PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in Colour Photography.

We, TECHNICOLOR MOTION PICTURE CORPORATION, a corporation of Maine, United States of America, and LEONARD THOMPSON TROLAND, a citizen of the United States of America, both of 110, Brookline Avenue, Boston, Massachusetts, 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 photographic films and the reproduction of same, particularly in color photography, whether for still or motion pictures.

The principle objects of the invention are to separate superposed complemental images supported by a single film or plate in order to obtain corresponding images on separate supports in accurate registry which can be further utilized in any desired manner for example, as matrices for imbibition printing, to simplify the art of producing color pictures, to reduce the time and cost required to produce such pictures and generally to improve the art of color photography.

In order to clarify the subsequent description of the invention the following definitions are here inserted.

The term "emulsion" is used generically to connote either a true emulsion or other composition which is sensitive to light. The "entrant" side of the emulsion is the side through which the exposing light enters the emulsion, whether or not it be next to the celluloid or other support, and the "emergent" side is the opposite side. The term "color" is used in its most common sense, not as being limited to a pure color but as including a range of colors in which a certain color predominates. The "warmer colors" are those nearer the red end of the spectrum and the "colder colors" are those nearer the violet end of the spectrum. The term "complemental images" is used to designate images representative of different color aspects of an object field, which when combined by printing, projection or otherwise, will yield a more or less accurate color reproduction of the object field, the images themselves not necessarily being colored, and the colors which the images represent not necessarily being exactly complementary. The term "developed images" connotes images which have been developed whether or not they have been subsequently bleached. The term "transparent image" means an image which is substantially transparent to light of one or more colors though not necessarily to all colors.

It is also understood that the present invention is not only applicable to photographic films in the customary use and significance of this term, but also to all records or recording articles or devices, whether the emulsion is supported upon celluloid or other supports or is self-supporting, and whether the film is adapted for either still or motion pictures.

According to this invention, the method of producing separate prints from two color aspect records contained at different depths of a single emulsion (or in different coatings on the same side of the supporting film or plate), is characterised by staining the records in colors not necessarily related to the recorded colors, printing one of said records with light transmitted by the other record and printing said other record with light transmitted by said first record.

When employing the reproduction methods according to the present invention, it is desirable (although not always necessary) that the portions of the light-sensitive strata bearing the respective superposed complemental images be separated by a free gelatine layer. For example, if it is desired to separate the images produced in the portions which are predominantly sensitive to different colors or if it is desired to impregnate or otherwise treat the portion bearing one image without affecting the other image or images, as herein described, it is advantageous to have the portions somewhat separated.

For good results in two-color work the negative film should have the following characteristics. The entrant stratum of the emulsion should be insensitive or relatively insensitive to orange, red and possibly yellow light, that is, light having

[*Price* 1/-]

wave lengths greater than approximately 590 mu. This stratum should be sensitive to blue, blue-green, and preferably green and yellow-green light. The same stratum should be of such color as strongly to absorb substantially all of the spectrum to which it is sensitive. The exact degree of this absorption is determined by the method of subsequent treatment and by the effects to be produced in the finished pictures, but in general it should be many times (e.g. of the order of one hundred times) greater than that which results from ordinary impregnation with dyes for the purpose of green sensitizing or orthochromatizing the emulsion. The emergent stratum of the emulsion should be sensitive to orange, red, and possibly yellow light. In general it is immaterial whether this stratum is also sensitive to other rays of the spectrum since the other rays are absorbed before reaching this stratum.

In the accompanying drawings:

Figure 1 is a diagrammatic view of one form of the negative film used for our improved printing method;

Figure 2 is a diagrammatic view of one way of producing the images thereon; and

Figure 3 is a diagrammatic view of the application of the invention to the production of three color pictures.

In Figure 1 we have illustrated one preferred embodiment of the negative film employed for our invention wherein F represents a support of celluloid or other suitable material and E represents the emulsion which may be of the kind predominantly sensitive to the colder colors. The emulsion is sensitized to the warmer colors throughout the cross-hatched portion W. If the portion W of the emulsion is thus rendered sensitive to the warmer colors and if the emulsion is originally more sensitive to the colder colors the other portion, represented by the cross-hatching C, is predominantly sensitive to the colder colors. The entire emulsion is dyed, preferably in the process of making the emulsion, with a dye which will permit either the warmer or the colder colors to be transmitted predominantly. For example, if the film is to be exposed through the back (i.e., through the celluloid), as is essential for some purposes, the emulsion may be dyed orange as, e.g., by use of dyes which absorb violet and ultra violet, thus rendering the emulsion predominantly transmissive to the warmer colors. Upon exposing the film to a colored object or image field through the back, an image representative of the warmer colors is formed in the portion W and a complemental image representative of the colder colors is formed in the portion C.

Fig. 2 shows one method of exposing the film wherein L represents a focusing lens of a camera, projection printer or the like, and F represents the celluloid, thus illustrating the method of exposing through the celluloid or other support. A suitable color filter X may be provided. After the film has been exposed, it is developed for the time required to give the proper gradations of the various areas of the images or each set relative to each other and of the respective sets relative to each other.

After development, the negative is fixed in a plain hypo fixing bath, is then washed until the dye has substantially disappeared, and is then dried in any suitable manner.

According to our method of separating the component negative images, we transform each of these images into an image in pure dye or other coloring matter, each image absorbing exclusively certain spectral rays or colors. For example, in the case of a two-color record the cold color image might be converted into an image in yellow or minus-blue dye and the warm color image into an image in magenta or minus-green dye or other coloring matter. There are various ways in which this could be accomplished. For example, both images may be converted into a dye such as Metanil yellow (color index 138) which when acted upon by an acid becomes magenta in color. A small amount of acid may then be diffused into the film so that the image next to the surface is converted into magenta while the other image is not sensibly affected. Another method is to convert the image next to the surface directly into a magenta dye image by controlled diffusion and then to convert the remaining image into a yellow image by some process which does not affect the first image, such as toning with metallic salts or the use of a dye having chemical properties different from that employed for the first image.

One such method consists in converting both negatives into unexposed light-sensitive silver salt, exposing one negative without substantially exposing the other negative, and then developing the exposed negative. The negative which remains in the form of silver salt may be employed as a mordanting base for a dye of the appropriate color which is not absorbed by the metallic silver image. The latter may be colored the desired color by any well-known toning process which does not act upon the silver salt or dye of the other negative. By employing a bleach which will convert the silver into silver iodide in the aforesaid bleaching operation a con-

siderable variety of dyes are available in the mordanting process. For example safranine may be employed to produce a magenta color. In the toning process a yellow image may be produced by employing a titanium salt. The negatives thus differently colored may be separately printed by using lights of different colors, the light used in printing each negative being absorbed strongly by that negative and weakly, if at all, by the other image.

It is clear that when this conversion of the images into respectively different colors, as above specified, has been accomplished, if blue light is employed to print through the combined film, only the yellow or minus-blue colored image will be printed, since the blue light will not be absorbed by the magenta image. On the other hand, if green light is employed, only the magenta or minus-green image will be printed, since the green light will not be absorbed by the yellow image. In this way it will be possible to effect an optical separation of the two images without removing either of them from the film and also without involving any appreciable adulteration of one image by traces of the other.

In the last aforesaid method the original exposure need not be made through the celluloid or other support, consequently the original exposure may be made much shorter.

While the invention has been described with particular reference to two-color work it is also applicable to the production of pictures with a greater number of color components, one application to three-color work being illustrated in Figure 3, where two films, each with its own celluloid base, are employed with their emulsion surfaces in contact.

One of these films may be similar in structure to the one shown in Fig. 1, (differing merely in color sensitivity) and the other an ordinary panchromatic film. Thus in Fig. 3 F^1 represents the celluloid of the first film carrying an emulsion E^1 the inner stratum C^1 of which is sensitive to cold color or colors e.g. violet, blue, and blue-green, and the outer stratum of which is sensitive to warmer color or colors, e.g., green and yellow-green. The outer stratum may or may not be sensitive to the colder colors.

The celluloid of the second film is designated F^{11} and carries an emulsion H^1 which is sensitive to still warmer color or colors, e.g. yellow, orange and red. Either the inner stratum C^1 or both strata C^1 and W^1 are impregnated with a dye which rapidly absorbs the colors to which the inner stratum is sensitive but which does not absorb the colors to which the outer stratum is sensitive. If the stratum H^1 is also sensitive to green and yellow-green a filter absorptive of these colors may be provided between the two films, which filter may be in the form of a superficial coating of dye on the face of either film. However, the filter may be eliminated by employing at H^1 an emulsion sensitive only to yellow, orange and red.

With these films in contact (instead of slightly separated as shown in Fig. 3) they are exposed from the side indicated by the arrow. The violet, blue and blue-green rays expose stratum C^1 and are absorbed thereby so that none of them reach the other strata. The green and yellow-green rays expose stratum W^1 And the yellow, orange and red rays expose stratum H^1. The latent images in strata C^1 and W^1 are treated and reproduced as described above in connection with the two strata in the two-color processes and the image in emulsion H^1 may be developed and printed in the ordinary way, it being understood that the three positives are suitably colored to give the desired colour effect when combined.

The present invention permits automatic attainment of register between the positive prints. For example, the original negative and the positive blanks to be printed upon may be similarly punched and, in printing, these punchings may be held in register by fitting both films over pins so placed in the printing frame as to fit the original perforations. Since the negative is geometrically identical in the printing of both color component positives, the application of the above method insures that both positive films may then be registered with respect to each other (or in the case of imbibition technique with respect to a third element or transfer blank) by use of the same perforations. If the mechanical features of this method are accurately adjusted this insures register of the final color images without placing any reliance on the eyes or mechanical skill of the operator.

For the purpose of simplifying and clarifying the description we have in many instances referred to the images being reproduced as negatives and the images being printed as positives but it is to be understood that the invention is likewise applicable to the production of negatives from positives if such reverse procedure is desired for any purpose.

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. The method of producing separate prints from two-color aspect records con-

tained at different depths of a single emulsion (or in different coatings on the same side of the supporting film or plate), characterized by staining the records in colors not necessarily related to the recorded colors, printing one of said records with light transmitted by the other record, and printing said other record with light transmitted by said first record.

2. Method according to claim 1, wherein the two-color aspect records are obtained by exposure of a bi-pack comprising a front film carrying an emulsion sensitized for said two color aspects and a rear film carrying an emulsion sensitized for a third color aspect.

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WM. BROOKES & SON,
No. 1, Quality Court, Chancery Lane,
London, W.C. 2,
Chartered Patent Agents.

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FIG. 1.

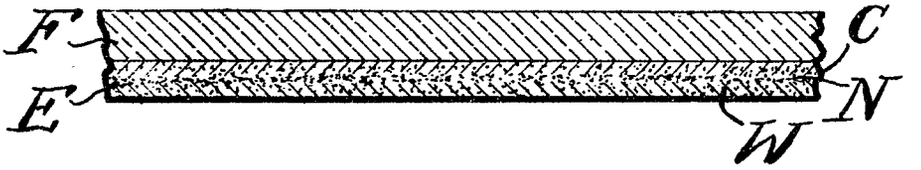


FIG. 2.

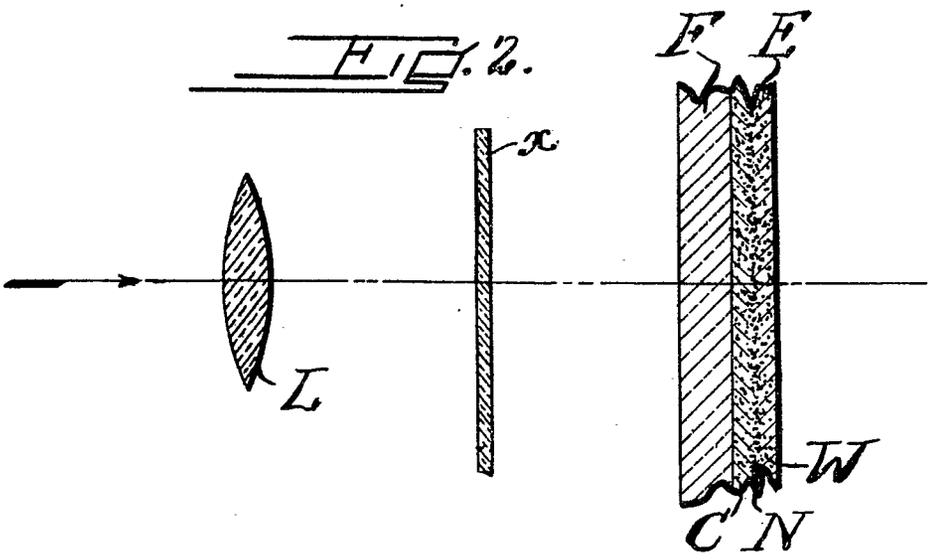
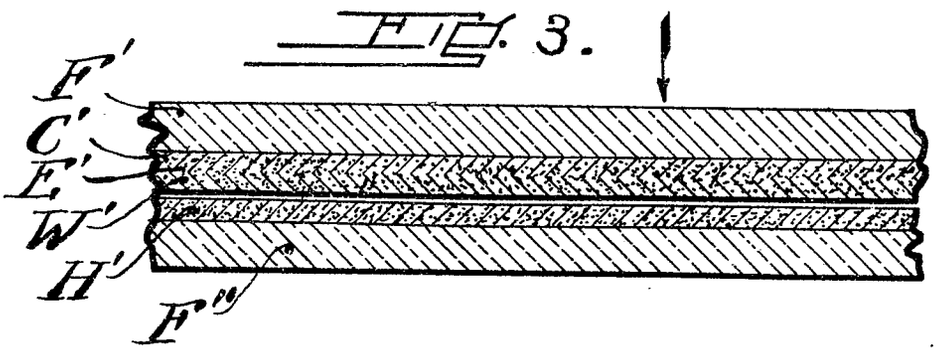


FIG. 3.



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