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PREVENTING COLOR STAIN IN PHOTOGRAPHIC EMULSIONS

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FIG. 1

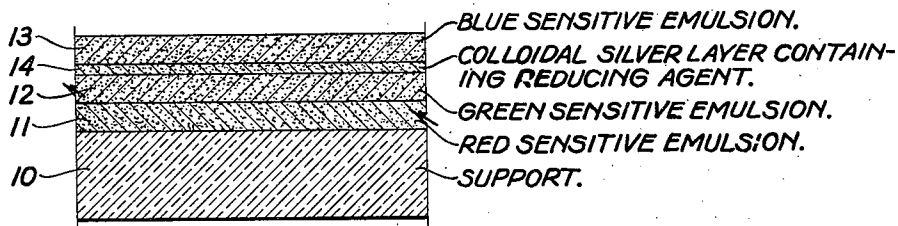
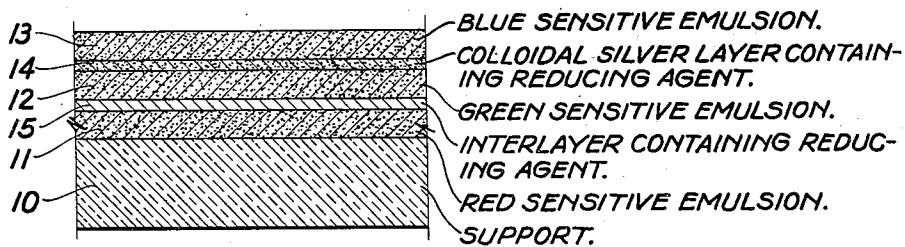


FIG. 2



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PREVENTING COLOR STAIN IN PHOTOGRAPHIC EMULSIONS

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7 Claims. (Cl. 95-2)

This invention relates to color photography and particularly to a method for preventing the formation of color fog in photographic emulsions.

One of the difficulties frequently encountered in processes of color photography in which a colored image is formed by coupling an oxidized developer with a coupler compound present either in the developer or the emulsion layer, is the formation of color fog or stain. In multi-layer photographic elements in which there is a filter layer of colloidal silver between the sensitive emulsion layers, it has been found that physical development of the colloidal silver takes place during color development. This physical development produces activated developer molecules which diffuse into the adjacent emulsion layers and produce dye images therein in areas which have not been exposed to light. Where the colloidal silver layer is between the blue-sensitive and green sensitive emulsion layers in which yellow and magenta dye images are formed, both yellow and magenta dyes may be produced in areas which have not been exposed to light. The effect of this is to produce an orange colored stain in the photographic material.

It is, therefore, an object of the present invention to provide a method for prevention of the color stain formed by coupling of the oxidized developer and a coupler compound in unexposed portions of a multi-layer material. A further object is to prevent the formation of color stain in multi-layer photographic materials caused by the physical development of colloidal silver in an intermediate filter layer. A still further object is to provide a method for overcoming the stain produced in multi-layer photographic materials containing color formers. Other objects will appear from the following description of our invention.

These objects are accomplished by incorporating in an intermediate layer, especially a colloidal silver filter layer, substances which destroy the activated developer without the production of dye. Such substances must not diffuse into the adjacent emulsion layers but must be sufficiently non-diffusing to stay in the interlayer in which they are incorporated. Compounds which we have found to be especially useful for this purpose are reducing agents such as amino phenols and dihydroxybenzenes, especially dihydroxybenzenes in which there is an alkyl substituent having a carbon chain of at least five carbon atoms.

In the accompanying drawing, Fig. 1 is a sectional view of a multi-layer photographic material containing a reducing agent in a colloidal silver interlayer according to our invention, and Fig. 2 is a sectional view of a multi-layer photographic material containing a reducing agent

in a plain interlayer according to our invention.

The incorporation of color forming components in silver halide emulsion layers was described in Fischer U. S. Patent 1,102,028, granted June 30, 1914. These components are compounds such as phenolic hydroxyl compounds or compounds with reactive methylene groups which are capable of reacting with the development product of primary aromatic amino photographic developers to produce dyes. The color formers may be added directly to the emulsion layers as described by Fischer or they may be incorporated in a separate medium which is insoluble in the carrier for the sensitive silver halide as described in Mannes & Godowsky U. S. application Serial No. 314,689, filed January 19, 1940, and in Jelley and Vittum U. S. application Serial No. 371,612, filed December 26, 1940.

In processes of this type in which color forming components are incorporated in the sensitive emulsion layers or in a process such as that described in Mannes, Godowsky & Wilder U. S. Patent 2,252,718, granted August 19, 1941, in which the couplers are contained in the developing solutions, it is frequently desirable to use a layer of colloidal silver between the blue-sensitive and green-sensitive emulsion layers in order to filter out any blue light which would expose the green-sensitive and red-sensitive emulsion layers underlying the blue-sensitive emulsion layer. The colloidal silver is readily removable from the film in the baths which remove the developed silver from the emulsion layers. During processing of the film, this colloidal silver is subject to physical development and activated developer molecules are produced. Since these developer molecules are readily diffusible through the emulsion layers, they may produce a dye image in immediately adjacent emulsion layers or in the filter layer itself where color forming compounds are used in the developing solution and also diffuse throughout the emulsion layers.

The compounds which we have found suitable for incorporation in interlayers according to our invention include aminophenols and dihydroxybenzenes such as the following:

- (1) 2,5-Dimethyl-4- γ -phenylpropylaminophenol
- (2) Amyl hydroquinone
- (3) Lauryl hydroquinone
- (4) Heptyl hydroquinone
- (5) Diamylhydroquinone
- (6) Dioctylhydroquinone
- (7) 2,5-Dihydroxydiphenyl
- (8) 2,5-Dihydroxy-4'-amylidiphenyl

The amount of these agents used in the gelatin interlayer may vary from about 0.1 gram to 5 grams per liter of gelatin solution (5 to 7%) gelatin but these values should be taken only as il-

lustrative since greater or less amounts may be used.

The agents used in interlayers according to our invention are preferably used in colloidal silver interlayers in a multilayer photographic element containing color formers in the emulsion layers. The following examples illustrate the formation of the interlayer according to our invention:

Example 1

To 50 cc. of a 5% gelatin solution containing 0.318 gram of colloidal silver there was added a solution of 0.05 gram of lauryl hydroquinone dissolved in a mixture of 6 cc. of ethyl alcohol and 0.5 cc. of 20% aqueous sodium hydroxide. The well mixed solution was then brought to the neutral point by adding aqueous citric acid in an amount equivalent to the sodium hydroxide used and the mixture was then ready for coating.

Example 2

A solution was made of 0.05 gram of diamylhydroquinone and 0.4 gram of tri-o-cresyl phosphate in 20 cc. of ethyl acetate. This solution was emulsified with 30 cc. of a 0.5% aqueous solution of triisopropylphthalenesulfonate by passing the whole mixture through a colloid mill. The emulsion was warmed with stirring to drive off the ethyl acetate leaving a dispersion in water of a solution of diamylhydroquinone in tri-o-cresylphosphate. This was added to 50 cc. of a 5% gelatin solution containing 0.318 gram of colloidal silver and was then coated.

Our invention will now be described by reference to the accompanying drawing. As shown in the Fig. 1 thereof, 10 is a support of paper, cellulose ester, synthetic resin, glass or other suitable material on which are coated emulsion layers 11, 12 and 13 sensitive, respectively, to the red, green and blue regions of the spectrum. These emulsion layers may or may not contain color-forming compounds and if color-forming compounds are incorporated in them they will ordinarily be of such composition that a cyan dye is produced in the red-sensitive emulsion layer, a magenta dye in the green-sensitive emulsion layer and a yellow dye in the blue-sensitive emulsion layer. Between layers 12 and 13 there is a layer 14 of gelatin containing colloidal silver and one of the reducing agents according to our invention.

Fig. 2 illustrates a similar material in which the support 10 is coated with emulsion layers 11, 12, and 13, and has a colloidal silver filter layer 14 containing a reducing agent. Between emulsion layers 11 and 12 there is an interlayer 15 of plain gelatin containing one of the reducing agents used according to our invention.

Our process is particularly useful with paper or other opaque supports where it is important to reduce the minimum fog density as far as possible. This applies both to negative developed material and to reversal material. Our method

may, of course, be used with multi-layer material coated on transparent supports as well as that on opaque supports.

It will be understood that the examples and modifications are by way of example only and that our invention is to be taken as limited only by the scope of the appended claims.

We claim:

1. A multi-layer photographic element having a plurality of emulsion layers sensitive to different spectral regions, and at least one insensitive gelatin interlayer containing a reducing agent selected from the class consisting of aminophenols and dihydroxy benzenes incapable of diffusing in gelatin.

2. A multi-layer photographic element having a plurality of emulsion layers sensitive to different spectral regions and containing non-diffusing color-forming compounds, and between two of said emulsion layers a gelatin layer containing colloidal silver and a dihydroxybenzene incapable of diffusing in gelatin.

3. A multi-layer photographic element having a plurality of emulsion layers sensitive to different spectral regions and containing non-diffusing color-forming compounds, and between two of said emulsion layers a gelatin layer containing colloidal silver and a dihydroxybenzene having attached thereto an alkyl radical of at least 5 carbon atoms.

4. A multi-layer photographic element comprising a support having thereon gelatino-silver halide emulsion layers sensitive respectively, to the red, green and blue regions of the spectrum, and between the green sensitive and blue sensitive layers, a gelatin filter layer containing colloidal silver and a dihydroxy benzene incapable of diffusing in gelatin.

5. A multi-layer photographic element comprising a support having thereon gelatino-silver halide emulsion layers sensitive respectively, to the red, green and blue regions of the spectrum, and between the green sensitive and blue sensitive layers, a gelatin filter layer containing colloidal silver and a dihydroxybenzene having attached thereto an alkyl radical of at least 5 carbon atoms.

6. A multi-layer photographic element comprising a support having thereon gelatino-silver halide emulsion layers sensitive, respectively, to the red, green and blue regions of the spectrum, and between the green sensitive and blue sensitive layers, a gelatin filter layer containing colloidal silver and lauryl hydroquinone.

7. A multi-layer photographic element comprising a support having thereon gelatino-silver halide emulsion layers sensitive, respectively, to the red, green and blue regions of the spectrum, and between the green-sensitive and blue-sensitive layers a gelatin filter layer containing colloidal silver and diamyl hydroquinone.

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