April 25, 1933. J. G. CAPSTAFF 1,905,438

PHOTOGRAPHIC COLOR PROCESS

Filed Feb. 25, 1930

Fig. 1.

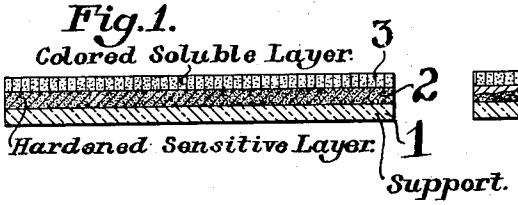


Fig. 2.



Fig. 3.



Fig. 4.



Fig. 5.

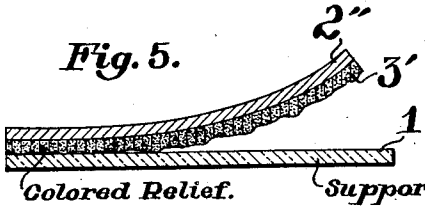


Fig. 6.

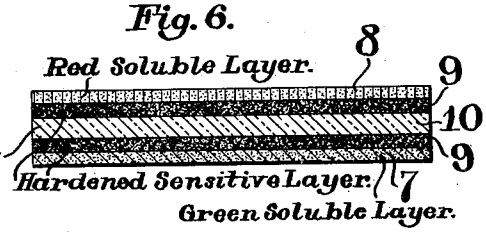


Fig. 7.



Fig. 8.

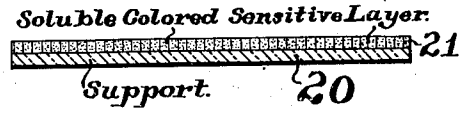
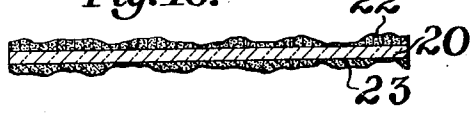


Fig. 9.



Fig. 10.



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UNITED STATES PATENT OFFICE

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PHOTOGRAPHIC COLOR PROCESS

Application filed February 25, 1930. Serial No. 431,300.

This invention relates to photographic processes and material and particularly to a product capable of use in the making of two-color motion pictures by a simple process.

The invention consists broadly in the making of two permanently adherent layers, one of which is a hardened colloid emulsion in which a silver photographic image is formed and the other of which is a soluble gelatin layer and the treatment of the silver in a bath of the type that removes the silver or renders the image transparent and at the same time hardens the soluble gelatin layer differentially in accordance with the density of the silver image adjacent thereto. This invention is of particular importance with a transparent support as a base and with a permanently colored soluble gelatin layer. For motion picture purposes the transparent support will have a pair of such adherent layers upon each surface thereof.

My invention is capable of use in a wide variety of processes, several of which will be explained hereinafter, reference being made to the accompanying drawing in which the same reference characters designate the same parts throughout and in which the several figures indicate on an enlarged scale sections of photographic elements embodying my invention.

Fig. 1 shows a section of a sensitive photographic element of the improved type;

Fig. 2 shows the same element with a silver image formed therein;

Fig. 3 shows the final form of the finished process;

Fig. 4 shows a modification of the sensitive element;

Fig. 5 shows a still further modified form in which the layers are being stripped from the support;

Fig. 6 shows the sensitive photographic film embodying the preferred form of my invention; and

Fig. 7 shows the finished product made therefrom.

Fig. 8 shows a further modified sensitive film.

Fig. 9 shows the product made therefrom.

Fig. 10 shows a double coated product of the same type.

In Fig. 1 there is indicated at 1 a support, preferably transparent and comprising a cellulosic composition such as cellulose acetate or other derivative. To this is adherent a layer 2 which is preferably a hardened sensitive gelatino-silver-halide emulsion and upon this is coated in turn a layer 3 of soluble gelatin which preferably carries a permanent dye, pigment or coloring material. This soluble layer is permanently adherent to the hardened layer in that it, as a layer, cannot be stripped or bodily removed therefrom. This material may, for instance, be of the type shown in the patent to Samuel E. Sheppard No. 1,290,794, January 7, 1919. A photographic latent image is formed in the layer 2 and is transformed by any suitable developer into a silver image. The element is now in the form shown in Fig. 2, where the silver is designated as 2′. The photographic element is now treated with a bath which may be of the type known as the Ozobrome process, a preferred bath being disclosed in the patent to Manly No. 851,296, April 23, 1907. As disclosed in that patent, this bath has the property of rendering the soluble gelatin differentially tanned or hardened in accordance with the density of the silver image. At the same time this bath attacks the silver image and transforms it into a silver salt which may be completely cleared by a bath of sodium or potassium sulphite. The unaffected silver salts are preferably fixed out with sodium thiosulfate immediately after bleaching. If desired, however, the sensitive salts may remain and be utilized for the formation of an additional image by known processes.

The photographic element either before or after clearing, or without clearing at all, is then washed in warm water which removes the unaffected soluble portions of the layer 3, leaving a relief 3′ as indicated in Fig. 3, which is colored with the original color of that layer.

If desired, the outer layer may be uncolored, as shown at 5 in Fig. 4 and capable of receiving a color by any desired process after the relief image is formed.

If desired, the soluble layer may lie between the support and the sensitive layer, in which case the process will be carried out in the same manner as above described until the element is submitted to warm water, at which time the soluble gelatin will act as a stripping layer and permit the removal of the originally hardened layer 2″ together with the relief image 3′ formed in the layer which was originally soluble. The act of stripping is indicated in Fig. 5.

This invention is particularly useful in the making of motion picture films on a double coated film, a section of the sensitive product being shown in Fig. 6 where 10 indicates the transparent support, 9 indicates hardened sensitive layers adherent thereto, 8 indicates a soluble gelatin layer permanently colored red and 7 indicates a soluble gelatin layer permanently colored green. Color component silver images are formed in the two layers 9 by printing from opposite directions through the colored layers from appropriate negatives. The sensitivity of the emulsions and the color of the printing lights must, of course, be adjusted in order that prints may be made through these colored outer layers.

The double coated element as a whole can then be successively submitted to the developing bath, bleaching bath, clearing bath and warm water without any distinction as to the treatment rendered to the two sides.

This results in the product shown in Fig. 7 consisting of a transparent support and the transparent layers 11 and, upon each side thereof, the colored relief images 12 and 14 respectively green and red or any other selected color that may be desired. These constitute registering color component images forming a natural color photograph suitable for projection by transmitted light.

It is obvious that this process is much simpler than any process requiring differential treatment of the two sides such as where they must be separately dyed, toned or the like. It is also obvious that the above described photographic elements and the processes mentioned may constitute parts of photographic processes for other than color purposes. I consider as included within my invention all such modifications and equivalents as fall within the scope of the appended claims.

One such possible modification is the inclusion in the soluble layers of transparent, colorless leuco compounds capable of being transformed into colors when submitted to an appropriate bath. This is specifically described in an application of Merrill W. Seymour and myself.

Another special example of certain aspects of my invention is indicated in Figs. 8, 9 and 10 wherein a single emulsion layer is used. This includes a support 20 and a single soluble gelatine layer 21 in which are incorporated sensitive salts and permanent dyes, pigments, or colored particles, for instance, of the type shown in the Sheppard Patent 1,290,794. When this is submitted to the described treatment, the gelatine of the single layer is differentially hardened and a relief dye image 22 is directly formed as shown in Fig. 9. Similarly a film having single, differently colored, soluble, sensitized layers on its surfaces would, when treated in the described manner, produce a film as shown in Fig. 10 comprising a support 20 with differently colored, single layer, relief images 22 and 23 on its opposite surfaces.

This process is, of course, useful for the making of anaglyphs as well as of natural color pictures.

What I claim as new and desire to be secured by Letters Patent of the United States is:

1. A photographic element comprising a support, a sensitive, hardened, gelatino-silver-halide emulsion layer thereon, and an insensitive, gelatin layer readily soluble in warm water on said first emulsion layer.

2. A photographic element comprising a support, a sensitive, hardened, gelatino-silver-halide emulsion layer thereon, and an insensitive, permanently colored gelatin layer readily soluble in warm water above said first emulsion layer.

3. A photographic element comprising a transparent support, a sensitive, hardened, gelatino-silver-halide emulsion layer on each surface thereof and an insensitive gelatin layer readily soluble in warm water on each of said first layers.

4. A photographic element comprising a transparent support, a sensitive, hardened, gelatino-silver-halide emulsion layer on each surface thereof and an insensitive, permanently colored gelatin layer readily soluble in warm water on each of said first layers, the soluble layers being differently colored.

5. In the process of making a picture, the steps that comprise forming a silver photographic image in a sensitive insoluble colloid layer having an unsensitized gelatin layer readily soluble in warm water adherent thereto, bleaching the silver image in a bath which will remove the silver and differentially harden the portions of the adherent layer that are adjacent the image, and then dissolving the soluble portions of the adherent layer, the adherence of the soluble layer to the hardened layer being sufficient to prevent its being stripped therefrom.

6. The method of making a colored picture that comprises forming a silver photographic image in a hardened colloid layer having an unsensitized, permanently colored, gelatin layer readily soluble in warm water adherent thereto, bleaching the silver image in a bath that will remove the silver and differentially harden the portions of the colored layer ad-

jacent the image and dissolving off the soluble portions of the colored layer, the adherence of the soluble layer to the hardened layer being sufficient to prevent its being stripped therefrom.

7. In a process for making a multicolor picture, steps that comprise making color-component, silver images in two distinct, insoluble, colloid layers each of which has an unsensitized gelatin layer readily soluble in warm water adherent thereto, treating the images in a bath that will remove the silver and differentially harden the soluble gelatin layers and dissolving off the unhardened gelatin, the adherence of the soluble layer to the hardened layer being sufficient to prevent its being stripped therefrom.

8. In the process of making a picture the steps that comprise forming a silver photographic image in close association with a soluble, permanently colored, gelatin layer, treating the silver image in a bath that will remove the silver and differentially harden the soluble gelatine adjacent the image, and then dissolving the unaffected, soluble portions of the gelatine.

9. In a process for making a multicolor picture, the steps that comprise making color-component, sliver images in two distinct, insoluble colloid layers on opposite sides of a common support, each of which layers has an unsensitized gelatin layer readily soluble in warm water adherent thereto, the soluble layers being differently colored, treating the images in a bath that removes the silver and differentially tans the soluble colored layers and dissolving off the untanned portions of the colored layers.

10. The method of making a two-color picture that comprises forming color-component, silver images in two insoluble colloid layers on opposite surfaces of a transparent support and having unsensitized gelatin layers readily soluble in warm water adherent thereto, the two soluble layers being differently and permanently colored, treating the images with a bath that removes the silver and differentially tans the soluble layers, and removing the unhardened gelatin.

Signed at Rochester, New York, this 19th day of February 1930.

JOHN G. CAPSTAFF.