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(Under International Convention.)

Date claimed for Patent under Patents and Designs Act, 1907, being date of first Foreign Application (in the United States), } 11th Feb., 1913

Date of Application (in the United Kingdom), 10th Feb., 1914

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

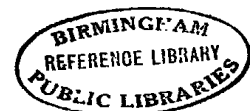
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COMPLETE SPECIFICATION.

Improvements in the Art of Color Photography.

I, PERCY DOUGLAS BREWSTER, of 65, Prospect Street, East Orange, Essex County, State of New Jersey, United States of America, Manufacturer, 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:—

- This invention relates to the art of making color pictures photographically, and more particularly to the production of negatives and positives and their projection in natural colors. Positives in accordance with this invention may be used either as motion pictures, lantern slides, transparencies or the like.
- 10 Heretofore the most successful practical method of color photography for motion picture work, known as the Urban-Smith kinemacolor method, consisted in making a negative by exposing the image to the film and alternately interposing a red shutter and a green shutter between the subject and the film, so that alternate pictures upon the film are taken in red and green light. The
- 15 positive made from this negative is then projected in a projecting apparatus having a similar red and green shutter. In order to blend the colors properly, the camera and projecting apparatus must be operated at twice the ordinary speed, and it is necessary to use a film of double the length of the ordinary non-colored motion picture film.
- 20 The principal objects of this invention are to produce a color picture from a single exposure on a negative which when printed on a positive will be suitable for projection in an ordinary motion picture projecting apparatus; to insure the proper superposition of the colors; to allow an increased time of exposure in making the negatives as compared with the kinemacolor process; to eliminate
- 35 the use of a moving color screen in making and projecting the pictures; to shorten length of the film and reduce the speed at which it travels through the projecting apparatus; to secure a more perfect blend of color; to reduce the amount of lighting necessary in projecting the pictures; and to produce a pure white.
- 30 Now in accordance with my invention, I provide a basically novel method of
- [Price 6d.]



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reproducing images in color upon a film or support coated on both sides with emulsions sensitive to light, which method consists in dividing the light emanating from the object into color groups, one of which acts on the emulsion on one side of the film while the other acts on the emulsion on the other side of the film.

In order that the invention may be more clearly understood, a number of methods of carrying same into practice will now be described in detail, and some of them with reference to the accompanying drawing, in which:—

Fig. 1 is an enlarged section through a film sensitized on both sides; Fig. 2 is a section through a film in which a stained medium is inserted between the body of the film and one of the sensitized surfaces; and Figs. 3 to 13 represent a colored object and the records of this object on both sides of the positive and negative films before and after staining and the projection of the negative and positive films.

Referring to Fig. 1 of the drawing, I will now describe a complete method of carrying the invention into practice. The photographic film 1 is sensitized on one side so that it will be acted upon by light of one group of colors, such as blue and green, while the other side of the film is sensitized so that it will be acted upon by light of other colors, such as red and orange. After the film has been exposed in a camera with the side of the film sensitized for green nearer the lens, it is developed and fixed, and the images on both sides of the film are colored or stained different colors, thereby producing a negative in color from which prints may be made on a similarly prepared film. The side of the film nearer the lens, which I call the front of the film, is coated with an emulsion 2 that is preferably adapted to be acted upon by the blue and green light and is made as transparent as possible to allow the maximum amount of light to pass through the film and act on the emulsion 3 on the other side which is panchromatic or sensitive to red and orange.

The exposure is generally made through a ray filter (not shown), preferably light yellow in color and adapted to cut off the violet and ultra-violet rays of light. The green and blue light with the addition of some yellow, after passing through the ray filter, act upon the transparent emulsion 2 on the front of the film, while the red and orange light with some yellow passes through the film and acts upon the panchromatic emulsion 3 on the back of the film. The color that the transparent emulsion 2 is stained prevents the passage of a substantial amount of blue and green light through the film to act upon the panchromatic film on the back.

The film may then be developed and fixed in the ordinary way and the silver deposited on the front of the film is stained a blue-green or green color, while the silver deposited on the back of the film is stained a red or orange color, the rest of the film not being acted upon by the stain, the two colors used being preferably substantially complementary to each other.

A positive film is now made from this negative by printing on a film that has been prepared in the same manner as the negative film, one side of the film being coated with a preferably transparent emulsion stained yellow and sensitive to blue and green, while the other side is coated with a panchromatic emulsion or with an emulsion sensitized for orange and red. The light used in printing the positive should preferably be without violet or ultra-violet rays or these rays should be eliminated by means of a color screen before the light reaches the positive film. Many other ways of eliminating undesired colors in the light used in printing the positive may be employed, as for instance, by printing the positives by light of two different colors, such as red and green. After the positive film has been developed and fixed, each side is stained a substantially similar color to that of the light that acted upon it, the silver deposited on the green or blue-green side of the film being stained a green or blue-green, while the silver deposited on the side of the film acted upon by the orange and red rays is stained

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a red or orange, the high lights on both sides of the film being left clear, and the depth of the stain varying with the amount of silver deposited on the film.

Suppose the subject photographed is a light red object *a* against a light blue-green background *b* with snow *c* in the foreground such as is shown in Fig. 3; on the front side of the negative, after it has been developed, the blue-green background *b* would be black, the red object *a* transparent and the snow *c* dark (due to the blue-green rays reflected by the snow) as in Fig. 7; while the back of the negative would show the red object as black, the blue-green background as transparent and the snow dark as in Fig. 6. After the negative is stained the front (Fig. 9) would show the object as transparent, the background as a dark green and the snow as a dark green, while the back of the negative (Fig. 8) would show the red object as a dark red, the background as transparent and the snow as red. If the negative film be held to the light, as in Fig. 4, the object would appear as dark red, the background as dark blue-green and the snow as black (due to the light being unable to pass through a deep red and a deep blue-green). The front of the positive film (Fig. 11) before staining would show the object as transparent, the background as a light grey and the snow as transparent, while the back of the positive film (Fig. 10) would show the object as a light grey and the background and snow as transparent. After the positive is stained the front side (Fig. 13) would show the object as transparent, the background as a light blue-green and the snow as transparent, and the back of the film (Fig. 12) would show the object as light red in color and the background and snow as transparent. When projected in white light the subject would appear in its proper colors, Fig. 5, the object as a red, the background as a light green-blue and the snow as white.

The whites in the final positive may be cleared (if slightly colored or stained) by a reducer or by treating with sodium carbonate, so that the film will be absolutely clear and a pure white projected. While the pictures are taken in two colors, substantially red and blue-green, the whites are actually reproduced in projection, inasmuch as white light, containing the violet rays, is thrown through the clear portions of the film onto the screen to form a pure white, in contrast with the "kinemacolor" method in which whites are obtained by addition of reds and greens.

A large number of modifications may be made in this process without departing from the spirit of the invention. The emulsion on the front of the film may be sensitized so as to be practically inert to any color light except blue and green and the use of the ray screen dispensed with. A transparent emulsion may be coated upon the front of the film and the celluloid or body of the film stained to prevent the passage of blue and green light rays, or the body of the film, Fig. 2 may be coated between the two sensitized surfaces 2 and 3 with a substance 4, such as gelatine, stained to cut off the blue and green light rays. The emulsion on the back of the film instead of being panchromatic may be treated so as to be extremely sensitive to red and orange thereby reducing the time of exposure. An ordinary emulsion may be sensitized for blue-green by treating with acridine orange usually designated by the letters NO and for red with cyanine. A large number of sensitizers or dyes are useful to secure different results. If the emulsion on the back of the film be treated with a sensitizer such as cyanine, which, while rendering the emulsion extremely sensitive to red also makes it comparatively inert to blue and green, the film could be used without staining either the emulsion on the front or the body of the film to prevent the blue and green light reaching the back of the film, thereby still further decreasing the time of exposure by avoiding a loss in the intensity of the red rays by passing them through the stained emulsion.

The negative and positive film may be colored by immersing them in an aqueous solution of iodine and potassium iodide to convert the silver into silver iodide, then treating the film with a basic dye, of suitable color, which precipitates the iodide and gives an opaque image which may be dissolved out with

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potassium cyanide or in an alum bath containing tannin or tartar emetic, the action of these substances preventing the dye washing out. After fixation the film is merely washed and the image consists of a perfectly transparent dye.

The ray filters may be made by staining gelatine with picric acid or naphthol yellow for a light screen, or with auracin for a deeper or orange screen, the details for making these screens being well known.

It will be obvious that positive films prepared in accordance with the aforesaid method may be made from any negative having images corresponding to different color groups of the object on each side thereof.

The films are developed and fixed in a manner similar to the treatment of the ordinary or orthochromatic films and plates. A negative film may be converted into a positive film by any of the well known processes, such as treating with potassium bichromate and redeveloping, then coloring, and then projecting same.

Equal action of light on the two emulsions may be secured by varying the shade of the color screen so that it reduces the action of the blue and green light rays until both the red and blue-green rays have equal action on their respective emulsions. The colors may be still further equalized by staining either side of the film a deeper or lighter color so that when blended they will closely reproduce the natural colors.

Throughout this specification orange and red or orange-red have been referred to, and blue and green or blue-green but it is intended that any of the red group of colors may be used in connection with any of the blue-green colors.

In motion picture work it is apparent that the pictures are made on a long strip of film that has been treated on either side to secure the proper results.

The advantages of this method in comparison with the well known "Urban-Smith kinemacolor" method of projecting alternate red and green pictures are that the whites of the pictures are reproduced in projection by virtue of the passage of the white projecting light (including violet and the weaker colour combinations) through the clear portions of the film, and are not compounded from the two colours used in the analysis of the scene; that pictures of both colors are taken simultaneously thereby preventing a failure of color registration owing to the object moving between the time of the red and green pictures; that only half the speed through the projector is required and only the same illumination as the black and white film, thereby allowing the color film to be projected through an ordinary projector without change of speed or lighting and avoiding the necessity of specially trained operators; and to produce a pure white.

I wish it to be understood that many modifications of my invention may be made without departing from the spirit thereof, and the particular methods hereinbefore described are given by way of example and not by way of limitation.

The films described herein are claimed in my Divisional Application No. 2465/15 filed February 16th 1915.

In the claims which follow I have used the term "double sensitized film or support" to mean a film or support sensitized on both sides.

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. The method of photographically reproducing images in color upon a film or support, said film or support being coated on both sides with emulsions sensitive to light, said method consisting in dividing the light emanating from the object into color groups, one of which acts on the emulsion on one side of the film, while the other acts on the emulsion on the other side of the film, for the purpose specified.

2. The method of producing a negative in color upon a double sensitized film, the emulsion on one side of which has been acted upon by light of one color group, while the emulsion on the other side has been acted upon by light of

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another color group, which consists in preliminarily treating the film (as by developing and fixing), and staining the images on each side thereof a different color, for the purpose specified.

3. Method of producing positives for color photography which consists in
5 taking a double sensitized film or support, the emulsion on one side of which is rendered sensitive to light of one color group, while the emulsion on the other side is rendered sensitive to light of a different color group, and then printing this positive from a negative in different colors.

4. The step in the method of reproducing images in color photographically
10 which consists in printing the positive upon a double sensitized film or support the emulsion on one side of which is rendered chiefly sensitive to light of one color group, while the emulsion on the other side is rendered chiefly sensitive to light of a different color group, and then staining the images on both sides of the positive different colors, for the purpose specified.

15 5. The method of reproducing positives upon double sensitized films or supports which consists in printing the positive from the negative in two or more colors, and treating the light used for printing so that only light of the desired color groups effects the printing, for the purpose specified.

6. The method of correcting the colors of a double sensitized film or support
20 which consists in staining the images on either side thereof a deeper or lighter color so that when blended they will closely reproduce the natural colors.

7. The method of correcting the colors of a double sensitized positive which consists in printing the positive by light passing through a filter and varying the amount of light of one color until the desired tone of color on one side of the
25 film is obtained relative to the tone of color on the other side thereof, for the purpose specified.

8. The improved method of reproducing images photographically substantially as herein described.

Dated this 10th day of February, 1914.

30 For the Applicant,

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[This Drawing is a reproduction of the Original on a reduced scale.]

