PATENT SPECIFICATION

384,334

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Complete Accepted: Dec. 5, 1932.

COMPLETE SPECIFICATION.

Method of Producing a Colored Motion Picture Film.

We, MULTICOLOR, LTD., a corporation duly organized under the laws of the State of California, of 7000, Romaine Street, Los Angeles, State of California, United States of America, 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 color photography and more particularly to the art of producing a colored motion picture film.

This invention relates to the production of a colored motion picture film having different colored images on opposite sides.

The method of the present application is a modification of the method set forth in patent specifications numbered 360,819 and 339,323, in which last named specification a dye bath was used between the iron treating bath and the uranium treating bath. In the specification numbered 360,819 the dye bath was lacking entirely. In the present application the dye solution is applied either simultaneously with or subsequent to the bath by means of which the film is uranium toned.

Accordingly, the present invention comprises a process of producing colored photographic films having images on opposite sides, which images are toned in different colors, including the step of treating a fixed silver image with a uranium toning bath and treating it subsequently or simultaneously with a basic dye.

In the accompanying drawings:

Fig. 1 shows diagrammatically a double coated film having images on opposite sides thereof colored orange-red and blue, respectively,

Figs. 2 and 2A are diagrammatic views illustrating an apparatus for carrying out the process of our invention in the production of a colored positive motion picture film.

In our process an object having several colors is photographed from the same viewpoint upon two negative films producing substantially complementary color value images, such as orange-red and blue-green.

[*Price* 1/-]

The numeral 10 designates a negative film exposed to the orange-red portion of the spectrum of the object photographed, and 11 designates a negative film which has been exposed to the blue-green portion of the spectrum of the object photographed.

In order to provide a single multicolored film for use in the standard projection machines, a positive film 12 is provided, having emulsions 13 and 14 provided upon opposite faces thereof, impregnated with a light retardent dye, which permits the simultaneous printing of the negatives 10 and 11 on opposite sides of the film 12.

In the present process the image 15 on the positive is treated so that it will be colored orange-red, and the image 16 on the positive is treated so that it will be colored blue.

The processes used at present for the treatment of the positive 12 for coloring the images 15 and 16 have certain defects which are overcome by the process of our invention, which may be carried on by the apparatus diagrammatically shown in Figs. 2 and 2A. This apparatus includes a fresh positive feed reel 17, a blue-green negative feed reel 18, an orange-red negative feed reel 19, a printing device 20, blue and orange-red winding reels 21 and 22, a series of tanks 23, 24, 25 and 26, a blue-toning tank 27, a series of treating tanks 28, 29, 30, 33 and 34, a drier 35, and a positive film winding reel 36. Air jet pipes 37 are mounted adjacent the film as it passes between the tank 26 and the blue-toning tank 27.

The printed positive film then passes through a bath of soft developer in the tank 23, and after that through a "stop" solution consisting of a weak solution of acetic acid, which is placed in the tank 24. The printing and developing of the positive 12 are carried on in a dark room, but the remainder of the process may be conducted in the light.

Leaving the tank 24, the film 12 passes through a fixing solution in the tank 25, after which the film passes through a water wash in the tank 26. Leaving the tank 26, the film 12 is practically dried

by jets of air blowing at high velocity from the pipes 37 disposed close to the film. The film then passes through a blue-toning tank 27, which completely converts the positive silver image 16 which was printed from the orange-red negative 10 into a blue image. One formula for the liquid placed in the tank 27 is as follows:

Ferric ammonium oxalate	4.5 grams
Potassium ferricyanide	2 grams
Ammonium chloride	4 grams
Hydrochloric acid (Sp. Gr. 1.18)	2 CC
Water	500 CC

The tank 27 may be of any suitable construction which restricts the application of the treating liquid to only one side of the positive film, but this tank is preferably of the form shown in the specification numbered 339,971.

The blue-toning solution chemically converts the silver image 16 to an opaque image consisting of silver ferrocyanide and ferric ferrocyanide. The opaqueness of the image is due to the silver ferrocyanide which is later converted to a transparent silver salt. It takes from three to five minutes to completely convert the silver image to a ferrocyanide image, after which it is substantially impervious to further color treatment. By color treatment we mean chemically toning, dyeing, dye-toning, imparting or restoring color, and specifically exclude removing the opaqueness (converting the silver ferrocyanide to a transparent silver compound) from the image.

After leaving the tank 27, the positive film 12 is run through a water wash for approximately four minutes in tank 28, and then into tank 29, where it is treated with a uranium solution. The formula for the uranium solution is as follows:

Potassium oxalate	12 grams
Uranyl nitrate	32 grams
Potassium ferricyanide	9 grams
Hydrochloric acid (Sp. Gr. 1.18)	32 CC
Distilled water	4000 CC

The uranium toning treatment chemically converts the image 15 from a silver image to an opaque image consisting of silver ferrocyanide and uranyl ferrocyanide. The color of the image is changed from black to colors ranging from brownish yellow to red, depending upon the concentration of the uranium bath and the time of treatment. In order to produce a satisfactory red color value image the film 12 requires from six to eight minutes in the uranium solution.

After leaving the uranium toning solution the film 12 is subjected to a water wash in the tank 30 for approximately 3 minutes.

After leaving the uranium solution in tank 29, the positive film 12 is given a water wash in tank 30. The film then passes into tank 31 which contains a solution of dye in which the entire film is immersed.

Ordinarily we prefer to use a dye solution substantially as follows:—

Rhodamine	0.01 gram
Safranine (purple)	0.03 gram
Safranine (red)	0.15 gram
Chrysoidine	0.5 gram
Ethyl alcohol	100 CC
Distilled water	2300 CC
Acetic acid (dilute)	100 CC

If a more vivid red is desired, the formula of the dye solution used is substantially as follows:

Basic safranine 8 B	1 gram
Distilled water	2000 CC
Acetic acid	10 CC

If a brighter orange-red is desired, the following formula is used in making up the dye solution:

Rhodamine B	0.1 gram
Chrysoidine	1.8 gram
Distilled water	800 CC

The dye in tank 31 is mordanted onto the image 15. The said image 15 is thereby converted to a chemically toned plus a dye-toned image.

The length of time required to complete the dye-toning in tank 31 is approximately from four to eight minutes. The quantity of dye which mordants onto the image increases each time, so that short immersion will give a slightly colored image, and prolonged immersion will give a strongly colored image.

The film is then given a water wash in tank 32 which removes the surplus of the dye. The film is then run through a hypo solution in tank 33.

Before entering the hypo solution, the images are usually opaque. The film usually requires from two to four minutes in this hypo solution to completely convert the silver ferrocyanide, thereby removing all traces of opaqueness from the images. The film is then washed in tank 34 from six to ten minutes, after which it passes through the drier 35, and is wound on the take-up reel 36.

We have found that the hypo solutions generally used remove not only the opaque silver ferrocyanide, but also some of the dye that is mordanted to the dye-toned image. In order to avoid the removal of the dye, we prefer to use a hypo solution that chemically converts the opaque silver compound to a transparent silver compound. We have found that a hypo solution containing potassium iodide converts the opaque silver ferrocyanide to

a transparent silver iodide, without affecting the dye that is mordanted to the images.

Although hypo solutions similar to those in general use may be used, we prefer to use a solution substantially as follows:

Sodium thiosulphate -	904 grams
Sodium bisulphite -	22.6 grams
Chrom alum - -	16.8 grams
Potassium alum - -	16.8 grams
Potassium iodide -	22.6 grams
Distilled water - -	3400 CC

The film is then washed and dried as set forth.

After the film is washed, the images on the opposite sides of the double coated film are perfectly colored so that when the said film is projected onto a screen an image of the original object in substantially its natural colors is produced.

We have found that it is sometimes advantageous to pass the film through a bath containing both the uranium toning and basic dye solutions, instead of the process disclosed above. One of the uranium toning basic dye solutions that we prefer to use in this modification is made up of equal parts of the following solutions:

Potassium oxalate - -	12 grams
Uranyl nitrate - -	32 grams
Potassium ferricyanide -	9 grams
Hydrochloric acid (Sp. gr. 1.18) - - -	32 CC
Distilled water - -	2000 CC
and	
Rhodamine - - -	0.02 gram
Safranine (purple) -	0.06 gram
Safranine (red) - -	0.30 gram
Chrysoidine - - -	1.00 gram
Ethyl alcohol - -	200 CC
Distilled water - -	2000 CC
Acetic acid (dilute) -	200 CC

In this modification, after the water wash in tank 28, the film is run through the tank 29, which contains the uranium toning and basic dyeing solution. Ordinarily it requires from six to ten minutes to produce a satisfactory color value image upon the film 12. The image 15 is first changed from a silver image to a chemically toned image, and then the dye is mordanted to the image. The resulting image is a chemically toned plus a dye-toned image. After leaving the tank 29, the film passes through a water wash in tank 30 for approximately four minutes.

The terms "red" and "blue" are used in a broad sense; i.e., to designate color values of their respective portions of the spectrum rather than single color values.

Although we have outlined the use of but one pair of substantially complementary colors, the features of our invention may be utilized in the production of any complementary color values. This may be accomplished by varying the time of the several treatments, by varying the strength of the solutions, or by using other dyeing and toning solutions.

Other blue-toning formulae that may be used instead of the formula already disclosed are as follows:

Iron ammonium alum -	2.5 grams
Potassium citrate - -	2 grams
Ammonium oxalate sat. sol. - - - - -	10 grams
Hydrochloric acid (conc.)	0.5 CC
Potassium ferricyanide -	2 grams
Distilled water - -	1000 CC
or	
Iron ammonium alum -	10 grams
Potassium bromide - -	6 grams
Hydrochloric acid (conc.)	1 CC
Potassium ferricyanide -	2 grams
Distilled water - -	1000 CC

Dyes that may be used are safranine, chrysoidine and rhodamine, or any other basic dye, or combination thereof.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A process of producing colored photographic films having images on opposite sides, which images are toned in different colors, including the step of treating a fixed silver image with a uranium toning bath and treating it subsequently or simultaneously with a basic dye.

2. A process of producing a colored motion picture film, as set forth in claim 1, in which the step of treating the images on one side with a uranium toning bath is carried out after the opposite side of the film has been treated in a toning bath imparting to said opposite side a different color and the treatment of the film with the uranium bath and the basic dye solution or the combined treatment of the film with the uranium bath and basic dye solution remaining without influence on that side of the film which had first been subjected to a toning solution.

3. A process of producing a colored motion picture film, as set forth in claim 1, including as dye solution for treatment of the film subsequent to the uranium toning bath a solution of the following composition:

Rhodamine - - -	0.01 gram
Safranine (purple) -	0.03 gram
Safranine (red) - -	0.15 gram
Chrysoidine - -	0.5 gram
Ethyl alcohol - -	100 CC
Distilled water - -	2300 CC
Acetic acid (dilute) -	100 CC

4. A process of producing a colored motion picture film, as set forth in claim 1 in which the film for the combined treatment in the uranium toning bath and the basic dye solution is passed through a solution of the following composition:

Potassium oxalate - -	12 grams
Uranyl nitrate - -	32 grams
Potassium ferricyanide -	9 grams
Hydrochloric acid (Sp. gr. 1.18) - - -	32 CC
Distilled water - -	2000 CC

and

Rhodamine - - -	0.02 gram
Safranine (purple) -	0.06 gram
Safranine (red) - -	0.30 gram
Chrysoidine - - -	1.00 gram
Ethyl alcohol - -	200 CC
Distilled water - -	2000 CC
Acetic acid (dilute) -	200 CC

5. A process of producing a colored motion picture film, substantially as described, and for the purpose set forth.

Dated this 4th day of June, 1931.

For the Applicants,
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Chartered Patent Agents,
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London, W.C. 2.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1932.

[This Drawing is a full-size reproduction of the Original.]

Fig. 1.

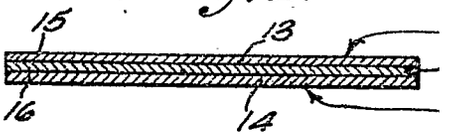


Fig. 2.

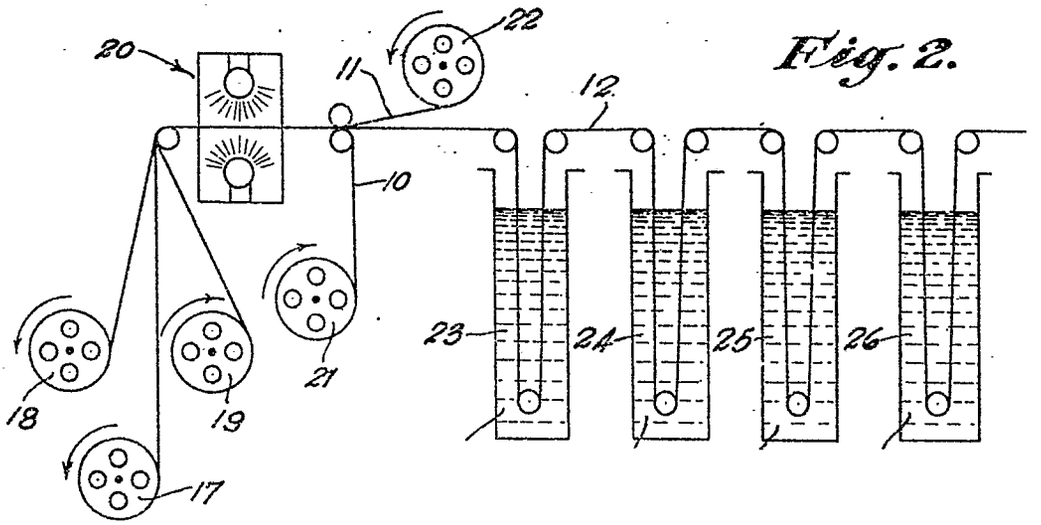


Fig. 2a.

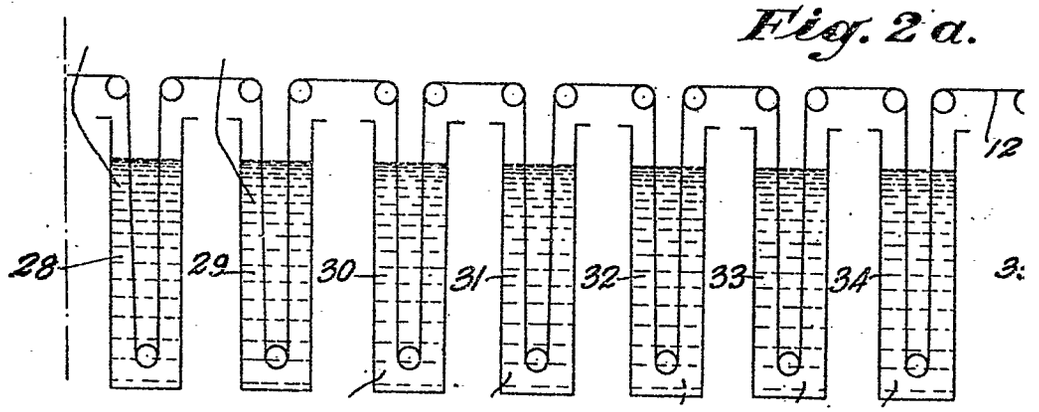


Fig. 1.

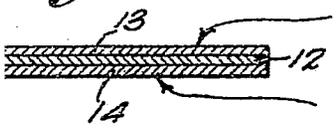


Fig. 2.

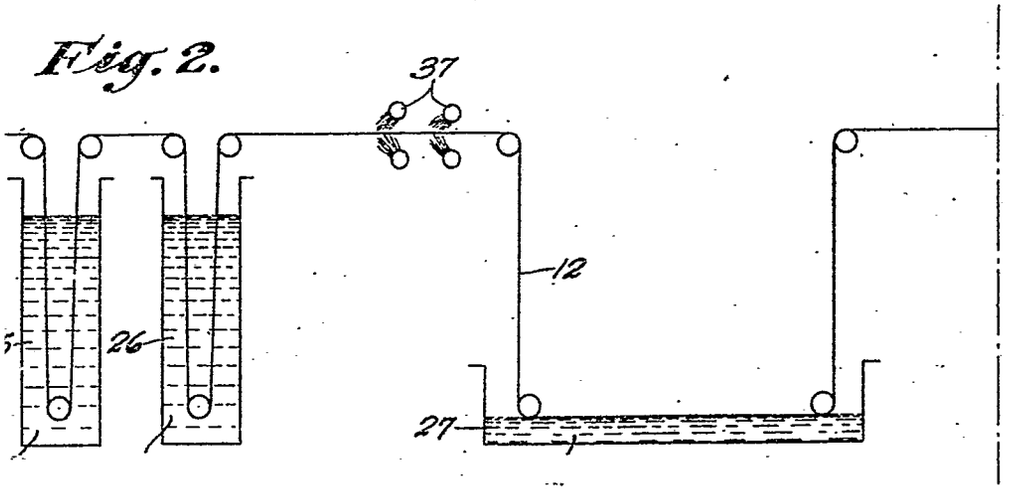
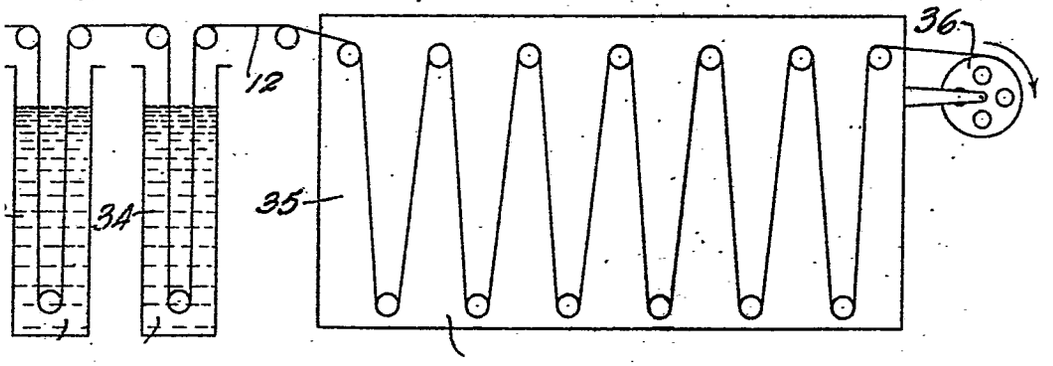


Fig. 2a.



Malby & Sons, Photo-Litho.

[This Drawing is a full-size reproduction of the Original.]

Fig. 1.

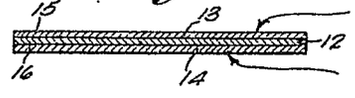


Fig. 2.

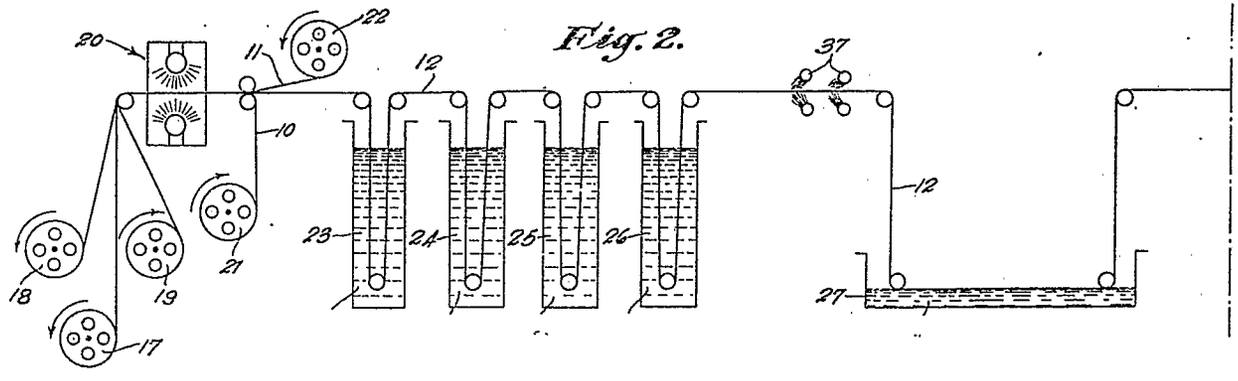
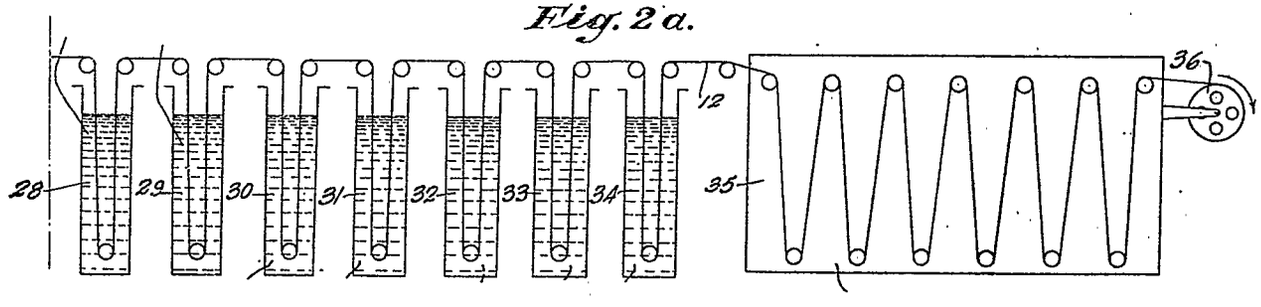


Fig. 2a.



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