PATENT SPECIFICATION

339,323

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Complete Accepted : Dec. 4, 1930.

COMPLETE SPECIFICATION.

Method of Producing Photographs in Colour.

I, WILLIAM WARREN TRIGGS, of the firm of Marks & Clerk, 57 & 58, Lincoln's Inn Fields, London, W.C. 2, a British subject, do hereby declare the nature of this invention (a communication to me from abroad by Multicolor Films, Inc., of 201, North Occidental Boulevard, Los Angeles, California, United States of America, a corporation organised under the laws of the State of California, United States of America) and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

My invention relates to colour photography and more particularly to the art of producing colour motion picture films.

It is an object of my invention to provide a process of producing a motion picture film whereby satisfactory colours may be given to respective images so that the clear spaces thereof remain substantially uncoloured.

The present invention consists in a process of producing coloured photographic films comprising treating a fixed silver image with a basic dye and then treating the dyed image with a uranium mordanting and toning bath.

The invention also consists in a process of producing coloured photographic films employing a film having an image or a series of images on both sides thereof, comprising iron toning the image or images on one side of the film and treating the film in a basic red dye bath.

Specifically an object having several colours is photographed from the same viewpoint upon two negative films. Interposed between the object and one of these negative films is a transparent green-blue filter and between the object and the other negative film a transparent orange-red filter. The negative films are then removed from the camera and developed. An unexposed positive film is then provided, having an emulsion applied to each of the opposite faces thereof. This emulsion is impregnated with a dye of a character to permit corresponding portions of the two developed negative films to be printed simultaneously upon opposite sides of the positive film.

When the positive film has been thus exposed, it is developed, fixed and washed the dye being washed out, and is then ready for having the opposite faces thereof coloured orange-red and blue-green as hereafter specifically described.

The subtractive primary colours are red, yellow and blue, or perhaps more correctly, magenta, yellow and blue-green. Any two-colour process will necessarily give but an approximation of perfect colour reproduction.

In my process as hereinafter described the images are not coloured orange-red and green-blue respectively, but orange-red and blue. Strictly speaking, these colours are not complementary, but the orange-red dye-toning and blue-toning solutions hereafter described give substantially complementary colour values. By the term "complementary colour values" we do not mean complementary colours in the sense that a physicist would use the terms, but to mean that the colours are such that when said complementary colour value images are projected on a screen, substantial colour reproduction will be produced. It is true that in the process carried out as hereafter described the greens, blue-greens and green-blues are coloured blue, but these hues may be obtained by incomplete or partial toning as described in detail hereinafter.

In the accompanying drawings an apparatus for carrying out my invention is diagrammatically illustrated wherein:—

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

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

To provide the single bi-coloured film for use in the standard projection machines, a positive film 25 is provided, having emulsions 26 and 27 provided upon opposite faces thereof. Emulsions 26 and 27 are impregnated with a dye which per-

[Price 1/-]

mits the simultaneous printing of the negatives on opposite sides of the film 25 and in exact superimposed registry with each other on the emulsion coatings 26 and 27, respectively.

The apparatus employed includes a fresh positive feed reel 40, a blue-green negative feed reel 41, an orange-red negative feed reel 42, a printing device 43, blue-green and orange-red winding reels 44 and 45, a series of tanks 48, 49, 50 and 51, a blue toning tank 52, a series of treating tanks 53, 54, 55, 56, 57, 58 and 59, a drier 60, and a positive film winding reel 61. Air jet pipes 62 are mounted adjacent to the film as it passes between the tank 51 and the blue toning tank 52. This apparatus is operated in the following manner to carry out my method of producing a double-coated positive colour film.

A supply of fresh double-coated film is provided upon the reel 40 and as the film is advanced through the apparatus, this fresh film is drawn from the reel 40 and passed through the printing device 43 between the blue and orange-red negatives which are unwound from the reels 41 and 42, respectively. After the positive 25 has been printed, the negatives 18 and 22 are wound upon the reels 45 and 44 respectively. The printed positive film then passes through a bath of a developer adapted to give a soft image, contained in the tank 48 and after that, through a stop bath formed by a weak solution of acetic acid which is placed in the tank 49. The printing and developing of the positive 25 is carried on in a dark room but the remainder of the process may be conducted in the light.

Leaving the tank 49, the film 25 passes through a fixing solution in tank 50 after which the film passes through a water wash in the tank 51. Leaving the tank 51, the film 25 is practically dried by jets of air blowing at high velocity from the pipe 62 disposed close to the film. The film then passes through a blue toning tank 52 which completely converts the positive silver image 32, which was printed from the orange-red negative, into a blue image. One formula for the liquid placed in the tank 52 is as follows:

Ferric Ammonium Oxalate	4.5 grams
Potassium Ferricyanide	2 ,,
Ammonium chloride	4 ,,
Hydrochloric acid	2 CC
Water	500 CC

The tank 52 may be of any suitable construction which restricts the application of the treating liquid to only one side of the positive film, as diagrammatically illustrated in Figure 3.

After leaving the tank 52, the positive film 25 is given a complete water wash in the tank 53, from which tank the film passes into the tank 54 which contains a solution of a basic orange-red dye in which the entire film is bathed for one minute. The preferred formula for this dye is as follows:

Stock Solution A.

Basic Magenta	1 gram
Distilled Water	250 CC
Glacial Acetic Acid	5 CC

Stock Solution B.

Auramine	1 gram
Distilled Water	250 CC
Acetic Acid	5 CC

For use we take 50 CC of Stock Solution A and 25 CC of Stock Solution B and 200 CC of distilled water.

The film is now run through a brief water wash in the tank 55, preferably for about thirty seconds, and then into the tank 56, where it is given a "uranium" bath. The formula for the solution of the uranium bath is as follows:

Potassium Oxalate	12 grams
Uranium nitrate	32 ,,
Hydrochloric Acid	32 CC
Potassium Ferricyanide	9 grams
Water	4000 CC

The surplus of the dye of the formulæ given is removed from the film in passing through the tank 55 prior to going into the uranium bath; furthermore, the dye is removed from the clear portions of the film by some chemical action in the uranium bath.

The orange-red dye in the image 31 is mordanted by the uranium bath so as to convert the silver image 31 into an orange-red image while the clear spaces thereof are automatically cleared by the uranium bath. The image 31 is therefore not only a dyed image but also a uranium toned image.

The length of time required to complete the orange-red dye toning in the uranium bath is approximately five to seven minutes. The quantity of dye which mordants on to the image increases with time, so that short immersion will give a slightly coloured image and prolonged immersion will give a strongly coloured image. After leaving the uranium bath, the film 25 passes through a water wash in the tank 57, a hypo bath in the tank 58, another water wash in the tank 59, and then passes through the drier 60 and is wound up on the winding reel 61. Before entering the hypo bath, the images are usually opaque due to the presence of silver ferrocyanide. The hypo dissolves this silver ferrocyanide, thereby removing all traces of opaqueness from the

images and is therefore said to fix the colour in the images.

Owing to the complete transformation of the positive silver image 32 printed from the orange-red component negative to a blue image in the tank 52, this side of the film is entirely unaffected by the orange-red dye and uranium baths so that the film 25 when wound upon the reel 61 has the opposite images thereof perfectly coloured to produce a projected image of the original in its natural colours.

The uranium bath used according to the invention gives remarkable clearness of the high lights of the images.

The reason why the blue image is not affected by the subsequent treatments is because the ferric bath formulæ given is not a mordant for basic dyes and consequently for the orange-red dye, but instead chemically tones the image so that it is substantially impervious to the red dye.

Where a blue-green or green colour is desired for some particular effect, said colour may be obtained by a modification of our process. The blue toning treatment is not carried to completion in toning tank 52, so that the silver image is only partially converted, leaving some unaltered silver grains. This may be accomplished in several ways, such as by using dilute solutions, or by shortening the time of treatment. The subsequent uranium bath acts upon the unconverted silver grains of the blue image to turn them a yellowish colour which modifies the blue colour of the rest of the blue image to give this image a greenish hue. Various hues ranging from blue-green to green can be obtained by varying the length or strength of the blue toning treatment, and by varying the length of the uranium bath treatment.

The terms "red" and "blue" are used in a broad sense, i.e. to designate colour values of their respective portions of the spectra rather than single colour values. By "partially converting", or "partially chemically toning", we mean that the process of conversion or chemically toning is not carried to completion, in that some of the silver grains of the image are left unaltered.

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 process of producing coloured photographic films comprising treating a fixed silver image with a basic dye and then treating the dyed image with a uranium mordanting and toning bath.

2. Process of producing coloured photographic films employing a film having an image or series of images on both sides thereof, comprising iron toning the image or images on one side of the film and treating the film in a basic red dye bath.

3. Process as claimed in claim 2 wherein the film is subsequently subjected to a uranium toning treatment.

4. Process as claimed in claim 3 wherein each of the images on one side of the film is only partially converted into ferric ferrocyanide by iron toning, the subsequent treatment of the film serving to modify the colour of the partially converted image and to give the formerly untreated images a complementary colour value.

5. Method of producing a coloured motion picture film employing a film having fixed silver images on both sides which consists in treating the images on one side of the film with a solution including substantially:

Ferric Ammonium oxalate	4.5 grams
Potassium ferricyanide	2 ,,
Ammonium chloride	4 ,,
Hydrochloric acid	2 cc.
Water	500 cc.

washing the excess of said solution from the images treated, treating said film with a solution of basic red dye, washing the excess red dye from said film, bathing said film in a solution including substantially:

Potassium Oxalate	12 grams
Uranium Nitrate	32 ,,
Hydrochloric Acid	32 cc.
Potassium Ferricyanide	9 grams
Water	4000 cc.

and washing the excess of said last-mentioned solution from said film.

6. A process as outlined in claim 5 in which the red dye comprises a mixture of solutions of basic magenta and auramine.

7. The improved process of producing photographs in colours substantially as described.

Dated this 2nd day of May, 1929.

MARKS & CLERK.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1930.

Fig. 1

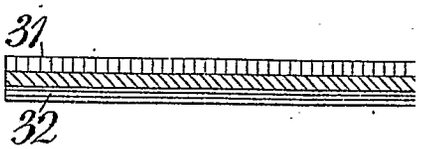

Fig. 2.

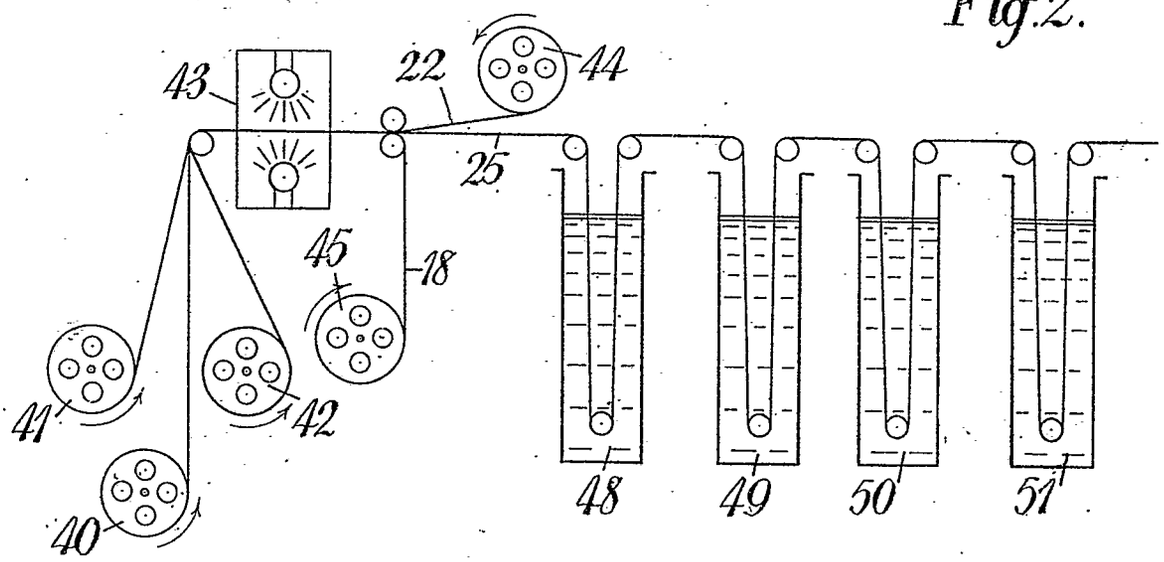

Fig. 2a.

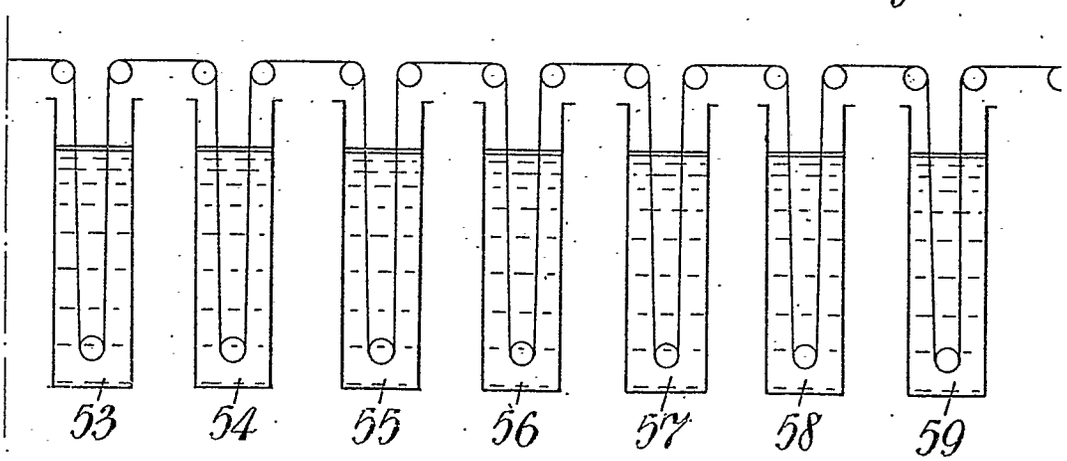

Fig.1

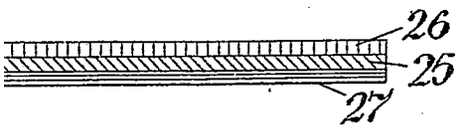

Fig.2.

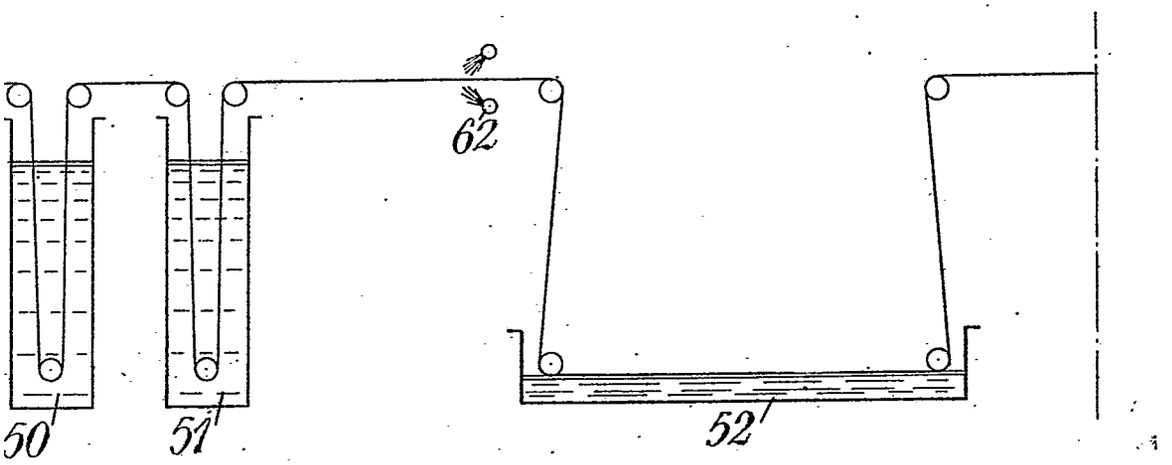

Fig.2a.

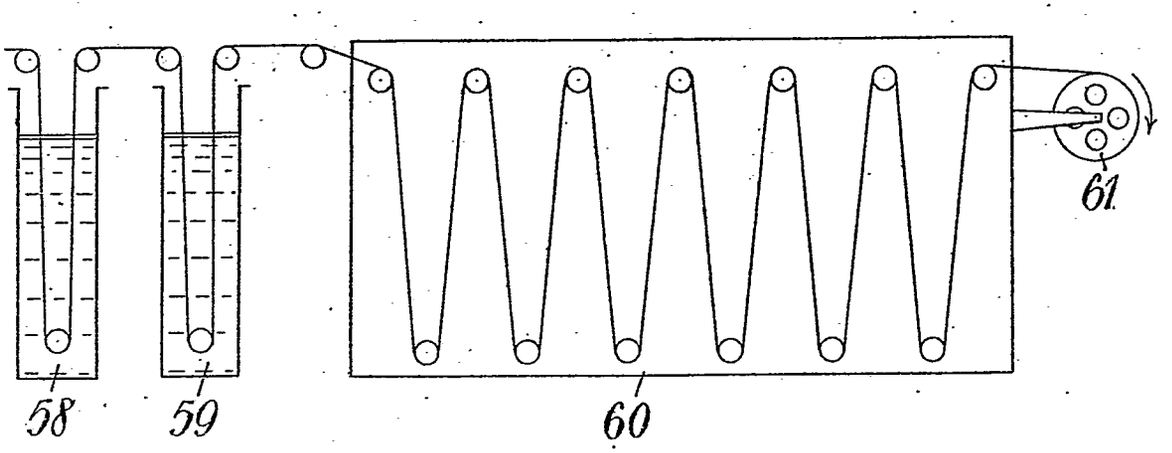

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Fig. 1

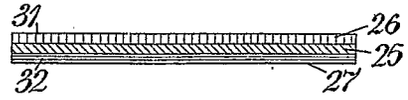


Fig. 2.

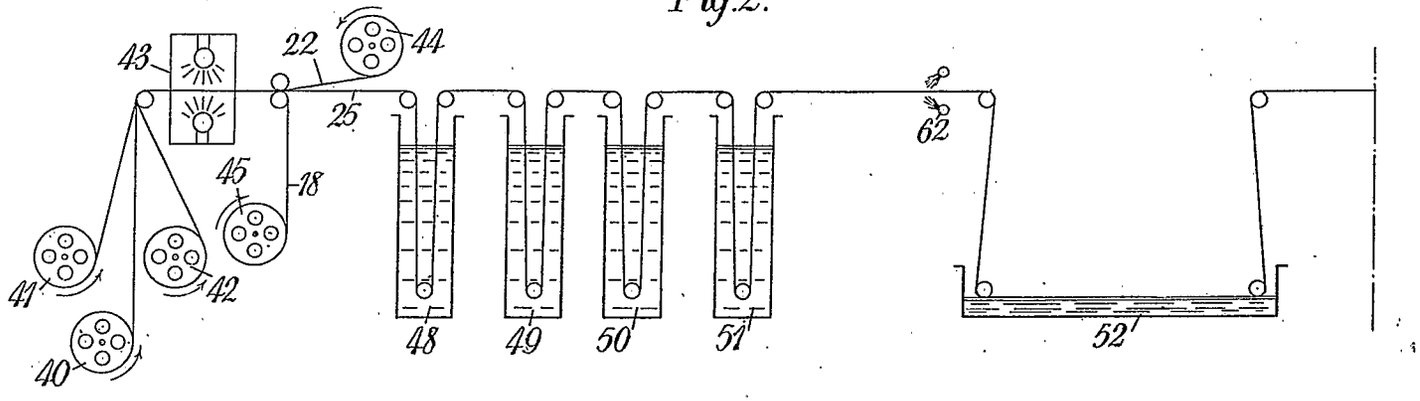
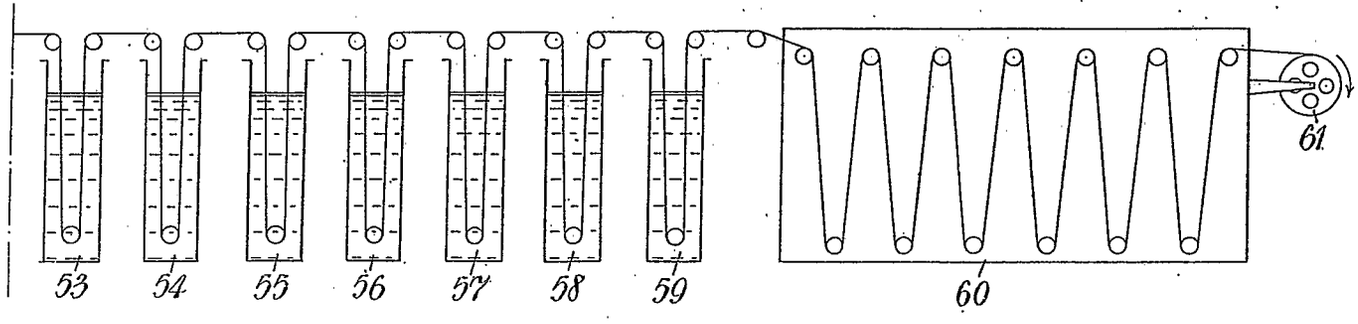


Fig. 2a.



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