J. E. THORNTON.

PHOTOGRAPHIC PRINTING PROCESS.

APPLICATION FILED JUNE 30, 1915.

1,288,753.

Patented Dec. 24, 1918.

2 SHEETS—SHEET 1.

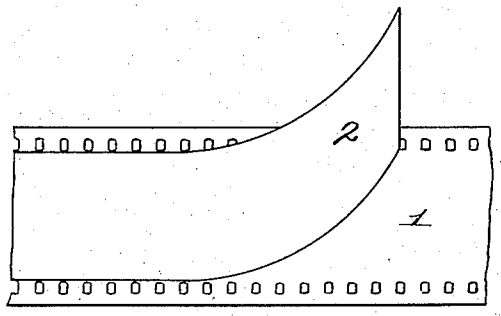

Fig.1.

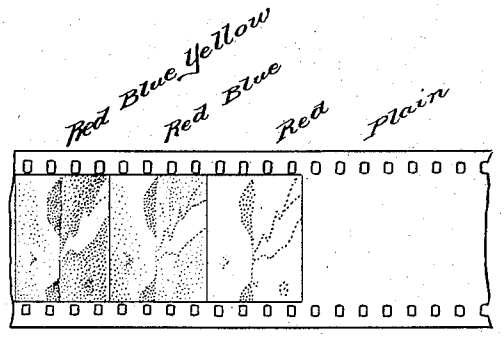

Fig.2.

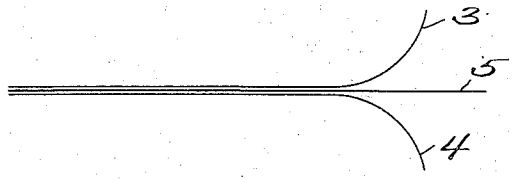

Fig.3.

Witnesses:
C. A. Patterson.
C. E. Kesler

Inventor
John E. Thornton
by James L. Norris
Attorney

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2 SHEETS—SHEET 2.

Fig. 4.

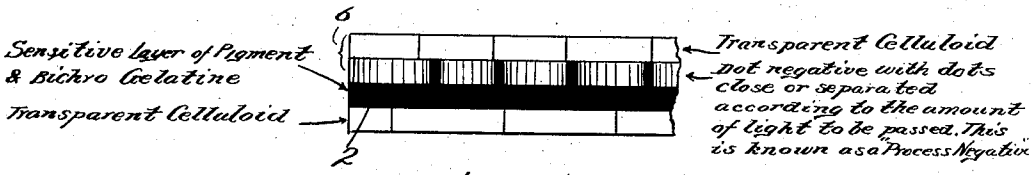


Fig. 5.

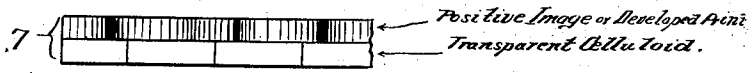


Fig. 6.

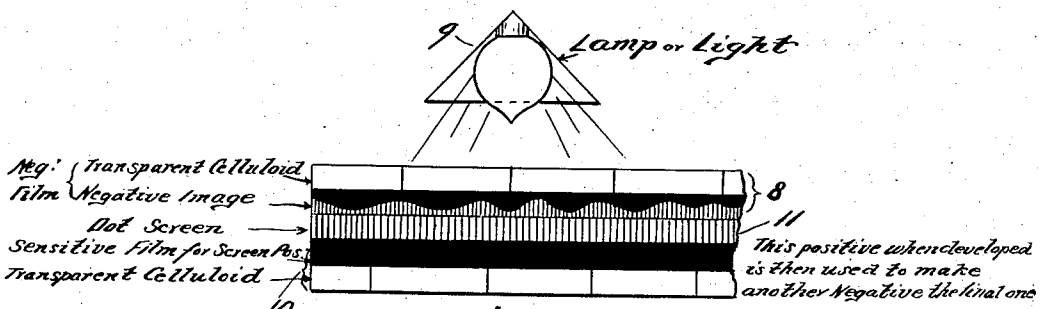
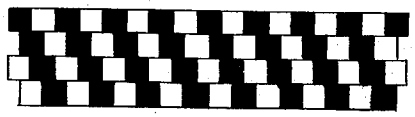


Fig. 7.



Fig. 8.



Inventor

John Edward Thornton

Witness

C. A. Bateman.

By James L. Norris

Attorney

UNITED STATES PATENT OFFICE.

JOHN EDWARD THORNTON, OF WEST HAMPSTEAD, LONDON, ENGLAND, ASSIGNOR TO JOHN OWDEN O'BRIEN, OF MANCHESTER, ENGLAND.

PHOTOGRAPHIC-PRINTING PROCESS.

1,288,753. Specification of Letters Patent. Patented Dec. 24, 1918.

Application filed June 30, 1915. Serial No. 37,323.

To all whom it may concern:

Be it known that I, JOHN EDWARD THORNTON, a British subject, residing at West Hampstead, London, England, have invented certain new and useful Improvements in and Relating to Photographic-Printing Processes, of which the following is a specification.

This invention relates to the manufacture or production of cinematograph films upon a bichromated colloid or upon a similar slow printing surface, and is specially intended for color printing where two or more colors are superimposed, though it can be used for single color work if desired. It forms an improvement upon the following applications recently filed by me in relation to this art; 733,633, filed November 26, 1912; 745,724, filed February 1, 1913; 745,725, filed February 1, 1913; 760,200, filed April 10, 1913; 772,440, filed June 7, 1913; 38,016, filed July 3, 1915.

In some of those inventions, for example, United States applications Serial Nos. 760200 and 772440, superimposed prints in different colors are made from continuous tone graduated negatives upon material sensitized with bichromated colloids. Such prints may be developed from the front by staining with suitable dyes of the type that only stain soft gelatin and do not stain the gelatin where hardened by exposure to light. Or the prints may be made by incorporating dye or pigment with the gelatin before coating, then printing through the back of the support if transparent, or else, where printing from the front, transferring the printed image on to another support for development from the back.

In all those inventions it is necessary when printing from the front to add the coloring matter by staining after development, or else print through the back if the pigment is added before, or else to transfer before development.

The purpose of this invention is to provide an improved process by which films—to the colloid of which dye or pigment is added before printing—are printed from the front, and developed from the front, without the necessity for any transfer or after staining, thereby securing greater simplicity and uniformity than is possible when the coloring matter or dye is added by means of development or staining after printing.

In the accompanying drawing—

Figure 1 is a perspective view of the film and sensitized layer;

Fig. 2 is a face view or plan of the film with a sensitized layer on each side thereof;

Fig. 3 represents a longitudinal section of the film and the sensitized layers on opposite sides thereof.

Fig. 4 is a diagrammatic view showing the method of producing a positive print from a dot negative.

Fig. 5 represents a cross-section of the print obtained from the dot negative.

Fig. 6 is a diagrammatic view showing a method of obtaining a dot negative such as that shown in Fig. 4.

Fig. 7 is a diagrammatic view showing the method of arranging the dots in different positions in the successive pictures of the final print; and

Fig. 8 is a diagrammatic view showing the relative positions of the dots of the pictures when projected in succession upon a screen.

In carrying out the invention the film or other support 1 is first coated with a sensitized colloid 2 such as gelatin, fish glue, albumen, gum, or mixtures thereof, in which pigment or else dye of the desired color has been incorporated.

The sensitized film is exposed from the front for the requisite period of time to print through to the base, under a screen printing negative 6 of the special type hereinafter described, then developed, washed, and dried. If the colloid be gelatin, hot water is used for development; and if it be fish glue, albumen or gum, cold water is used for development.

The development is rendered capable of accomplishment from the front of the sensitized colloid 2 (Fig. 4) and a sharp carbon print thus obtained because of the breaking up of the image into a large number of very fine dots (say about forty thousand to the square inch) by the use of a screen printing negative 6 known as a "process negative" in which the image is composed of a similar number of fine dots or lines, such negatives being used for half-tone block making and other well known photo-mechanical proc-

esses. Fig. 4 shows diagrammatically the negative 6 in printing relation to the sensitized and colored colloid 2, and Fig. 5 represents in section the print 7 secured by exposure thereof through such a negative, such print being composed of dots all of the same height or depth but varying in their closeness in inverse ratio to that of the negative, and the whole of the dots composing the image are insoluble from back to front, the soluble portions having been dissolved and washed away during development.

By using such a negative the light is obstructed by the lines or dots and the image is broken up into non-continuous blacks and half-tones, the tones being of uniform density and varying in area, instead of the regular graduated tones of varying density that would be obtained by using a graduated continuous tone negative.

The effect of this is to leave the bichromated colloid in the form of having unprinted spaces that dissolve completely away during development, leaving intervening parts composed of insoluble colloid (containing pigment or dye) extending right through from the front to the base which stand up as lines or dots owing to the light which passes through the transparent spaces between the dots of the negative, penetrating through to the base supporting the colloid film, and thereby rendering it insoluble so that the pigment or dye is locked up in the insoluble portions of colloid.

The resultant image is one having a somewhat "grainy" appearance, but is more transparent than one in continuous graduated tones.

The screen printing negative 6 which is used in accordance with the present invention is made, as shown diagrammatically in Fig. 6, by placing a continuous tone positive cinematograph film 8, which latter is made by contact from the original continuous tone negative, in front of a powerful light 9 and placing behind such film a sensitive silver bromid film 10, a dot screen 11 being interposed between the two films.

Upon developing the sensitive film so exposed the screen negative 6 will result bearing a series of images that are counterparts of the original except that they consist of dots or grain varying in size and closeness, thus producing a picture in broken tones instead of continuous tones.

This film is used as a negative for producing the required cinematograph films.

By suitable modifications of screen, diaphragm, light distances, and exposure, a variety of effects are obtainable according to character of subject and other governing factors.

For cinematograph films in two or more colors, (multi-colors after the style of the Lumiere autochrome screen plates or the Sanger-Shepherd superimposed prints), the positive film is sensitized, printed and developed, two, three or four times, each time from one of these special screen negatives according to number of colors required, each sensitizing and printing being superimposed upon the preceding one as set forth in my pending applications Serial Nos. 760200 and 772440.

The special broken tone or screen printing negatives for such color work may be made in the manner already described, either from continuous tone negatives, each of which represents one color only, out of the two, three or four colors; or they may be made from a multi-color negative of the Lumiere autochrome type, by covering such negative during each reproduction with a color filter that will only allow one color to pass and therefore only one color of the multi-color group to be reproduced at a time, the operations being repeated through different filters, for each separate color.

In making these color prints the film is re-sensitized and re-printed for each different color, where two or more colors have to be superimposed, on the same side of the film; but where two prints are made on opposite sides of the same piece of film they may be sensitized together and printed simultaneously.

By coating two layers of sensitized emulsion in two colors on one side of the film such as red and green, one on top of the other, and then exposing through a red filter, and then giving a second exposure through a green filter, two colors may be printed immediately one after the other, and development of the two proceed simultaneously. In this case a two-color finished picture is obtained at one complete operation.

The same effect may be got if the two layers of colored sensitized emulsion 3 and 4 are coated upon opposite sides of the film 5, as shown in Figs. 2 and 3.

By coating the other side of the film with a third layer of colored sensitized emulsion a three color picture is obtained.

And by coating the second side of the film also with two layers of sensitized emulsion in two colors one on top of the other, such as orange and violet, and exposing them twice first through an orange and then through a violet filter, followed by one development, a four color picture is obtained.

A cinematograph film produced as described will, when magnified by projection, show a "grainy" image on the screen, but I reduce this effect to a minimum by shifting the ruled screen slightly between the exposure of successive pictures when making the reproduced grainy or screen printing negative, as shown diagrammatically in Fig. 7, so that the lines or dots of each picture come in a different place on the projection

screen and are more or less mixed up upon the observer's eye by persistence of vision, the relative positions of the dots of the successive pictures as projected onto the screen being shown diagrammatically in Fig. 8.

It will be understood that the term "negative" applies to the transparent cliche used in printing the final print, but it may be either a negative or a positive according to the character of print desired.

The image may be converted into and printed in the form of fine lines instead of fine dots if preferred.

What I claim as my invention and desire to protect by Letters Patent is:—

1. In the production of a cinematograph films by the carbon process upon a colored sensitized colloid, the improved process which comprises preparing from an ordinary cinematograph full tone negative a reproduced negative of broken tones or dots and printing through such reproduced negative and through said colored sensitized colloid from front to back to produce a final print composed of dots of colored colloid all of the same height or thickness but varying in their area or distance of separation which dots have been rendered insoluble.

2. The process of producing cinematograph films from a negative taken by a camera which consists in printing from the negative on to a sensitized film to produce a positive, photographing such positive through a screen onto another film to produce a screen printing negative and finally printing therefrom, on to the front and through to the back of a colored sensitized film and developing same from the front.

3. In the process of producing multi-color cinematograph films by superimposing a plurality of printings of section color pictures on the same film, preparing each color negative by photographing through a screen to break the image into dots, and then printing from each dot negative thus obtained each in succession and in superimposition, each print being in a different color and upon a different sensitive layer upon the same film base.

4. A cinematograph film having pictures thereon represented in dots of gelatin of which the film is composed, said dots being of uniform depth or height, the area of or distance between the dots varying to give varying gradation of light and shade to different parts of the picture and which dots are obtained through the intervention of a screen.

5. A cinematograph film having a series of pictures superimposed thereon, each picture being represented in dots of gelatin of which the film is composed, the dots being of uniform depth or height and the area of or distance between the dots varying to give varying gradation of light and shade to each picture.

In testimony whereof I have hereunto set my hand in presence of a subscribing witness.

JOHN EDWARD THORNTON.

Witness:

I. OWDEN O'BRIEN.