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COLORING PHOTOGRAPHIC IMAGES

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This invention (subject of the present application, a continuation in part of my copending application Serial No. 143,298, filed October 21, 1926, renewed July 30, 1932) relates to color cinematography, more particularly to changing or transforming a silver image into one composed, at least in part, of dye, and the chief object of the invention, stated generally, is the conversion of the silver image into a silver iodid or like dye-adsorptive compound of adequate dye-mordanting power, and composed of clearly defined grains or deposits which occupy substantially the same positions as the corresponding silver grains or deposits of the original image. The term "adsorption" as here used refers chiefly to the property of taking up and holding the dye-stuff, and does not necessarily imply a chemical reaction.

Among processes heretofore known for converting or changing a silver image into one containing more or less dye, the most promising are that described in Traube United States Patent No. 1,093,503, issued April 14, 1914, hereinafter referred to as the Traube process, and that described in Miller United States Patent No. 1,214,940, issued February 6, 1917, hereinafter referred to as the Miller process. In the former, the silver image is treated with a solution of iodine and an iodid, forming a silver iodid image which, after clearing in a bisulfite solution, is yellowish-white in color and substantially opaque. After dyeing, the image is sharply defined, following well the general contour of the original silver grains, but the dye-adsorption is so poor and the opacity of the image so great that for purposes of color photography, and particularly for projection upon a screen as in cinematography, it is necessary to remove all or a large portion of the silver iodid, as by treatment in a hypo (sodium thiosulfate) bath. This removal of the silver iodid is not satisfactory, as it requires a long time and causes or results in severe "bleeding" of the dye image into the undyed gelatin, which can not be stopped by any known means. In other words, the clearing operation destroys what was the best feature of the Traube patent, namely the sharpness of the image. For such reasons this method has never proved usable in practical work, although much time and labor have been expended upon it.

The Miller process gives an image of high trans-

parency and brilliancy of coloring, but lacking in sharpness, and from long experience with the process I have come to the conclusion that the lack of sharpness is due to the solubility of the mordanting compound in the bleaching solution, which causes or permits migration of the molecules or clumps of the compound from their original positions into other parts of the gelatin, especially into the highlights, where such migration is most objectionable as causing a lack of definition and a clouding of the whites when the image is projected. The effect is as if there were an almost total destruction of the grain contour in the highlights, and a substantial bleed from the heavy grains of the shadows.

It is my belief, based on extended study and a large number of experiments, that the silver of the image, when treated with iodine in the presence of gelatin and potassium iodid, is converted into a colloid or gel complex consisting of silver iodid and potassium iodid in the proportion of one mol of the former to one or more mols of the latter. These colloids or gels vary widely in ability to adsorb dye and retain definition, and I believe that the greater the number of potassium iodid mols in the complex in proportion to the number of silver iodid mols, the greater the tendency, in general, to form a mordant of brilliant color when dyed but of poor image definition, as is characteristic of the Miller process; and conversely, the smaller the number of silver iodid mols in proportion to those of potassium iodid the greater the tendency to form a mordant of the Traube type, of good image definition but opaque and dull in color. Except for a narrow range of concentration of the iodine and iodid (in the bleaching solution) to form the Miller mordant, all higher concentrations of iodine in the iodid solution form the opaque white or yellowish-white mordant of Traube.

In order to obtain a mordant having the brilliancy of coloring and sharpness of image desirable in cinematography, I have found certain special conditions to be necessary, which will be explained hereinafter. By observing these conditions I am able to produce a mordant which is, I believe, a silver iodid gel or colloid, containing more mols of potassium iodid to silver iodid than does the Traube but less than the Miller mordant. This new mordant combines the desirable

qualities of both, being sufficiently transparent and dye-adsorptive to give the necessary brilliance of color and sufficiently stable to give the necessary sharpness when projected on the screen.

In addition to the effect of the ratio of potassium iodid mols to silver iodid mo's upon the characteristics of the mordant complex it appears that the physical-chemical conditions under which the complex is formed have an important bearing, especially on the definition of the image and on the ability of the whites to be washed clear. In the Miller process the film is subjected for nearly two minutes to the action of a 5 per cent iodid solution very weak in iodine. The latter has to be carried by its solvent into the gelatin, where it is consumed to form a gel of silver iodid. The bleaching (conversion) of the silver in the high lights of the image is completed quickly, and then the fine details are subjected to what may be termed a mechanical scouring action by the liquid as it continually forces its way through the membranes of the gelatin to establish a salt pressure balance to replace the iodine as it is consumed. This scouring increases the solvent action of the solution upon the newly formed gel, with the result of actually dissolving it, or of forming a different gel complex by further increasing the number of potassium iodid mols to the silver iodid mols in the complex. At any rate, the effect is to allow a certain amount of migration of the gel complexes of the image, especially in the highlights, thereby impairing definition and causing poor washing of the whites or clear portions of the image. It seems likely that silver molecules on the surface of the heavy or shadow portions of the image are first converted and then, while the underlying silver grains are being converted, are more or less dissolved, causing the bleed from heavy image densities characteristic of the Miller process.

In accordance with one form of the present invention the film is first treated with a preliminary or preparing solution and then with an acid reagent or reagents in solution, which causes iodine to be liberated within the gelatin (impregnated with the preliminary solution) merely by the penetration of acid ions. This greatly decreases what I have called the scouring action, cuts down the reaction time, thereby decreasing the dissolving effect upon the gel complexes formed, and forms an excess of iodine over the highlights after they are bleached (that is, after the silver therein is converted into the mordant complex) and while the shadows are being bleached. The mordant so produced is highly adsorbent of dye and produces brilliant images with the sharpness of definition necessary for color-cinematography. The best quantitative analysis, at present available to me, of mordants having these desirable characteristics indicates, and it is my present belief, that the ratio of silver iodid to potassium iodid therein ranges from about 1/20 to about 1/40, but I do not desire to be bound by these limits, which on the basis of the analysis represent the optimum for the mordant.

In general I prefer to impregnate the gelatin with an iodid, for example potassium iodid or the like, with or without other salts, and then bleach the image by treating the impregnated gelatin with a reagent which will liberate iodine from the iodid salt already in the gelatin to react with the silver image in the presence of an iodid. An excellent general method of re-

leasing this iodine is to impregnate the gelatin with an iodid and a suitable oxidizing agent in neutral or alkaline solution (sometimes referred to hereinafter as the "presoak"), and then treat the film with acid ions in liquid or gaseous form. A considerable number of oxidizing agents produce this reaction and are useful to varying degrees for the production of dye mordants. Among the inorganic oxidizing agents are the iodates, periodates, bromates, perbromates, chlorates, perchlorates, chromates, dichromates, ferri-cyanides, permanganates, nitrites, peroxides, and certain metallic salts having double valence such as the stannates, stannic salts, manganic salts, ferric salts, cupric salts, plumbic salts and so forth. Among these compounds I have found sodium nitrite very effective, using it preferably in amount to provide nitrite ions chemically equivalent to the iodate ions in a presoak such as solution A, below. In most cases I prefer to avoid the use of the heavy metal salts owing to the tendency to form double iodids or to produce a more opaque mordant that usually does not adsorb as much dye, but if a dull monochrome image is desired, oxidizing agents that form a more opaque mordant are desirable. Other oxidizing agents produce mordants of varying value, some have a tendency to release gas bells within the emulsion, others affect the translucency and mordant power of the silver iodid formed.

Broadly considered, the reaction of oxidizing agents with an iodid in the presence of acid ions is well understood, and a suitable formula for the presoak which would liberate all the iodine can be readily determined by the molecular balance between these substances. I prefer a formula which has an excess of iodid over the molecular requirements in an alkaline solution or in one which does not liberate an appreciable amount of iodine.

In the practice of the invention when using liquid acids it is possible to use the iodid only in the presoak and then release the iodine within the gelatin by treatment with an acidified oxidizing agent. Other modifications are, a presoak containing an iodid and an acid, and a "bleach" containing an oxidizing agent; an oxidizing agent in the presoak, and a bleach containing an acidified iodid; and an acidified oxidizing agent in the presoak, and a bleach containing an iodid. The second and third modifications produce iodine within the gelatin as the bleach comes into contact with the oxidizing agent and acid. In general these methods are usually improved by the addition of certain hardening salts and in some cases by free iodine in the bleach (dissolved in compatible solvent), as described later in this specification. It is also possible to substitute hydriodic acid for the iodine salt in the presoak or in the bleach, as the case may be.

Iodine can be liberated in the gelatin by treating the same (impregnated or "presoaked" with an iodine compound) with an oxidizing gas, for example chlorine, bromine, ozonized air, or nitrogen mon-, di-, tri-, tetra-, or pent-oxide. The addition of acid ions to the presoaked film or the addition of gaseous acid ions to the oxidizing gases usually helps the reaction. A suitable concentration of the gas (diluted with air or other inert gas) can be readily ascertained by trial, but in general the concentration should be such as will effect the desired bleaching in approximately one minute. If the gas is too strong and

the bleaching too rapid the bleached image tends to be opaque.

As I now understand it, the mechanism of my improved process (in which the image is "bleached" by a reaction which liberates iodine within or largely within the emulsion) is that when or as the highlights and thin parts of the image are bleached the grains or grain clumps of the conversion-product are protected from being dissolved in the iodine or other iodine salt solution by an increasing iodine content in the immediate vicinity of the grains. Meanwhile, the conversion of silver in the shadows to silver iodide consumes the iodine almost if not quite as fast as the iodine is provided, so that the grains in the shadows are not acted upon by a high iodine content such as is protecting the highlights. Consequently the shadows bleach properly to the gel condition, and as soon as they are completely bleached they also are protected by the increase of iodine content.

In carrying out my invention in one way the novel action described above is obtained by impregnating the emulsion, before bleaching with a solution containing iodine salts, preferably including an iodate, from which iodine can be liberated at relatively slow reaction velocity while the image is being bleached by treatment with an acid reagent, so that the amount of iodine in the emulsion around or in the immediate vicinity of the grains which are bleached or which are undergoing bleaching, will progressively increase.

In a practice which I have found gives satisfactory results the image, for example on a cinematographic positive film, is developed, fixed in a plain fixing bath, washed, hardened in a weak solution of formaldehyde, and dried without washing. After drying the film is treated with a strong solution of potassium chlorate or other non-staining oxidizing agent. After thorough washing it is treated, preferably without drying, in a solution containing an iodide and an iodate, say of the following composition:

Solution A

Potassium iodide	63.6 grams
Potassium iodate	14.4 grams
Ammonium hydroxide 28%	0.1 cc.
Water to make	1000 cc.

The ammonia or other suitable alkali serves to prevent premature liberation of iodine, as I prefer to have the solution quite clear and free from iodine, though it may contain enough free iodine to give a straw color without apparent harm.

The film is well soaked in the above presoak solution, for a time which may vary from a few seconds to 2 or 3 minutes, depending upon circumstances, such as the thickness of the emulsion, the degree of pre-hardening to which it had been subjected, the amount of water already contained in it, etc.

After the emulsion of the film is well charged with the presoak, it is bleached by treatment with an acid solution, or with an acid gas. The solution may be, for example, either of the following:

Solution B₁

Potassium iodide	60 grams
Iodine	2 grams
Aluminum acetate	10 grams
Sulphuric acid	0.5 cc
Water to make	1000 cc

Solution B₂

Potassium iodide	60 grams
Iodine	2 grams
Ammonium chrome alum	5 grams
Acetic acid 98%	5 cc
Water to make	1000 cc

After the image has been bleached to the desired extent, usually until the black image entirely disappears, the film is removed and cleared of iodine in a reducing solution, say in a weak solution of sodium bisulfite, which may be of about 1 per cent strength. The film is then washed briefly, after which it can be died in a solution of basic dye of the desired color. The excess dye is then washed out and the film dried in any well known and convenient manner.

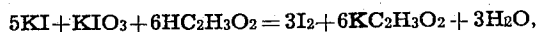
As explained hereinafter, the purpose of the aluminum acetate or ammonium chrome alum or like metallic salt in the bleach is to aid in coagulating the silver iodide. Such salt may be included in the presoak instead of in the bleaching solution, in which case I prefer the presoak to be as follows:

Solution A₁

Potassium iodide	80 grams
Potassium iodate	14 grams
Aluminum acetate	10 grams
Ammonium hydrate 28%, to make solution colorless . . . q. s.	
Water to make	1000 cc

Ammonium chrome alum or other hardening salt may be substituted for the aluminum acetate in the above.

The iodide-iodate preparing solution or "presoak" is inherently stable but should be either neutral or slightly alkaline, and I accordingly include the alkali, preferably ammonium hydroxide, as in Solution A, in order to insure that the solution will not be in any degree acid. On the other hand, while the composition of the bleach may otherwise be varied, it should be sufficiently acid to cause or permit liberation of iodine from the iodate or iodide, or both, with which the emulsion was charged by its immersion in the presoak solution. It is my present belief that the reaction between the iodide and iodate of Solution A, and the acid ingredient of bleaching Solution B₂, follows the equation



an analogous reaction taking place when an acid other than acetic is used.

The proportion of potassium iodate in the presoak or preparing solution depends, in general, upon the amount of iodine which is to be liberated within the gelatin when the latter, soaked with the preparing solution, comes in contact with the free acid of the bleach. The amount of potassium iodide in the gelatin should be sufficient to so condition the latter that it will not produce a mordant of the opaque Traube form and yet will, with the iodate, produce an iodine content sufficiently high to avoid or substantially prevent the formation of a gel which is transparent in all densities. An increase of iodine in an iodide-iodine bleaching bath or solution tends to produce more of the visible yellowish-white silver iodide, while increase of the iodide component to sufficient concentration produces the invisible type of gel; but in my process the iodine appears to have an effect analogous to a toughening, as it were, of the gel structure.

Acidulating an iodid-iodate mixture in which the proportion of these salts is five mols of iodid and one mol of iodate, releases all the combined iodine, but I do not limit myself to these proportions. An excess of iodid may sometimes be employed, as with hard gelatin, or an excess of iodate may be incorporated. The amount of iodid-plus-iodate may vary widely but is preferably between 50 and 100 grams per liter, the higher concentration tending to a more colloidal condition of the mordant, but I prefer a concentration which will, with a given bleaching reagent, produce a clear faintly whitish mordant, characterized by substantial transparency in the highlights and translucency elsewhere. The presoak, that is, the iodid-iodate solution, may also be prepared by treating iodine with a solution of an alkali, as for example sodium or potassium hydroxid.

While I prefer to employ potassium salts in the presoak, because they are effective and commercially available at low cost, I may use iodids or iodates of any other base (for example sodium iodid and ammonium iodate) which are sufficiently soluble and are otherwise not incompatible with the reactions. It is possible to produce an adequate mordant in the emulsion by merely immersing the presoaked film in an acid solution, an alum solution, or a solution of any other easily dissociated acid salt, but I prefer, when the bleaching is to be effected by a solution, to compound the same along the following lines:

(a) Any acid or acid salt (compatible with a soluble iodid) but preferably a weak acid, as for example acetic or citric, in order to obtain a low reaction velocity without the necessity of using an amount of acid so minute as to be not easily controllable, as would be the case with a strong acid or an acid salt, such as acid sodium sulfate.

(b) A soluble iodid, preferably an alkali iodid, as for example sodium, potassium or ammonium iodid, but soluble iodids of the base metals may be used, say stannic iodid. Base metal iodids, however, are prone to interfere with the smooth action of the bleach.

(c) A metallic salt to aid in coagulating the colloidal silver iodid to a gel, as for example aluminum acetate or ammonium chrome alum. The acid employed in (a) will alone cause conversion of the silver image to a colloidal iodid containing silver, but conditioning of the gel is aided by the metallic salt. The bleach solution will produce an excellent mordant in the total absence of a metallic coagulant, but greater sharpness is obtained if the gel is first formed and the excess iodine is allowed to toughen or harden it, as described above. The free acid would ordinarily retard or impede the effect of the alum, but the conditions are such that the acid is consumed approximately as fast as it penetrates the gelatin.

(d) Iodine to retard the diffusion, into the bleaching solution, of iodine produced within the gelatin from the presoak solution. Although iodine in the bleaching solution has but little effect on the silver image, it is important to prevent, as far as possible, the iodine which the gelatin has brought with it, from the presoak or preparing solution, from going into the bleaching solution. After the film, presoaked with the iodid-iodate solution, is immersed in the weakly acid bleaching solution, the iodine salts carried by the gelatin supply sufficient iodine for the conversion of the silver image, but if there is any difference in the salt pressure in the bleaching solution and in the emulsion, there is a tendency to diffusion

of the iodine and iodate from the emulsion into the solution, which would weaken the action of the iodine and by the circulation in the emulsion tend to dissolve the gel of silver iodid and cause it to permeate the emulsion, this permeation being apparent as bleeding and lack of sharpness when the image is dyed.

From the foregoing it will be seen that at the instant of immersion of the presoaked gelatin in the bleaching solution the iodine in the gelatin and the iodine in the solution are in approximate equilibrium, and that conditions are favorable for colloid formation. As the acid and alum (of the bleaching solution) diffuse into the gelatin, iodine is liberated, staining the gelatin but being locally consumed in converting silver grains to iodid, thus producing a deficiency of iodine with the formation of a gel. Before the gel can diffuse further, the continued iodine liberation toughens, hardens, "condenses", or in some other way decreases the solubility of the mordant in the potassium iodid or other bleaching solution. I do not mean to say that the mordant is totally insoluble in the bleach or in the iodate-iodid solution carried over from the presoak, but it does not appear to be sensibly affected in the ordinary period of treatment when protected by excess iodine, and the grain complexes are not noticeably blurred after considerably longer immersion. In the bleaching there is not only a local excess of protective iodine but the iodid component of the presoak mixture largely disappears. Thus small grains are bleached, toughened, or "condensed", and protected automatically, before larger grains are fully bleached.

Instead of treating the presoaked emulsion with an acid solution to accomplish the bleaching and simultaneous liberation of iodine, these results can be produced with even better effect in many cases by treatment with any acid gas or gas charged with or containing any acid ions, or any acid-producing substance, in proper concentration as explained below, as for example acetic, hydrochloric, nitric, chloroacetic, dichloroacetic, sulfurous, sulfuric, formic, propionic, hydriodic, etc., the oxides of nitrogen or phosphorus, acetic anhydrid, acetyl chlorid, carbon dioxid, antimony trichlorid or bromid, bismuth trichlorid or bromid, phosphorus trichlorid or bromid, etc. In this form of my invention as I prefer to carry it out, the excess liquid of the presoak or preparing solution is removed from the surface of the film, as by an air-blast or other means which will not harm the image, after which the treatment with a gas or the like may be conveniently effected by passing the film into or through an atmosphere carrying the acid gas or acid ions. Such an atmosphere may consist, in the case of a weak acid, of the acid vapor or gas itself, as for example the vapor of acetic acid at ordinary temperatures, this being the preferred reagent; but with stronger acids, as for instance sulfuric, nitric or hydrochloric, it is desirable to dilute the vapor with air or other inert gas to prevent too rapid a reaction in the emulsion. Preferably the acid atmosphere, whether consisting of pure acid vapor or of acid vapor diluted as indicated, should have about the same acidity as the vapor of glacial acetic acid at a temperature of approximately 20° C. With such acidity the film is usually bleached in about one minute. With greater concentration of the acid vapor or acid ions the action is faster, but if too fast the image may lack the desired translucency. In any case a concen-

tration suitable for good results may readily be found by trial.

The presoak or preparing solution employed when the acid gas method is to be used to bleach the image may be the same as when a solution is used for the latter purpose but I prefer the following composition:

Solution A₂

10	Potassium iodid	80 grams
	Potassium iodate	14 grams
	Ammonium hydrate 28%, to form colorless solution . . . q. s.	
15	Water to make	1000 cc.

The bleached image may be colored by means of any dye suitable for use in the Traube or Miller process, for example malachite green or rhodamine 6G.

It is to be understood that the invention is not confined to the specific details herein described but can be carried out in other ways without departing from its spirit as defined by the following claims.

I claim:

1. Process for converting into a dye mordant a photographic image carried by a gelatin coating, comprising treating the gelatin coating successively with reagents, one of which is an iodine salt, to liberate iodine within the gelatin.

2. In a process for converting into a dye mordant a photographic silver image carried by a gelatin coating, impregnating the gelatin coating with an iodine salt and a reagent adapted to cause liberation of iodine when acidified, and treating the impregnated gelatin with acid ions.

3. In a process of coloring a photographic silver image carried by gelatin, bleaching the image by treatment which includes conversion of the silver into a gel mordant and continued liberation of iodine within the gelatin to impede solution of the silver conversion product.

4. In a process of coloring a photographic silver image, converting the silver of the image into silver iodide gel by treatment separately with reagents including an iodine compound, adapted to react with liberation of iodine within the gelatin.

5. In a process of coloring a photographic silver image carried by gelatin, bleaching the image by separate treatments with reagents adapted to react with liberation of iodine within the gelatin, and subsequently dyeing the bleached image.

6. In a process for converting into a dye mordant a photographic image carried by gelatin, impregnating the gelatin with a salt solution containing an iodide, and treating the impregnated gelatin with a reagent adapted to react with at least one salt of the said solution to liberate iodine within the gelatin.

7. In a process of treating photographic silver images carried by gelatin to convert the silver thereof into a dye-mordanting compound, impregnating the gelatin with an iodine salt and an oxidizing agent, and supplying acid ions to the impregnated gelatin to liberate iodine within the gelatin.

8. In a process of coloring a photographic silver image carried by gelatin, acting upon the silver of the image with a solution relatively high in iodide and low in iodine and as the silver bleaches increasing the iodine content within the gelatin to impede solution of the silver conversion product.

9. In a process of coloring photographic silver

images carried by gelatin, acting upon the silver of the image with a solution relatively high in iodide and low in iodine and as the silver bleaches increasing the iodine content within the gelatin to impede solution of the silver conversion product, and thereafter dyeing the image.

10. In a process of coloring a photographic silver image carried by gelatin, treating the silver of the image with separate solutions one of which contains an iodine compound and the other a reagent adapted to react with the iodine compound to liberate iodine within the emulsion.

11. In a process of treating a photographic silver image carried by gelatin to convert the silver thereof into a dye-mordanting compound, impregnating the gelatin with an iodide-iodate mixture and causing liberation of iodine therefrom to convert the silver of the image into an iodine compound.

12. In a process of treating a photographic silver image carried by gelatin to convert the silver thereof into a dye-mordanting compound, impregnating the gelatin with an iodide-nitrate mixture and causing liberation of iodine therefrom to convert the silver of the image into an iodine compound.

13. In a process of coloring a photographic silver image carried by gelatin, impregnating the gelatin with a solution of an iodide and an iodate containing an alkali to prevent premature liberation of iodine, and treating the impregnated emulsion with a reagent adapted to cause liberation of iodine.

14. Process of converting into a dye mordant a developed and fixed photographic silver image carried by a gelatin coating and subsequently coloring the image, comprising washing the gelatin coating and treating the same with formaldehyde, drying the coating, impregnating the coating with an iodide-iodate mixture, causing liberation of iodine therefrom to convert the silver of the image into an iodine compound, and subsequently dyeing the image.

15. In a process of coloring a photographic silver image carried by gelatin, treating a developed, fixed, formaldehyde-treated and dried image with an iodine compound and an oxidizing agent, and with a gaseous acid reagent adapted to react therewith to liberate iodine within the gelatin.

16. In a process of coloring a photographic silver image carried by gelatin, impregnating the gelatin with potassium iodide and potassium iodate in solution and subjecting the impregnated gelatin to an acid gas to liberate iodine within the gelatin with conversion of the silver of the image into an iodine compound thereof.

17. In a process of treating a photographic silver image carried by gelatin to convert the silver thereof into a dye-mordanting compound, impregnating the gelatin with iodine compound, and treating the impregnated gelatin with a gas adapted to react with said compound to liberate iodine within the gelatin.

18. In a process of treating a photographic silver image carried by gelatin to convert the silver thereof into a dye-mordanting compound, impregnating the gelatin with an iodine compound, and treating the impregnated gelatin with gaseous chlorine to liberate iodine from the said compound within the gelatin.

19. In a process of coloring a photographic silver image carried by gelatin, impregnating the gelatin with potassium iodide and potassium iodate

and treating the impregnated gelatin with acetic acid.

20. In a process of coloring a photographic silver image carried by gelatin, treating the developed, fixed, formaldehyde-treated and dried image with a non-staining oxidizing agent, impregnating the gelatin with potassium iodid and potassium iodate in solution, and bleaching the image by contact of the gelatin with gaseous acetic acid.

21. A photographic image composed of a mordant consisting of sharply defined complexes of silver iodid gel substantially transparent in high lights and translucent in shadows, said mordant

being substantially insoluble in potassium iodid solution.

22. A photographic image composed of a dyed mordant embedded in gelatin and consisting of silver iodid gel substantially insoluble in potassium iodid solution.

23. A cinematographic positive film having a photographic image composed of a dyed mordant embedded in the gelatin coating of the film, said mordant consisting essentially of silver iodid gel which is substantially insoluble in potassium iodid solution.

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