C. RALEIGH & W. V. D. KELLEY.

FILM OR THE LIKE FOR COLOR PHOTOGRAPHY.

APPLICATION FILED APR. 13, 1916.

1,216,493. Patented Feb. 20, 1917.

Fig: 1.

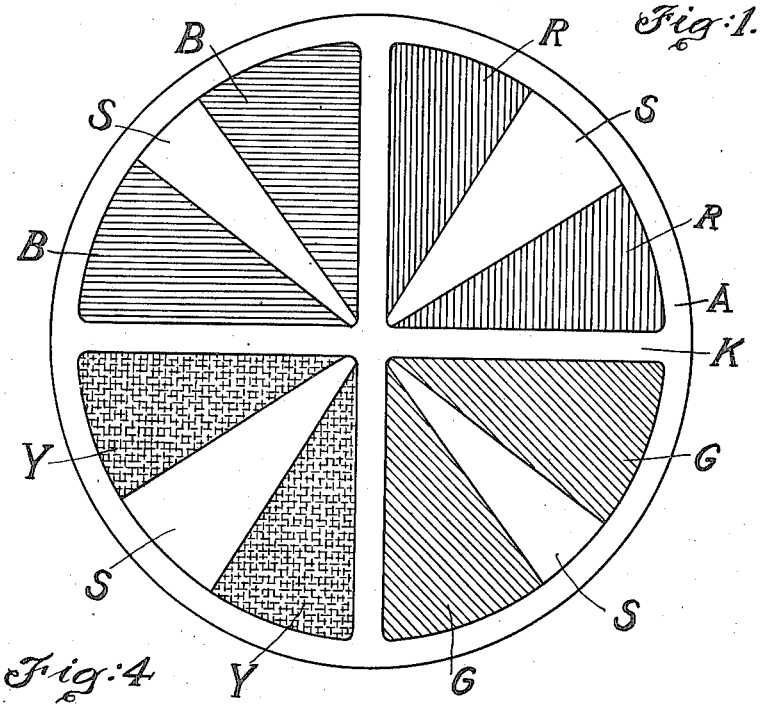


Fig: 4

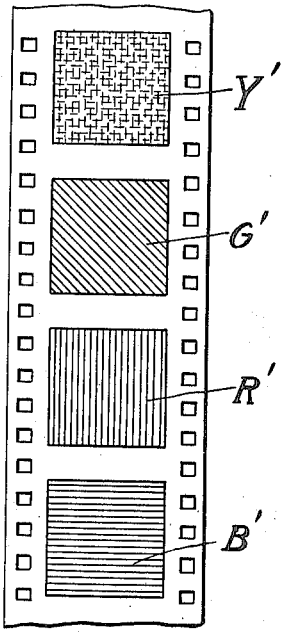


Fig: 2.

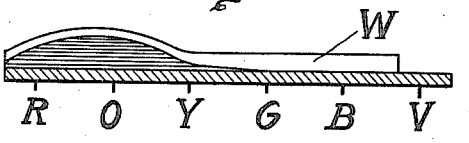
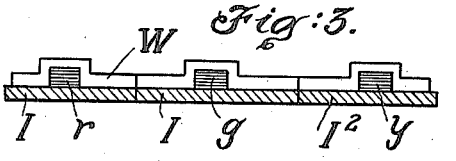


Fig: 3.



Inventors
Charles Raleigh, &
William V. D. Kelley,
By their Attorneys
Edwards, Sager & Wooster.

UNITED STATES PATENT OFFICE.

CHARLES RALEIGH, OF JERSEY CITY, NEW JERSEY, AND WILLIAM V. D. KELLEY, OF BROOKLYN, NEW YORK, ASSIGNORS TO PRIZMA INCORPORATED, A CORPORATION OF VIRGINIA.

FILM OR THE LIKE FOR COLOR PHOTOGRAPHY.

1,216,493. Specification of Letters Patent. Patented Feb. 20, 1917.

Original application filed October 7, 1914, Serial No. 865,431. Divided and this application filed April 13, 1916. Serial No. 90,832.

To all whom it may concern:

Be it known that we, CHARLES RALEIGH and WILLIAM V. D. KELLEY, citizens of the United States, residing at Jersey City, county of Hudson, State of New Jersey, and Brooklyn, county of Kings, State of New York, have invented certain new and useful Improvements in Films or the like for Color Photography, of which the following is a full, clear, and exact specification.

This invention relates to photography in colors, and has particular reference to a photographic image, and a series of images, which will give reproductions of motion pictures of full detail in delicate natural colors, instead of the usual exaggerated colored images deficient in photographic detail. The image of this invention differs from previously known images produced by exposures through color screens in that it is a combination of a color value and substantially white light values, and thereby has a greater intensity and depth of perspective than a simple color image alone. In recurring series for different color values, the several color value images of each series are of more uniform intensity and when projected in motion pictures, either with or without color screens, have a very decidedly greater effect of solidity and relief more nearly approaching a stereoscopic effect than has heretofore been obtained either in color or black and white work.

The apparatus at present used for producing photographic pictures in natural colors, records color values in black and white on panchromatic emulsions, the several color values being obtained by filtering the light from the object in taking, and passing the light from the source, in projecting, through color screens. The number of colors in the screens varies with different methods, but commonly ranges from two to four. That is, the screen carrier employed either in taking or projecting may be divided into two, three, four or more selective colored sections, each section transmitting only rays corresponding thereto and excluding others, thus a recurring series of images is produced wherein the successive images of each series differ from each other in color values, intensity and perspective. In such prior process, the resultant pictures are deficient in detail and perspective owing to the inaccurate and uneven color value records made by such rays as pass through the color screens and record themselves on the panchromatic emulsion.

In the aforementioned multi-color processes it is necessary to photograph and project at a speed of from 32 to 48 per second, as compared with a speed of about 16 per second for ordinary black and white work, which reduced exposure for color work tends to accentuate the inaccuracies and defects.

By our present invention, the varying densities of the different color values in a recurring series of panchromatic pictures are leveled and intensified, while at the same time the images retain a differential color value, enabling us to produce colored motion pictures of great detail and perspective, of natural and delicate color. The images can be made with at least a fifth of the exposure hitherto essential, and at a speed practically equal to that of ordinary black and white.

Our invention is adapted to two, three, four, or more color processes. That is, processes in which a corresponding number of different color filters are used for successive pictures. We make an image through a color filter according to the common practice, but in addition we expose each image as made to white light, or light substantially white. By this we mean a light which will record non-selective values, whether exactly isochromatic or not, on the sensitive emulsion, as distinguished, from the predetermined selective color values recorded by colored light. These relatively non-selective values can be produced by a wide variety of lights modified or not by a special filter according to the result desired, or to suit the actinic characteristics of the sensitive emulsion used. For example, some emulsions are more sensitive to certain rays in white light than to others, but we still consider such light as white even after such undesirable rays have been partly or wholly filtered out, because non-selective values will still be recorded by such light. Also, some lights contain a preponderating constituent which, when reduced or eliminated leaves a light which will record non-selective values, and which we consider substantially white as herein defined.

By this addition of white light for each

color screen, or for some of them only, the negatives and positives made therefrom not only record values corresponding to that color, but in addition are intensified and leveled up throughout by the white light. The degree of intensification for any image will depend upon the proportion of the white light exposure to the color exposure. By our invention, instead of having only an open spot on the red image and a black spot on the green image, with a two color process, for example, we get an exposure or record of the red spot on both the images, but unequal in intensity. These successive images may appear almost alike to the eye, but there will be a difference, due to the color values, in both the negative and in the positive made therefrom. Correction for excessive blue violet rays, as where arc light is used, can be made by exposing the emulsion to white light modified by a yellow filter. Any other preponderance of color rays can be similarly corrected by properly coloring the filter, either in taking or in projecting, without affecting the color value records. This will be useful in case the emulsion is unduly sensitive to certain rays, or where artificial light is used in taking or projecting, or both.

From the foregoing description, it will be seen that the images made according to our invention, whether negatives or positives, will, owing to the exposure to both white or substantially white light, and colored light, have a different character, intensity, and perspective, together with color values, than images previously known and made by a single exposure to white or colored light alone. The images of this invention can be produced in various ways, both as respects method and apparatus, but we prefer to use the method and apparatus now to be described, without intending thereby to restrict ourselves either to such specific method or such specific apparatus.

The invention will be fully understood in connection with the accompanying illustrative drawing, wherein—

Figure 1 shows a four color screen, each having intensifying leveling apertures;

Fig. 2 is a diagram illustrating the intensification of an exposure to a complete spectrum;

Fig. 3 is a diagram illustrating how the respective color images in recurring series are intensified, and

Fig. 4 shows a section of film wherein a recurring series is made up of four images of respectively different selective color values, intensified by non-selective values of white or substantially white light.

A represents a rotary disk having four color screens, B for blue, R for red, G for green, Y for yellow, separated by spaces K. It will be understood that this screen will be applied to an ordinary camera in taking, and that while the image is being exposed the disk revolves one screen section, being moved from one color to begin the next while the film is being changed from one section to the next. Each of these screens is provided with a slot S which passes the white or substantially white light as above described, the slots being proportioned so as to permit the desired volume of white light for each color, and ordinarily being uneven, as shown, the wider slots being associated with the less actinic colors. Uneven colors, with equal slots would produce the same result. Thus each image of a recurring series is made by an exposure to a different color, and a common color, (white, etc.) Each image made by this double exposure is a composite having selective color values derived from the screen color, and non-selective values distributed throughout, either exactly isochromatic or not, but derived from a white or similar light exposure.

Fig. 2 illustrates one form of this invention. This represents the markings of a spectrum, wherein a film has been exposed, for example, to red. This has caused the greatest action on the red parts of the picture. Then upon exposure to the white light, the action was not so great upon the red, but still having some action, while on the remainder of the image, the white makes a partial record on the sensitive emulsion. This evens up the exposure of the entire picture, by bringing it all up, (but to a lesser extent than the red portion), even though the red receives a further exposure after, as well as before, the white light. This also applies, if the color is all exposed at once, but better effects are secured by separating the color exposures, as herein shown.

In Fig. 3, the sections I, I^1, I^2, represent successive images taken through the screens R, G, Y, for example. The shaded portions r, g, y, represent the approximate intensities of the images produced by the respective red, green and yellow rays alone, while the letter W shows how each image is intensified by the addition of white or substantially white light. The result is that there is not the extreme variation between the intensities r, g, y plus W, as there would be in images produced by ordinary color processes between r, g and y alone, and illustrated by the omission of the space W from Fig. 3.

In Fig. 4 is shown a series of images Y′, G′, R′, B′, each of which is considered to represent by the lines the color values, and by the white the additional non-color selective image or detail effected by the exposure to the white or substantially white light. It is to be understood that the entire surface of the picture is thus exposed to both col-

ored and white light. Thus, the image Y′ represents the result obtained by exposing a single section of panchromatic emulsion to the screen section Y and the slot S therein, and the images G^1, R^1, B^1, respectively, represent similar images made by exposing the sections G, R, B, to successive sections of emulsion, together with the accompanying clear slots S of these sections. Obviously, the images Y′, G′, R′, B′, can be made by a different apparatus, it only being essential that a film capable of recording color values be also exposed to white or substantially white light. Within the meaning of substantially white light we intend to include such light as that from an arc or artificial light which would be corrected by slightly coloring the clear sections S. To correct arc light, which contains a preponderance of blue violet, the slots S, are made of a yellowish tint. By means of this correction, the light effect on the emulsion can be made isochromatic, or as much so as desired, for any or all colors. In some cases, depending upon the number of colors used, it might not be necessary to expose each color value image also to white light, but any series of recurring color value images in which at least one is also exposed to white or substantially white light is within the scope of this invention.

Where we speak of white light, we mean a light which records non-selective values and usually containing all the screen colors, whether corrected to compensate for any preponderance, or not. This evens up or intensifies the entire exposure, but leaving a preponderance of color value in the image corresponding to the color of the screen through which this particular image is made. The images thus obtained have an effect of solidity and relief more nearly approaching a stereoscopic effect, are more uniform in density, depth and detail, and can be made at a much lower speed and in a much less intense light then images heretofore obtained for use in motion picture photography in colors.

The increased effect of solidity and relief is due to the fact that each image is a composite containing values representing both the color screen exposure and the non-selective values for white, or substantially white light. Each composite image has a greater detail and perspective than either a black and white record or a simple selective color value record alone can have. For example, in the ordinary two color process employing red and green-blue screens, a red ball only records or impresses on the red negative film area, and is represented on the green negative film area only by a white circle having no rotundity. In the projection of positives made from two such negatives, it will be seen that only the red image helps to give the impression of rotundity to the ball. The images of our invention have on the red negative not only the same red values as before, but also the non-selective values, while the green negative areas show a non-color selective image of the same object which possesses to a certain degree, the necessary shading required to produce the effect of rotundity. Of course, if there is any green in the object this is also recorded on the green negative in addition to the non-selective values. Thus every image produces an effect of solidity and relief more nearly approaching a stereoscopic effect, and which differs both from a plain black and white image and from a plain color image, and this effect is especially pronounced where the pictures are exhibited in recurring series.

When images consisting of combined color and white light values are once obtained, positives can be made therefrom by present known methods, and such positives can be projected either with or without a color screen. If projected without a color screen, black and white pictures are obtained which, even in black and white, have the effect of solidity and relief approaching the stereoscopic effect hereinabove described, but when the images of this invention are properly shown through color screens, not only are the natural colors delicately and accurately reproduced, but the stereoscopic effect is even more pronounced and realistic. Owing to the leveling of the respective color value images, a long film made up of a great number of sets or series can be much more easily handled in developing. It will be understood that the number of color value images in a series will depend upon the particular process being used, and while we have shown what is known as a four color process herein by way of illustration, we do not limit ourselves to any particular number of colors. This application is a division of application Serial Number 865,431, filed October 7, 1914.

Having thus described our invention, we declare that what we claim as new and desire to secure by Letters Patent, is:—

1. A composite photographic image having a color selective value and non-selective values.

2. A composite photographic image having overlying selective and non-selective color value impressions.

3. A photographic image composed of a selective color value intensified by values corresponding to substantially white.

4. A photographic image composed of a selective color value uniformly intensified by values corresponding to substantially white.

5. A composite photographic image comprising a color value impression and an isochromatic impression.

6. A film or like transparent support carrying an image having non-selective values, and an image having a selective color value, said images being correlated so as to be simultaneously reproduced.

7. A composite photographic image having a color selective value and uniformly distributed non-selective values, said non-selective values being deficient in a predetermined constituent of the light recorded thereby.

8. A photographic color record composed of a plurality of selective correlated color value images in recurring series, at least one of said color value images in each series being composite with a uniformly distributed non-selective color value impression.

9. A photographic record composed of a plurality of correlated color value images in recurring sets, each image in a set being a composite of a different color value record and non-selective color values.

10. A photographic record composed of a plurality of correlated color value images in recurring sets, each image in a set being a composite of a different color value record and common non-selective color values.

In testimony whereof we affix our signatures in presence of two witnesses.

CHARLES RALEIGH.
WILLIAM V. D. KELLEY.

Witnesses:
JULIUS LICHTENSTEIN,
JOSEPH MASON.