the negative images before dyeing being bleached and differentially tanned in such a manner that a substantially transparent and substantially colourless body is obtained for treatment in the dye bath, thus facilitating the dyeing of the image to the requisite depth or intensity.

2. A process for making transparent photographs in colours as claimed in Claim 1 in which the bleaching and differential tanning is produced by treating the negative image in a bath of potassium ferricyanide, potassium bromide, potassium bichromate, acetic or similar acid and potassium alum preferably in the proportions specified.

3. A process as claimed in Claim 1 in which the films are dried after treatment in the bleaching and differential tanning bath and then, after dyeing, are treated with dilute acid to fix the dye.

4. The process for making transparent photographs in colours as herein described.

5. Transparent photographs in colours made according to the process herein described.

Dated this 21st day of September, 1915.

KILBURN & STRODE,
Agents for the Applicant.

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