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MANUFACTURING POLYCHROMATIC PHOTOGRAPHIC PICTURES

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The present invention relates to the manufacture of photographic, transparent pictures, and is particularly concerned with improvements in producing polychromatic diapositives and films.

Generally speaking, the manufacture of polychromatic diapositives and films is known, and various methods are being used herefor. These methods require however a great deal of work and consume appreciable time, while the results are unsatisfactory.

The oldest manner of producing colored films consists in applying the colors manually to the developed picture. It will be easily understood, that this method is not adapted to work on a large scale. Another method is to color the pictures by means of stencils. It requires the use of as many stencils as there are colors in the picture, which is a costly and time consuming procedure in view of the work involved in making the different stencils. Other known methods are based on the formation of colors by the reaction of certain chemicals with the silveroxyd which forms in a photo-sensitive layer at all parts struck by the light. Referring more particularly to this last mentioned method, the film or plate when treated with the chemicals after exposure, takes the respective color produced by the reacting chemicals and silver at the parts previously struck by the light, while the other parts are left free.

However, a serious disadvantage, which cannot be avoided, must be considered with all colored films and diapositives in which the pictures were produced on photo-sensitive layers sensitized by silver-salts or the like. The entering light produces more or less dark parts, and the entire picture, on the negative as well as on the positive, is formed by a combination of dark parts, covering the scale from transparent to gray to black. If such a picture is colored, the pure color can only appear at parts formerly transparent, while at all other parts the color impression is disturbed by the underlying dark shadows. This is a very serious handicap and greatly decreases the utility of such polychromatic films for many purposes, particularly for those which require a high intensity of light, as e.g. polychromatic cinematographic films.

In order to overcome these difficulties, it was attempted to bleach the white and black picture; the success was, however but small, because this bleaching severely impairs the quality of the pictures.

It will be understood from the foregoing that the use of silverfree photo-sensitive layers, as e.g. layers sensitized by bichromates, is preferable in the manufacture of polychromatic transparent pictures by photographic means. Such photo-sensitive layers on exposure harden at all parts struck by the light, while the other parts are left unhardened, soluble and absorbent.

The known coloring of these last mentioned films or glass plates with colored liquids, either by absorption of the liquid by the absorbent parts of the sensitive layer, or by washing off the soluble parts of the film and then treating the remaining hardened parts by means of a suitable coloring material, permits the application of only one color.

The attempt was made to use double coated films or plates sensitized by bichromates, and to expose one side under a negative obtained by taking a picture with a certain color filter, and the other side in register under a negative obtained by taking a second picture of the same scenery with a different color filter. By subsequent coloring either the hardened or unhardened parts on either side of the double coated material, a polychromatic film was obtained. This method requires, however, two different negatives obtained by the use of color filters during exposure which causes well known disadvantages, i.e., loss of light intensity and long duration of exposure.

The principal object of the present invention is to eliminate all these disadvantages and to produce polychromatic diapositives and films efficiently, at low cost and fast.

Another object of the invention is to manufacture transparent polychromatic diapositives and films in which the transparency is not disturbed by underlying shadows.

Still another object is to manufacture polychromatic films and diapositives having
projection-correct pictures, i.e., pictures correct in accordance with the direction of the view, or, in other words, opposed to the mirror picture.

These objects are realized by copying the films or diapositives on double coated material, in such a manner, that one side is exposed under a negative and the other side under a positive of the same image. The double coated material is not sensitized by means of silver salts which produce a darkening of the parts struck by the light, but by means of chemicals which cause a hardening of the colloid layer under the influence of the light. Bichromates are particularly suitable herefor. Taking a suitable transparent carrier of glass, celluloid, celluloid compounds or the like, and applying on each side a colloid layer sensitized with bichromates, then exposing one side under a negative and the other side under a positive corresponding to this negative, hardened parts will appear on both sides of the double coated carrier which are located on opposite sections of the same. More particularly stated, each hardened part on the one layer will have a corresponding unhardened part on the other layer, and vice versa. Now, by coloring the unhardened parts on one side with one color and the unhardened parts of the other side with a different color, a picture will appear which is at least two-colored, when the picture is projected on a suitable screen or when the picture is held against the light.

It is also possible to wash off the unhardened parts on both sides by a well-known method, and to color the remaining hardened parts on the sides each with a different color. The result is the same as in case of the previously stated process, but the method is not recommended, because the hardened parts may be affected detrimentally during the washing off of the soluble colloid layer.

The method, applied in its simplest form is as follows: An ordinary silver negative is obtained from a given scenery in any generally known manner. A silver positive is obtained from this negative. One side of a double coated material sensitized on both sides with bichromates is exposed under the negative, while the other side is exposed under the positive. The double coated material is then developed in some known manner and on both sides colored with different colors. It is also possible to produce first a bichromate negative from the original silver negative, and likewise a bichromate positive from the silver positive, by copying the respective silver-salt-negative and -positive each on a transparent film or plate sensitized by means of bichromates. These two chrome pictures may be dyed with impermeable anilin dyes in any known manner and then used for copying on the double coated material. This last procedure has the advantage to furnish true projection pictures, while reverse projection pictures will result in direct copying from the silver negative and the silver positive on the double coated material.

In accordance with the present method, one original exposure made without the use of a light filter, is entirely sufficient for the production of polychromatic diapositives and films. Formerly two negatives were used made by two original exposures with different light filters. In accordance with the present invention the negative of the original is copied on one side of the double coated material, while on the other side a positive corresponding to the negative is copied.

If so desired, the original picture may, of course, be taken with a suitable color filter, without in any manner influencing the execution of the new copying method. The use of a negative for copying on one side of the double coated material and of a positive for copying on its other side is a characteristic feature of the present invention.

The invention is explained in detail in the following description referring to the single sheet of drawings which form a part of this specification.

Figs. 1 to 5 are cross sections of a film or a glass plate.

Fig. 1 shows a double coated material; Fig. 2 illustrates a double coated material with one opaque layer; Fig. 3 shows a double coated material with two light retarding layers; Figs. 4 and 5 show the distribution of colors on the finally colored double coated plates, and the impression obtained by viewing the picture against the light or by projecting it on a suitable screen. In Fig. 4 only the full-tones are shown, in Fig. 5 also the half-tones.

All five figures show double coated carriers. Reference character $b$ illustrates the transparent carrier, $a$ the one and $c$ the other colloid layer sensitized with bichromates. Reference characters $d$ and $e$ illustrate light retarding layers. The purpose of the light retarding layers is to prevent light rays striking one side of the double coated material from penetrating to the other side during the exposure of the first side, and thereby affecting the photo-sensitive layer on the other side. This light retarding layer, as is well-known, may consist of a material which is impermeable to chemically active parts of the light rays, particularly rays of short wave length. Eosin, for example, is suitable for this purpose. Other light rays must, of course, be able to permeate undisturbed, in order to warrant the transparency of the picture.

Fig. 4 shows the cross section of a part of a finally colored film. The left hand layer on this figure is colored blue and the right hand layer yellow. The hardened parts $f$ and $f'$ of the left and of the right colloid layer re-
mained uncolored, while the right side was colored with yellow dye and absorbed this dye on the unhardened parts indicated by reference character $A$. In a corresponding manner, the coloring with blue dye took place on the left side. The unhardened parts $g$ are, therefore, colored blue. When the picture is projected on a suitably painted color distribution will be as follows: all parts indicated by $f$ are blue and all parts indicated by $m$ are yellow.

The manner of producing a three colored film in accordance with the described method is illustrated in Fig. 5. It must be remembered that so-called half-tones appear in the chromatic process. These correspond to the gray sections of a silver negative or silver positive. These half-tones, of course, appear on the positive and on the negative in the same places, and are, therefore located exactly opposite each other on the double coated material. The blue half-tone is indicated by reference character $i$ and the yellow half-tone by $k$. The picture in accordance with Fig. 5, when projected, shows the following sequence of colors, from top to bottom, on the screen: blue, green, yellow, blue. The green color appeared by the addition of the yellow and blue half-tones $i$ and $k$.

The simple procedure may be varied by starting from two silver negatives taken with different color filters, making a silver positive from the one negative and continuing with the other silver negative. While possibly complementary color filters were used in connection with the hitherto known methods treating double coated material in negatives which were taken with color filters, other color combinations must be chosen with the present method. It will be easily seen that by utilizing two filters with complementary colors, the positives of the one exposure would register with the negative of the other exposure, so that the hardened and the unhardened parts of the two colloid layers would be located opposite each other, instead of being located in different sections.

I claim:

1. The process of manufacturing polychromatic transparent films comprising the steps of exposing under a negative one side of a transparent body having on its opposite sides photo-sensitive layers sensitized for hardening but for remaining transparent where light struck, exposing the other side of said body under a positive of the same image in register with the negative aforesaid, developing both sides of said body, coloring on one side those parts not affected by the light with one color, and coloring on the other side the parts not affected by the light with another color.

2. The process of manufacturing polychromatic transparent films comprising the steps of exposing under a negative one side of a transparent body having on its opposite sides photo-sensitive layers sensitized for hardening but for remaining transparent where light struck, producing a positive of the same image, exposing the other side of said body under said positive in register with said negative, developing both sides of said body, coloring on one side the parts not affected by the light with one color, and coloring on the other side the parts not affected by the light with a complementary color.

3. The process of manufacturing polychromatic transparent films comprising the steps of exposing under a negative one side of a transparent body having photo-sensitive layers on its opposite sides adapted to harden but remain transparent when exposed to light, producing a positive of the same image, exposing the other side of said body under said positive in register with said negative, developing both sides of said body, treating one side of said body with a colored liquid, and treating the other side of said body with a liquid of different tint, whereby said liquids are absorbed on both sides by the unhardened parts of said layers.

4. The process of manufacturing polychromatic transparent films comprising the steps of coating a suitable transparent carrier on opposite sides each with a photo-sensitive colloid layer adapted to harden but remain transparent where exposed to light, exposing under a negative one layer, exposing the other layer under a corresponding positive in register with said negative, developing both sides of said carrier, partially coloring one side by treating it with a colored liquid, and partially coloring the other side by treating it with a differently colored liquid.

5. The process of manufacturing polychromatic transparent films comprising the steps of coating a suitable transparent colored carrier on both sides each with a photo-sensitive colloid layer adapted to harden but remain transparent where exposed to light, exposing one layer under a negative, exposing the other layer under a positive of the same image in register with said negative, developing both sides of said carrier, partially coloring one side by treating it with a colored liquid, and partially coloring the other side by treating it with a differently colored liquid.

6. The process of manufacturing polychromatic transparent films comprising the steps of coating a suitable transparent carrier on both sides each with a colloid layer photosensitized by means of bichromates, exposing one layer under a negative, exposing the other layer under a positive of the same image in register with said negative, developing both sides of said carrier, partially coloring one side by treating it with a colored liquid, and partially coloring the other side by treating it with a differently colored liquid.
7. The process of manufacturing polychromatic transparent film comprising the steps of coating one side of a transparent carrier with a suitable light retarding layer, then coating each side of said carrier with a colloid layer photo-sensitized by means of bichromates, exposing one layer under a negative, exposing the other layer under a positive of the same image in register with said negative, developing both sides of said carrier, partially coloring one side by treating it with a colored liquid, and partially coloring the other side by treating it with a differently colored liquid.

8. The process of manufacturing polychromatic transparent films comprising the steps of coating both sides of a transparent carrier each with a suitable light retarding layer, then coating both sides of said carrier each with a colloid layer photo-sensitized by means of bichromates, exposing one layer under a negative, exposing the other layer under a positive of the same image in register with said negative, developing both sides of said carrier, partially coloring one side by treating it with a colored liquid, and partially coloring the other side by treating it with a differently colored liquid.

9. The process of producing polychromatic transparent films comprising the steps of taking a photograph on a silver salt sensitized film, producing a positive of said photograph, producing a second negative of said photograph, exposing under said positive one side of a photo-sensitive transparent body the opposite sides of which are provided with photo-sensitive colloid layers adapted to harden when exposed to light, exposing the other side of said body under said second negative, thereby hardening the photosensitive material of said body at those parts of both surfaces affected by the light rays, developing both sides of said body, treating one side of said body with a colored liquid, and treating the other side of said body with a liquid of different color, said liquids being absorbed on both sides by the unhardened parts of said surfaces.

10. The process of producing polychromatic transparent films comprising the steps of taking a photograph on a silver salt sensitized film, producing a positive of said photograph, producing a second negative of said photograph, exposing under said positive one side of a photo-sensitive transparent body each side of which is provided with a photosensitized layer adapted to harden when exposed to light, exposing the other side of said body under said second negative in register with said positive, treating one side of said body with a colored liquid, and treating the unhardened portions of the other side of said body with a differently colored liquid.

11. The process of producing polychromatic transparent films comprising the steps of taking a photograph on a silver salt sensitized film, producing from said photograph a silver salt positive, producing from said photograph a silverfree second negative on a body sensitized with bichromates, producing from said silver salt positive a silverfree positive on a body sensitized with bichromates, exposing under said silverfree negative one side of a transparent carrier provided on each surface with a colloid layer photosensitized with bichromates, exposing the other side of said carrier under said silverfree positive in register with said silverfree negative, developing both sides of said carrier, partially coloring one side by treating it with a colored liquid, and partially coloring the other side by treating it with a liquid of different color.

In testimony whereof I affix my signature.

CARL ROEHRICH.