W. V. D. KELLEY.

COLORING PHOTOGRAPHIC IMAGES.

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1,259,411.

Patented Mar. 12, 1918.

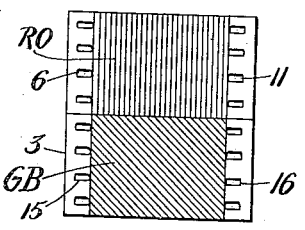


Fig: 1.

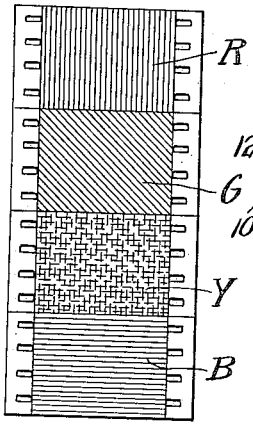


Fig: 2.

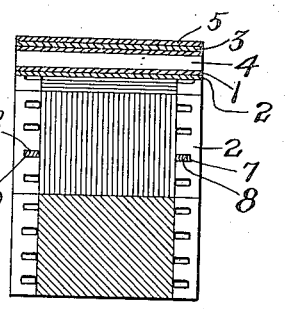


Fig: 3.

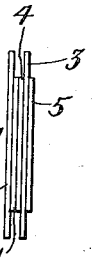


Fig: 4.

Fig: 5.

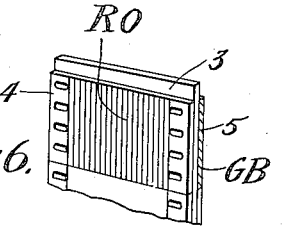
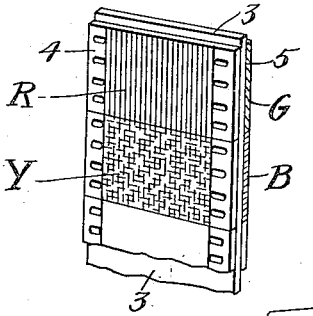


Fig: 6.

Fig: 7.



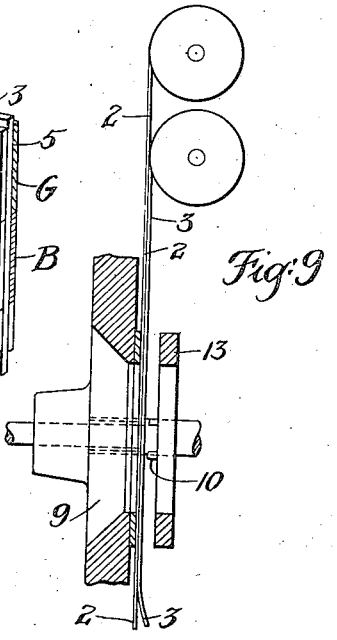


Fig: 9.

Fig: 8.

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UNITED STATES PATENT OFFICE.

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COLORING PHOTOGRAPHIC IMAGES.

1,259,411. Specification of Letters Patent. Patented Mar. 12, 1918.

Application filed July 26, 1917. Serial No. 182,858.

To all whom it may concern:

Be it known that I, WILLIAM V. D. KELLEY, a citizen of the United States, and a resident of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Coloring Photographic Images, of which the following is a specification.

This invention relates to colored photographic images, and has particular reference to a process for producing double colored images on double coated base, together with the product. The invention is applicable to the production of single transparencies, but is especially intended for obtaining motion picture film for projection in color.

The object of the invention is to provide a complete process for producing a double colored double projecting positive from a negative strip containing color value records in recurring cycles, without permitting defective registration, and without employing temporary intermediate steps during the coloring process.

If a double coated positive is printed first on one side with a color value image belonging to one color family, and then on the other side with another color value image from a complementary color family, the results in projection are unsatisfactory unless the images are accurately registered before and during printing, even when accurately colored, because a very slight displacement of one image affects the entire result, and becomes very apparent when enlarged on the curtain. If one print is developed and colored before the other is printed, developed and colored, it is impossible to obtain absolute registration of the second print, because the baths used in finishing the first cause celluloid film to shrink, so that the first print becomes smaller than the second. This is true, whether the second print is made in the same sensitive emulsion as the first, or in an emulsion applied after the first print has been partly or wholly colored. Efforts have been made to print two images on double coated positive simultaneously by a light on each side of the positive, which requires an extra negative or negatives to be made for printing and careful adjustment of lights. This procedure also involves registration difficulties. Sometimes an opaque coating, or coloring of the film to prevent one side from being fogged by the other, is employed where the prints are made after one another, but such coatings or colorings usually have to be removed before the positive is finished. Furthermore, in coloring, a dark room process is undesirable, because it does not facilitate accurate work, and a daylight process which requires the application or removal of temporary coatings or baths, or the use of intermediate prints, introduces additional complications and expense.

By this invention the final prints are successively made with a single light directly from the original negatives in accurate registration on the positive, first on one side of the positive and then on the other side in exact registration after reversing both positive and negative, then developed and fixed, then one print is colored and covered with a final protective coating, and finally the remaining print is colored.

The coloring is done with dyes in daylight, and an especially advantageous feature of the invention is that the colors are applied by immersion in tanks, permitting complete control by the operator, with a minimum amount of handling of the film itself. The invention is particularly useful in producing long lengths of film for projection in natural color on ordinary projectors.

The accompanying drawing illustrates various features of the invention, and preferred appliances employed.

Figure 1, shows a two color value negative,

Fig. 2, shows a four color value negative,

Fig. 3, shows one negative of Fig. 1 in registered printing position with one side of the double coated positive, partly in section,

Fig. 4, shows in elevation, one printing position, negative emulsion to first positive emulsion.

Fig. 5, shows the other printing position, negative base to second positive emulsion,

Fig. 6, shows the finished two color projecting positive,

Fig. 7, shows the finished four color projecting positive,

Fig. 8 shows a suitable form of film carrying frame used in the tank operations, and

Fig. 9, shows a form of mounting for the registering pins shown in Fig. 3.

In a two color process, recurring cycles of

negative color value records of the red family R O and the green family G B shown in Fig. 1 are alternately recorded on panchromatic emulsion 1 carried by transparent base 2, Fig. 4. In a suitable printing machine, transparent base 3 carrying a relatively "slow" emulsion on each side, as 4, 5, is first registered and printed on one side as 4, with all of the red value negatives, R O, as in Fig. 3, then the positive base and the negative are reversed, and all of the remaining green value negatives, G B, are printed on the other side, by the same light, after having been accurately registered with the first print. Both printings are by contact, see Figs. 4 and 5, and made with a strong light and short exposure so that one coating or image is not fogged by printing the other.

It is of particular importance that accurate registration be had, and this is accomplished in the following manner. In printing the first negative, having for example four standard perforations on each side, with emulsion to emulsion, a certain perforation in the negative, as 6, is registered in one direction only with a perforation, as 7, in the double coated positive base 3 by a registering pin 8 passing through both positive and negative at one side of the printing window 9. This pin 8 may for example effect vertical registration only by being so shaped as to fill the perforations in both films from top to bottom, but not from side to side, as seen in Fig. 3. At the same time, another pin, as 10 on the other side of the printing window, and shaped to completely fill the perforations 11 in the negative, and 12 in the positive passes through both positive and negative and effects horizontal registration. These pins act together, but register independently. As soon as registered, the films are clamped in printing contact by a reciprocatory clamp 13, and printed, emulsion to emulsion. The clamp also carries the registering pins 8, 10, and is reciprocated by any suitable means. Feeding of the films is controlled so that all of the red value images R O on the negative will be registered and printed in succession on the first positive emulsion, and all of the green value images G B on the second positive emulsion. With a two color process, the negative feeds two images for each positive image. In printing the other side of the positive in the preferred manner by the same light, both the positive and negative are reversed, bringing the negative base 2 to second positive emulsion 5, as shown in Fig. 5. The pins 8, 10, are also reversed, so that the holes 7 and 12 in the positive retain the same relation with the pins 8, 12, as before, but now register the holes 15, 16 of the green value images G B with the positive holes 7, 12, respectively. After the strips are registered and clamped, the exposure is made by light through window 9, either by a hand or power driven shutter moving in front of a suitable light. The positive strip is then developed, fixed, and washed on both sides at once, and now contains color values of one family all on one side, and color values of another family all on the other side, but each registered horizontally with one certain perforation in the positive, and independently registered vertically with another certain perforation therein. The coloring can now be applied.

Fig. 2 shows an example of a four color process negative having a red color value image R, a green color value image G, a yellow color value image Y, and a blue color value image B, the images R and Y, being of the red family, and the images G and B of the blue family, and together rendering complete color. In printing from such a negative having these images in recurring cycles, the red family images are all printed on one side, alternating red and yellow, and the green family images, alternating green and blue, on the other side of the positive as shown in Fig. 7. These images are both registered by the predetermined perforations in the positive and the pins 8, 10, in the manner before described, but each positive area does not now contain values for complete color. Each two positive areas do, however, contain complete color values, and when the opposite sides are colored in complementary colors and projected in succession, complete color is rendered on the curtain upon the principle of additive lights. Both sides of the positive are developed, fixed, and washed, together, and are now ready for coloring, it being seen that the images are of the same size, and in absolute register.

The additive principle can also be carried out with four colors, such as red, green, magenta, and blue green negative records, so printed on the positive as to superpose red and green value images on one positive area, and magenta and blue green value images on the next area, which when properly dyed, give complete color in each two areas in projection. In case of a single transparency made of two images, one image is then colored, or all like family images on one side in case of a long strip, are colored. This may be done by passing the strip horizontally over a bleaching spray which is so controlled as to only attack the images on one side of the double coated strip. If the images are formed of silver bromid, they may be bleached by being converted to silver iodid by a spray bath containing iodin, potassium iodid, and distilled water. The whites may be cleared by passing over a second spray of sodium bisulfite, and then the whole film is washed and coiled on a frame such as shown in Fig. 8, for subsequent handling. The silver on one side is now trans-

parent and mordanted ready to receive the dye. The frame is of flat, rectangular form having bars which support the coils at the edges.

After being coiled on the frame and while still wet from the last washing, the whole strip is immersed in a dye bath of color complementary to the color values on the treated side. The latter side only takes and permanently sets the dye in those portions containing converted silver deposit, while the untreated side will not fix the dye. This is done in daylight. The strip is now washed and dried, the dye having washed out of the untreated side and only remaining precipitated in the converted silver on the treated side. The colored side is then coated with a celluloid varnish final coating, which not only protects the color during subsequent treatment of the other side, but protects the strip in use and enables the operator to readily tell the front from the back when projecting. This drying affects both images equally so that any shrinkage of the material does not affect registration.

The remaining side is now colored by repeating the process in ordinary tank operations, including converting the remaining opaque silver deposit to mordanted deposit capable of taking the other dye color. This dye is then applied by immersion, and washed as before described. The strip can now be removed from the frame and when dried is ready for use in an ordinary projector. With the strip once on the frame, all subsequent operations can be by immersion in tanks, which is a decided advantage, not only in eliminating useless steps, but in preventing damage to the strip, and permitting inspection at all times in daylight. The frame used ordinarily holds about 200 feet or more of film with the edges only in contact, so that full access of the baths is had to each side. The dyes used may be basic or acid, or a combination of both, depending upon the particular process followed in applying the color.

Various methods of coloring are known besides the examples given herein, and I do not restrict myself to any particular process of applying the color. Instead of employing transparent silver deposit to take the dye, silver bromid can be bleached, then mordanted to take the dye, and then the silver dissolved out, leaving pure color in the film. Also, a silver bromid image, such as one printed from the green value negative, can be bleached by a vanadium chlorid bath to a yellowish color and then fixed, and then immersed in a red dye, such as rhodamin, to give a good red in the finished print. The green dyes are well known, such as malachite green, and do not need detailed description.

By the two color process herein described, a strip film is produced having the registered red values on one side dyed green, and the registered green values on the other side dyed complementary red, and each area giving substantially complete color rendering. By the four color process herein described, the registered red and registered yellow values on adjoining positive areas, are colored green, and the registered green and registered blue values on the other side are colored complementary red, each coloring being by a single dye, and each two positive areas rendering complete color in projection. This latter process has an especial advantage not only in more complete color rendering, but enables balancing to be controlled, because by variation of the printing exposure, the red family colors can be favored in one cycle, and the green family colors in another set, but giving the proper balance when projected.

The process of this invention therefore furnishes a simple and direct daylight process, in which the prints are made by contact before any chemical treatments, and then simultaneously developed, without requiring temporary treatments or coatings, and enabling all operations after bleaching the first image to be rapidly done by immersion in tanks with the strip on a frame.

The terms used herein such as "first" and "second," "positive" and "negative," are used in the relative sense and not as limitations, and it will be understood that colors or color values may belong to complementary color families without being themselves complementary.

What is claimed, is:

1. The method of producing a double colored photographic transparency which consists in printing images in registry on opposite sides of a double sensitized transparent base, developing and fixing said images, treating one of said images to render it capable of absorbing dye and transmitting light, dyeing said image, washing and drying the entire base, applying a protective coating to the dyed side, treating the other image to render it dye absorbent and capable of transmitting light, dyeing with a second color, and washing and drying to complete the transparency.

2. The method of producing a double colored photographic transparency which consists in printing images in registry on opposite sides of a double sensitized transparent base, simultaneously developing and fixing said images, spraying one of said images with a solution to render it capable of absorbing dye and transmitting light, immersing the base in a dye bath to color the treated image, washing and drying the base, applying a protective coating to the dyed side, treating the other image to render it dye absorbent and capable of transmitting light,

dyeing said latter image with a second color, by immersion, and washing and drying to complete the transparency.

3. The method of producing a double colored photographic strip film, which consists in printing images in registry on opposite sides of double sensitized transparent film, developing and fixing said images, treating one side of said film to render the images thereon capable of absorbing dye and transmitting light, immersing the film in a dye bath to color the treated side, washing and drying, applying a protective coating to the dyed side, treating the other side to render the images thereon capable of absorbing dye and transmitting light, immersing the entire film in a second dye bath to differently color the images on the last treated side, and washing and drying to complete the film.

4. The method of producing a double colored photographic strip film, which consists in printing images in registry on opposite sides of double sensitized transparent film, developing and fixing said images, treating one side of said film to render the images thereon capable of absorbing dye and transmitting light, coiling the film on a frame, immersing the film in a dye bath to color the treated side, washing and drying, applying a protective coating to the dyed side, treating the other side to render the images thereon capable of absorbing dye and transmitting light, immersing the entire film in a second dye bath to differently color the images on the last treated side, and washing and drying to complete the film.

5. The method of producing a double colored photographic strip film, which consists in printing on one side of a double sensitized transparent film images containing color values of one color family, printing in registry on the opposite side images containing color values of a complementary color family, developing and fixing said images, treating one side of said film to render all the images thereon capable of absorbing dye and transmitting light, immersing the film in a dye bath to impart to the images on the treated side a color complementary to the family color recorded thereby, washing and drying, applying a protective coating to the dyed side, treating the other side to render all the images thereon capable of absorbing dye and transmitting light, immersing the film in a dye bath to impart to the latter images a color complementary to the family color recorded thereby, and washing and drying to complete the film.

6. The method of producing a double colored photographic strip film, which consists in recording the two families of color in cycles of four color values, printing all of one family of color value records upon one side of double sensitized film in recurring sets, printing all of the other family of color value records upon the other side of said film in recurring sets registered with said first prints, developing said images, treating one side of said film to render all the images thereon capable of absorbing dye and transmitting light, immersing the film in a dye bath to impart to the images on the treated side a color complementary to the family color recorded thereby, washing and drying, applying a protective coating to the dyed side, treating the other side to render all the images thereon capable of absorbing dye and transmitting light, immersing the film in a dye bath to impart to the latter images a color complementary to the family color recorded thereby, and washing and drying to complete the film.

7. The method of producing a double colored photographic transparency carrying the colors in coatings on opposite sides, which consists in printing in registry in said coatings images containing different color values, developing said images, coloring one of said images with a color having a predetermined relation to the color recorded thereby, applying a protective coating thereto, and coloring the other image with a color complementary to said first color.

8. The method of producing a double colored photographic transparency carrying the colors in coatings on opposite sides, which consists in printing in registry in said coatings images containing different color values, developing said images, mordanting and converting one of said images to render it capable of taking a dye and transmitting light, immersing the film in a dye bath of a color complementary to the color recorded by said mordanted image, washing and drying, applying a protective coating thereto, mordanting and converting the second image to render it capable of taking a dye and transmitting light, immersing the film in a dye bath of a color complementary to the first dye bath, and completing the film.

9. The method of producing a double colored photographic transparency carrying the colors in coatings on opposite sides, which consists in registering an image carrying negative having edge perforations in a printing position determined by predetermined perforations in a double sensitized positive film, printing on said positive, registering a second image carrying negative having like perforations with the same perforations in said positive film on the opposite side of said film and making the second print, developing said images, coloring one side of said film, drying and applying a protective coating to the colored side, and finally coloring the remaining image on said positive.

10. The method of producing a double colored strip transparency which consists in

registering the perforations of a color value negative strip and a double coated sensitive strip independently horizontally and vertically with the sensitive strip as the standard, printing like color family images in succession on said strip, registering color value images of a complementary color family on the remaining sensitive side of said strip with like relation to the sensitive strip as the standard, printing said second images, developing and fixing said images, coloring the images on one side in one color, covering said colored images with a protective coating, removing the color from the uncovered images, and coloring said images with a color of different color family.

11. The method of producing a double colored photographic strip transparency carrying the colors in coatings on opposite sides, which consists in printing in succession on one side of said strip different color value records of one color family and in registry on the other side different color value records of a complementary color family so as to have on each two areas of said strip a combined record of complete color on the additive principle, developing said images, coloring all of the like color family images on one side with a color having a predetermined relation to such color family, applying a protective coating thereto, and coloring the images on the other side of the strip with a color complementary to said first color.

12. The method of producing a double colored transparency which consists in registering the perforations of a color value image and a double coated sensitive strip indenpendently horizontally and vertically with the sensitive strip as the standard, printing said image on said strip, registering a similar color value image of a complementary color family on the remaining sensitive side of said strip with like relation to the sensitive strip as the standard, printing said second image, developing and fixing said images, coloring one of said images with a color complementary to its color family, and coloring the other image with a color complementary to its color family.

13. The method of producing a double colored transparency which consists in registering the perforations of a color value image and a double coated sensitive strip independently horizontally and vertically with the sensitive strip as the standard, printing said image on said strip, registering a similar color value image of a complementary color family on the remaining sensitive side of said strip with like relation to the sensitive strip as the standard, printing said second image, developing and fixing said images, coloring one of said images with a color complementary to its color family, applying a protective coating to the colored side, and coloring the other image with a color complementary to its color family.

14. The method of producing a double colored transparency which consists in registering the perforations of a color value image and a double coated sensitive strip independently horizontally and vertically with the sensitive strip as the standard, printing said image on said strip, registering a similar color value image of a complementary color family on the remaining sensitive side of said strip with like relation to the sensitive strip as the standard, printing said second image, developing and fixing said images, rendering one of said images capable of absorbing dye and transmitting light, applying a dye thereto of color complementary to the color family of the treated image, and similarly treating the remaining image without decoloring the first image to impart to the remaining image a color complementary to its color family.

15. The method of producing a double colored transparency carrying the colors in coatings on opposite sides, which consists in registering the perforations of a color value image and a double coated sensitive strip independently horizontally and vertically with the sensitive strip as the standard, printing said image on said strip, registering a complementary color value image on the remaining side of said strip with like relation to the sensitive strip as the standard, printing said second image, developing and fixing said images, coloring one image with a color complementary to the values recorded thereby, and coloring the second image without decoloring the first image with a color complementary to said first color and to the values recorded by said second image.

16. A double coated perforated transparency comprising a plurality of image areas, those on one side having successively different color value images of one family and those on the other side having successively different color value images of a complementary color family, the images on each area being both registered with the same perforation in the transparent base, and said families of images being colored with complementary colors.

17. A double coated perforated transparency comprising a plurality of image areas, those on one side having successively different color value images of one family and those on the other side having successively different color value images of a complementary color family, the images on each area being both registered with the same perforation in the transparent base, and said families of images being arranged and colored with complementary colors, so that each two image areas additively render complete color in projection.

18. A double coated perforated photo-

graphic transparency having a record on each side, each of said records being registered horizontally with a certain perforation as a standard, and vertically with a certain other perforation as a standard, the records on said sides being colored in different colors.

Signed at New York city, in the county of New York and State of New York, this 24th day of July A. D. 1917.

WILLIAM V. D. KELLEY.

Witnesses:

C. A. ROTH,

HERBERT KLINE.