N° 2465 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), 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

Accepted, 10th May, 1915

COMPLETE SPECIFICATION.

Improvements in the Art of Colour 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 a film for color photography, and especially for motion picture color photography.

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 subject to the film and alternately interposing a red shutter and a green shutter between the image and the film, so that alternate pictures upon the film are taken in red and green light. The 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.

In my co-pending Application for British Letters Patent No. 3435 of 1914, filed Feb. 10th, 1914, I have described a novel method of 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 accordance with my present invention I provide a sensitized film or support for color photography having emulsion coatings on both sides thereof, the emulsion coating on one side being rendered sensitive to light of one color group, while the emulsion on the other side of the film is rendered sensitive to light of a different color group, the colour groups being preferably complementary or substantially complementary for the purpose hereinafter set forth.

My invention further provides a motion picture film bearing on its two sides

[*Price 6d.*]

images of the same object taken through the same lens, the images on one side being recorded by light of one color group from the object such as red, and the images on the other side being recorded by light of another color group such as green or blue-green from the object.

My invention further provides a finished motion picture film having on each side of the film photographic images colored different colors, and in photographic registry as hereinafter explained, such that when light is projected through it the images on each side will blend to form a unitary image in color.

In order that the invention may be more clearly understood, same will now be described with reference to the accompanying drawings and in connection with the method set forth in my aforesaid co-pending application.

Referring to the drawings:—

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, 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 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 (they are projected in three colors) 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 1, 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 iodine 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 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 napthol 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 bichromatic 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 colours 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 pictures are projected in three colors, white light including violet being introduced through the parts of the film that are transparent, and also into the weaker color combinations;" 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 as compared with that of the Urban-Smith method 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.

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.

The term "photographic registry" as employed hereinbefore and in the claims, implies that the pictures on the back of the finished motion picture film are in register with the pictures in front, and both pictures show the component parts of the moving object in exactly the same position of the object, and viewed from the same point, owing to the pictures on the positive being made by photographic means from a negative in which the pictures are in register due to photographing the object simultaneously in point of time on the said negative through the same lens.

It has already been proposed to make a photographic film with a transparent base, and coated on one side or on opposite sides with emulsions of different speeds or differently orthochromatised. According to the present invention two

emulsions are used, that on one side being sensitive to light of different color groups from that on the other side, such color groups being preferably complementary or substantially complementary to each other in order to attain the purpose hereinbefore set forth.

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 double sensitized film or support for color photography, the emulsion on one side of the film being rendered sensitive to light of one color group, while the emulsion on the other side of the film is rendered sensitive to light of a different color group, said color groups being complementary for the purpose specified.

2. A double sensitized film or support for color photography, in which the emulsion on the front of the film is stained with a color which prevents light of an undesired color reaching the emulsion on the back of the film, for the purpose specified.

3. A double sensitized film or support for color photography, in which the emulsion on one side of the film is treated with a sensitizer, (such as cyanine) which renders the emulsion extremely sensitive to red and comparatively inert to blue and green, for the purpose specified.

4. A motion picture negative bearing on opposite sides coinciding images of the same object taken simultaneously through the same lens, one set of images being recorded by light of one color group, such as red, from the object, and the other set of images being recorded by light of another color group, such as blue and blue green, from the object, for the purpose specified.

5. A finished motion picture color film made from a double sensitized film, and having on each side thereof photographic images colored different colors, and in photographic registry or coincidence as hereinbefore defined, such that when light is projected through it, the images on both sides will blend to form a unitary image in color, as and for the purpose specified.

6. A finished motion picture color film having colored photographic images on each side thereof in photographic registry or coincidence as hereinbefore defined, such that when light is projected through it, the images on both sides will blend to form a unitary structure, said film made from film stock sensitized on both sides, the emulsion on one side being chiefly sensitized to light of one color group, and the emulsion on the other side chiefly sensitized to light of another color group.

7. The improved negatives, positives and films, for reproducing images in color photographically, substantially as herein described and illustrated.

Dated this 16th day of February, 1915.

For the Applicant:

H. A. GILL & Co.,
Chartered Patent Agents,
55/56, Chancery Lane, London, W.C.

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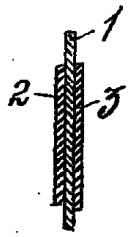

FIG. 1.

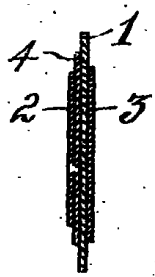

FIG. 2.

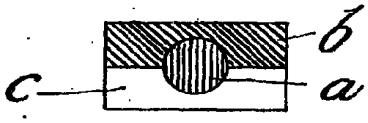

FIG. 3.

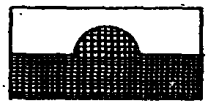

FIG. 6.

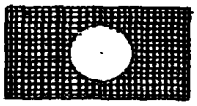

FIG. 7.

FIG. 8.

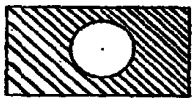

FIG. 9.

FIG. 4.

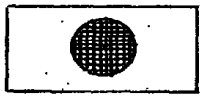

FIG. 10

FIG. 11.

FIG. 12.

FIG. 13.

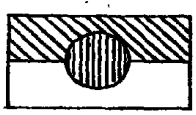

FIG. 5.

Malby & Sons, Photo-litho.