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COLORED GELATINE RELIEF IMAGE

Filed April 14, 1932

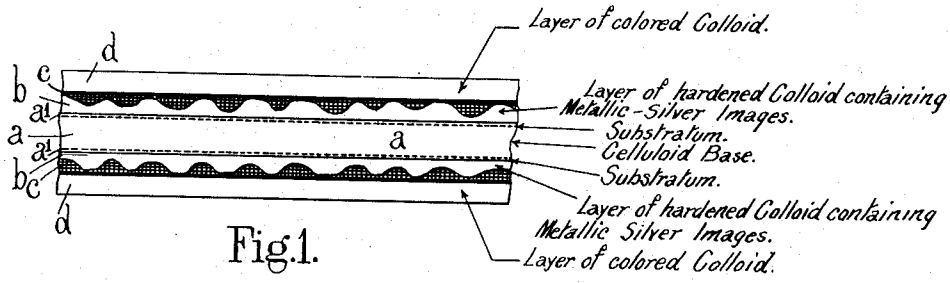


Fig.1.

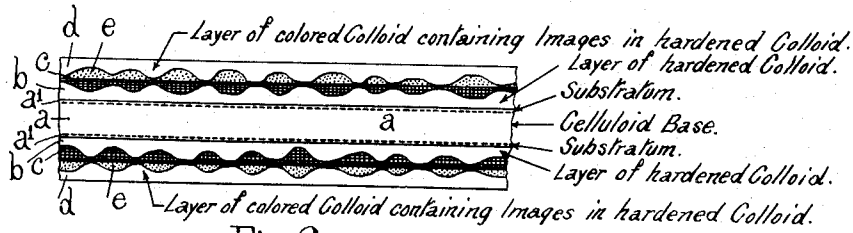


Fig.2.

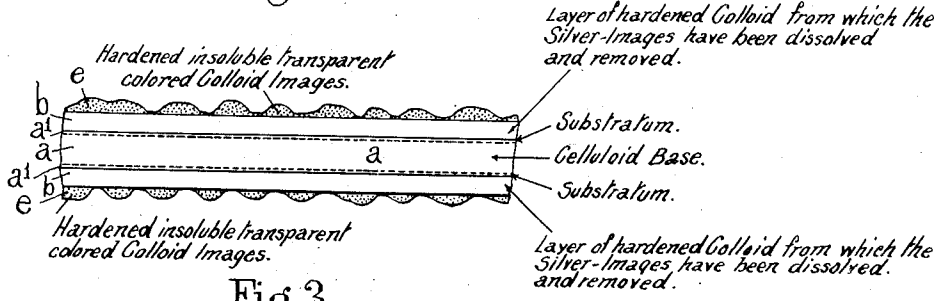


Fig.3.

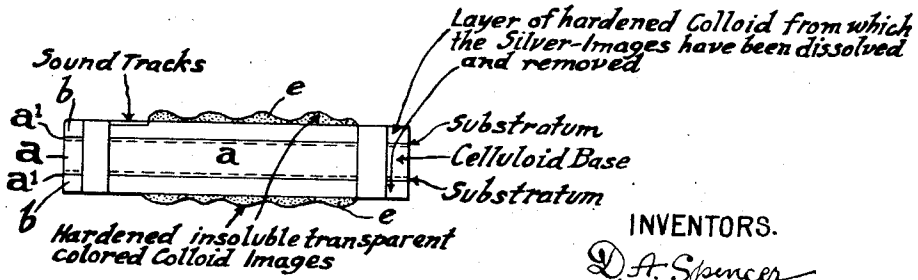


Fig4.

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COLORED GELATINE RELIEF IMAGE

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8 Claims. (Cl. 95—2)

This invention relates to improvements in kinematograph positive films, either with multicolor images or with monochrome colored images and to improvements in the process for the production thereof.

The invention is based on the well known principle that photographically produced silver can be bleached on chemical treatment with the liberation of substances which harden, or by reaction with other substances as produce compounds which harden the surrounding gelatine.

The most usual application of this principle is carried out in the following manner:— A layer of gelatine, colored by the incorporation therewith of a pigment insoluble in water, and coated on a paper or other base, (which is usually termed a "carbon tissue") is first soaked in a bleaching bath. The "carbon tissue" is then superimposed upon a positive photographic image in metallic silver, the image being carried upon an appropriate support. The action of the bleaching solution soaked into the gelatine layer, now in superimposition upon the silver image, is to produce a bleaching of the image and simultaneously, a hardening of the colored gelatine wherever the latter is in the neighbourhood of metallic silver and to a degree proportional to the amount of the silver present at any given point. After the colored gelatine layer has been in contact with the print for the necessary length of time, the silver image is stripped away from the now-hardened gelatine film, and the latter is superimposed with intimate contact upon a suitable support. The gelatine-coated support is then dried and finally immersed in hot water, the action of which is to dissolve off the surplus uninsolublized gelatine of the hardened film, and at the same time to detach the first backing paper from the film, leaving, as the result, a relief image in colored gelatine adhering to the second support.

Another manner of carrying out the same principle has also been suggested in which the colored colloid is applied to the metallic silver print in liquid form by hand by means such as a brush, the bleaching and hardening agents being either incorporated with the colored colloid solutions or the silver print treated therewith after the application of the colored colloid.

None of the methods hitherto employed for carrying out the hereinbefore described principle could conveniently be employed for the production of kinematograph positive films. In the method where a "carbon tissue" is employed the surface thereof cannot be brought into optical contact with the surface of the silver print, as firstly an isolating layer of liquid, formed by a mixture of water from the wet silver print and of bleaching solution from the wet carbon tissue, separates the colored colloid from the silver image and secondly any slight unevenness in the coating of either the film or the carbon tissue result in local bad contact between the surfaces. Consequently, the hardening agents, liberated by the action of the silver image on the bleaching solution, have to pass through a thin layer of liquid before entering the coloured gelatine which they are to harden. This results in a certain amount of lateral diffusion of the hardening agent, which, although it may be negligible in the case of prints on paper which are to be viewed without magnification, is a material disadvantage in the case of kinematograph films, where the colored image is greatly enlarged on projection since the diffusion referred to results in considerable loss of definition. This loss of definition is accentuated, when, in addition, there is any unevenness in the surface of the gelatine coating or the film support, or when solid particles of foreign matter are accidentally introduced between the surfaces of these parts.

Further the methods where a solution of colored colloid is applied by hand could not be applied on a commercial scale for the manufacture of colored kinematograph positive films and it has never been suggested that kinematograph films could be produced by such methods.

That there have been difficulties in the way of applying such processes to the production of kinematograph films is shown by the fact, that to best of our knowledge, no such films have been produced thereby on a commercial scale. The usual processes employed for the production of colored kinematograph films are dye-mordant, dye-imbibition and chemical toning methods, each of which has one or more of the following disadvantages:—

(a) The amount of dye mordanting does not bear a constant relation to the amount of silver originally present and, consequently there is a great difficulty in maintaining colour balance.

(b) The erratic nature of dye-toning which is emphasized by the present necessity for using dilute dye solutions over comparatively long periods.

(c) The general all-over tinting by the dye, which results if strong solutions are used for shorter times. Attempts to remove this tinting by washing in water usually result in bleeding of the mordanted image and loss of depth.

(*d*) The necessity for using distilled water at every stage of the process after the bleaching of the silver image adding greatly to the cost of the process.

(*e*) Owing to the water soluble nature of the dyes used, the difficulty of re-coating the dyed film with emulsion and hence production of a third dye-colour upon the one already present. This difficulty limits dye-toning processes to two colours on either side of double coated films since the alternative of varnishing and re-coating is expensive and impractical. Moreover, treatments which involve, drying up and re-wetting film lead to register troubles.

(*f*) If the silver image on which the dye is mordanted is left in the film there is a loss of transparency of the image. As the dyestuffs used are water soluble it is a matter of considerable difficulty to fix out the silver image without causing a slight loss of sharpness of the dye image which is easily noticeable on screen projection.

(*g*) The difficulty of preserving a monochromatic sound record on the film edge.

Another type of 2-color process sometimes employed depends upon the chemical toning of the silver images themselves. In known processes the blue green image is a Prussian blue toned image and the orange is uranium toned combined with dye-toning with a pink dye.

The range of colours obtainable by chemical toning is very limited and in the case quoted only an approximation to the correct colours is obtained. Moreover the chemically toned images are not completely transparent—the brown red uranium image being indeed very opaque. These chemical toning processes are erratic and need the same accurate control at every stage described for dye toning.

The process according to the present invention consists in producing in known way a kinematograph film having a series of metallic silver images on one or both sides embedded in a layer of colloid, coating the surface of such film by mechanical means with a thin layer of a hot liquid solution of a transparent emulsoid, and a transparent pigment or dye lake, cooling and setting the thin layer of colored colloid so that the surfaces of the two colloid layers become intimately interlocked and incorporated together, treating the coated films with a solution containing a bleaching agent to reduce the metallic silver of the photographic image to a salt and a hardening agent to harden the colored colloid layer on the bleached silver image, treating the bleached-hardened film with hot water until all surplus non-hardened gelatine not required in the bleached image has been dissolved and washed away, leaving colored images in relief, treating the film in a fixing bath to dissolve and remove all the metallic silver and finally washing and drying the film.

An important detail of the invention is that the colloid layer containing the silver images must be hardened relatively to the layer of colored colloid so that when the hot water is subsequently applied to dissolve and remove the unhardened portion of the colored colloid layer it will not also dissolve the colloid of the layer containing the silver images.

If the colloid layer is not hardened it is liable to be affected by the hot water and will not remain firmly adhering to the transparent film base or interlocked with the colored colloid images.

Such hardening of the colloid layer may be brought about at any stage of the process prior to the treatment with hot water but it is preferably carried out before the application of the colored colloid layer or even before the formation of the silver images.

This process for the production of colored cinematograph films presents the following advantages over the dye toned or imbibition processes hereinbefore described for the production of colored kinematograph films.

1. The amount of colloid hardened can be made strictly proportionate to the amount of silver present in the positive image. Accordingly the maintenance of color balance is determined only by ensuring that the two pigments are present in the colloid coating solution in complementary amounts. This control is a mass operation and is therefore capable of adjustments to exceedingly fine limits as we have proved.

2. There is no risk of bleeding of the images during any stage. This is particularly noteworthy in that the silver image is finally removed in a fixing bath, a stage at which dye toned images usually commence to bleed.

3. At no stage is distilled water required. The necessity for using distilled water in dye toning processes is an indication of the critical nature of dye toning.

4. Except when printing the positive, a stage common to any procees of kinematography, at no stage is there critical timing, and at no stage, except the weighing out of the pigment coloring matter when making up and adjusting the bulk colloid solutions, is there any need for critical proportioning. Accordingly after the proper exposure has been given to the positive the whole of the subsequent operations can be carried out continuously by apparatus of simple design and control.

5. The range of colors available is not restricted to dye colors capable of being mordanted by silver complexes or of transfer from soft gelatine. The only criteria are the obvious ones viz that the coloring matter shall be:—

(*a*) Insoluble in warm water;

(*b*) Unaffected by contact for periods of five minutes or so with weak solutions of dichromates;

(*c*) Transparent;

(*d*) Without hardening action on gelatine.

The process forming the present invention also has the following advantages over the known carbon tissue processes hereinbefore referred to:—

1. The possibility of obtaining perfect optical contact between the image and the gelatine base of the film.

2. The greater ease and cheapness of production dependent upon coating the film direct with a colloid solution thereby facilitating the making of modifications in the concentration and nature of the pigments contained in the solution and applied at any moment to the film surface.

The resulting colored kinematograph film produced by the process of the present invention comprises a series of colored relief images which are in absolute optical contact and firmly interlocked with the colloid base of the film so that when the images are magnified on projection there will be no loss of definition.

The preferred transparent emulsoid for use in the process is gelatine, and for this reason, in the description hereinafter given of specific embodiments of the invention gelatine will in the main be referred to but it is to be understood that other transparent emulsoid may be employed in

substitution for gelatine such as for example, albumen, agar, gum tragacanth and the like.

It is further to be understood that the term "colored" in reference to the gelatine or other colloid, is used throughout the specification in its broadest sense as embracing any "color" including black.

The carrying out of the invention is illustrated diagrammatically on the accompanying drawing which shows the different stages as applied to a two-color film; Fig. 1 showing a longitudinal section of the film after the application of the colored gelatine layer, Fig. 2 showing a similar longitudinal section after the bleaching, hardening process, Fig. 3 showing the finished film after removal of surplus colored gelatine and Fig. 4 showing a cross section of a film having a sound record. It is to be understood that the proportions of the film are greatly exaggerated particularly as to relationship between width and thickness.

In carrying out the invention the metallic silver images are printed on a film base of transparent material *a* in known manner such as by coating the transparent base on one or both sides with an adhesive substratum layer *a'* and then with a layer *b* of gelatino-silver emulsion which is cooled, hardened and dried. A series of positive images *c* of metallic silver is then produced in the gelatine layer *b* by exposing the sensitized film to light through a negative film after which it is developed with a developer, washed, hardened and dried.

The film is preferably perforated with a series of traction and registration perforations after the application of the gelatino-silver emulsion.

The colored gelatine solution is next prepared and maintained at a temperature which will keep it in the liquid or sol (plastic) form. It is applied to the surface or surfaces of the film by means of any known coating device capable of spreading an even and continuous layer *d* of the colored gelatine upon the surface or surfaces of the silver images *c*, the latter being advanced at a uniform speed past the spreading element of the device.

The next step in the process is that of bleaching and hardening which may be similar to that which has been obtained hitherto in the known processes, that is to say, two reagents may be employed, one, the bleaching agent, functioning to reduce the metallic silver of the photographic images to a salt, and the other, which may be termed the hardening agent, reacting with the salt formed from the silver of the images to produce a substance or substances, capable of hardening the gelatine in which they are produced, either directly or else by reaction with a third substance.

Hitherto, the bleaching and hardening baths which have been employed have usually comprised a mixed solution of a soluble bichromate and a ferricyanide or a copper salt. Sometimes, in addition to these substances, soluble bromides are present in the solution.

Any of these known solutions may be employed in the process of the present invention, or any equivalent thereof, the colored-gelatine coated silver images being passed through a bath of the solution or otherwise suitably brought into contact therewith.

According to a preferred modification of the invention, both the bleaching agent and the hardening agent may be incorporated with the colored colloid prior to its application to the silver print.

When operating in accordance with this last form of the invention, difficulties may be encountered, owing to the inception of bleaching taking place before the colloid layer on the print has set to the solid state. This difficulty however, may be overcome, by first coating, the silver images with a thin isolating layer of gelatine and allowing this layer to set, before applying the colored gelatine layer proper, that is to say, the layer containing the bleaching and hardening agents. The isolating layer should preferably be composed of the same colored gelatine as that of which the subsequently applied colloid layer proper is composed.

The preferred composition of the bath for effectuating the bleaching and hardening operation consists of a mixed bath containing a copper salt, potassium bichromate and potassium bromide. It is found however that by the use of such a bath that the whole of the colored gelatine layer tends to become insolubilized and the colloid will not easily develop away, unless the developing bath of hot water be very hot. This disadvantage can be overcome, by treating the film, between the step of bleaching and hardening and the step of developing, in a bath of dilute alkali such as 1%–3% solution of ammonium hydroxide of 0.880 specific gravity.

After the film has been subjected to the bleaching-hardening step it is passed through a developing bath of warm water to dissolve and remove all the colored gelatine which has not been hardened by the bleaching-hardening step leaving only the hardened parts from the relief images *e* and is finally treated in a fixing bath to dissolve and remove all the bleached silver image and is finally washed and dried.

An important advantage of incorporating the bleaching and hardening agents with the gelatine prior to its application to the silver images is that it permits of the production of colored images on kinematograph positive film bearing a sound track in silver.

This is accomplished by applying the colored gelatine (sensitized in the mass by the incorporation of the bleaching and hardening agents) locally to those areas of the film which bear the image to be converted into color, leaving the area containing the sound track uncovered by the gelatine. After the bleaching is complete the film is treated with warm water, as previously described, appropriate precautions being taken to prevent the bleaching agents, diffusing into the developing water, from attacking the sound track. To this end large volumes of vigorously stirred development water may be used.

When the bleaching agents are not incorporated in the original gelatine coat the sound track may be protected from attack by the bleaching bath by a water-impervious varnish.

The invention is applicable to multi-color kinematograph films on which the several images are complementary to one another and correspond, respectively, to different complementary colors; and also to a kinematograph film in which the images in one line along the film are in one color and those in a second line in a second color. For example, where the images in one color are all on one face of the film and the images in another color are all on the opposite face, each face of the film may be coated with its layer of colored colloid by being drawn at uniform speed past the coating device.

In the case of multi-color kinematograph film in which the differently colored images are arranged in a recurring succession along the film

on the same face of the latter, the variously colored deposits of gelatine may be applied to the respective picture areas of the film by means of a succession of rotating fingers adapted to operate in succession upon successive areas as the film is drawn past the fingers, and to deposit each its own color of gelatine. Alternatively, the succession of variously colored deposits of colloid may be applied by means of stencils.

In the further case, moreover, of a multi-color kinematograph film in which complementary images are disposed in lines of picture areas extending along the film side by side, the gelatine layers, of the colors corresponding respectively to the silver images, may be applied simultaneously in continuous strips along the film, so that one strip overlies one row of picture areas and the other strip overlies another row.

In the case of a multi-color film with the gelatine images in the different colors disposed in parallel rows along the film, the finished film is folded or split longitudinally along the film between the rows, and the two or more lengths of the film are superimposed upon one another in accurate register and cemented together.

Two or more color films may also be produced by forming different films each of one complementary color and superimposing such films one upon the other in accurate register and cementing them together.

Several examples of the invention will now be described purely by way of illustration of how the invention can be carried into effect.

Example I

To obtain a two-color kinematograph film an appropriate negative record is obtained by any known method, for example, by exposing in a kinematograph camera a bipack film consisting of an orthochromatic sensitive emulsion on an orange stained base backed by a panchromatic film.

Such a combination records on the front film the blue green portion of the spectrum and on the rear film the orange red.

The blue green record is now printed upon one side of double coated positive film and the orange red record is printed in register upon the opposite side of the film.

The film is developed in a normal photographic developer and fixed in a bath which may contain a hardener for gelatine such as potash alum in addition to sodium thiosulphate. Alternatively the gelatine of the positive film can be rendered insoluble during manufacture by means of chrome alum or formalin, when a plain hypo bath may be used for fixation.

After washing to remove all soluble salts, that side of the film bearing the images obtained from the blue green negative record is coated with a warm solution of gelatine coloured orange red by a transparent pigment or dye lake whilst the other side of the film is coated with a similar gelatine solution colored blue green.

A suitable red gelatine solution consists of

	Parts
Pure gelatine	10
Crimson lake	3
Water	100

and a suitable blue green gelatine is

	Parts
Pure gelatine	10
A jade green dyestuff	4
Water	100

Other red and green pigments may be employed, and are so chosen and proportioned that mixtures of equal parts of the two gelatine solutions are of a neutral grey color.

After coating upon the film the gelatine is set by chilling and the film then passed into a solution such as

	Percent
Chromic acid	0.08–0.18
Potassium bromide	1.0 –2.0
Potassium ferricyanide	1.0 –2.0

When the silver image has been bleached the film is passed through a bath of water maintained at a temperature of approximately 40° C. which is slightly above the melting point of the unhardened colored gelatine solutions with which the film has been coated.

The film remains in the warm water until all the colored gelatine other than that hardened during the bleaching of the silver image has been removed. The film is then passed through a fixing bath such as 10% sodium thiosulphate, washed and dried.

Example II

A kinematograph film, containing positive silver images on each side is obtained by any of the known methods in such a way that one side records the blue green, whilst the other side records the orange red, and is developed and fixed in the usual way. It is hardened, for example, with alkaline formaldehyde, and washed. Whilst still wet but with the surface freed from surplus water by means of an air blast, it is coated upon the blue green record side with orange colored gelatine and upon the orange red record side with green colored gelatine.

Suitable orange and green-colored gelatine solutions may be made up as follows:—

Green pure gelatine	5 gms.
A jade green dyestuff	15 gms.
Water	100 c.c.
Orange pure gelatine	5 gms.
A brilliant orange dyestuff	15 gms.
Water	100 c.c.

It will be understood that the actual proportions in which the pigment is used will depend in any given case upon the pigmental power of the pigment and can be readily determined by preliminary test.

After coating on either side with the above gelatine solutions maintained at a temperature slightly above the melting point the film is rapidly cooled, preferably by means of a blast of cold air. It is then immersed in a bleaching bath of the following composition:—

Cupric chloride	5.0 gms.
Potassium bichromate	0.5 gms.
Potassium bromide	10.0 gms.
Water	100 c.c.

The concentration of the potassium bichromate in the above bath determines the contrast of the resulting pictures. The less the quantity of bichromate present the greater the contrast. The film is now well washed in water and passed for three minutes through a bath of 3 per cent solution of ammonia of specific gravity 0.880. It is then passed for about the same length of time through water maintained at a temperature of approximately 42° C. It is finally sprayed with water at the same temperature, passed through a bath of 10 per cent sodium thiosulphate, washed and dried.

Example III

In the procedure described in Example II, the bleaching agents may be incorporated with the colored gelatine as follows:—

After solution has taken place, 25 c.c. of the bleaching bath of Example II is added to the mixture, the gelatine solution being maintained during the addition at a few degrees only above its melting point. The resulting mixture may be coated directly upon the silver image of the print and after bleaching of the image has taken place, the gelatine may be developed as before in hot water.

Where, in the above examples, another colloid, such as albumen, for example, is substituted for the gelatine, the details of the procedure may require to be modified slightly to suit the particular colloid used; thus the temperature of the developing bath in any given case has to be chosen to suit the solubility of the colloid.

A suitable orange-red color for use in the preceding examples may be obtained by mixing together equal parts of Windsor and Newton's 3 color fast yellow No. X.P.1 and Windsor and Newton's 3 color fast red No. X.P.2. Similarly a suitable blue-green color may be obtained by mixing together equal parts of Windsor and Newton's 3 color fast yellow No. X.P.1 and Windsor and Newton's 3 color azure blue No. X.P.3.

Such red, yellow and blue lakes are produced by striking a suitable red, yellow or blue dyestuff, which is permanent to mild acids, mild alkalies, potassium bichromate and light, upon a transparent alumina base in known manner.

What we claim as our invention and desire to protect by Letters Patent is:—

1. A process for the production of positive kinematograph films having relief images in colored colloid thereon which consists in producing metallic silver images in known manner in a layer of hardened colloid carried by a film base of transparent material, coating the surface of such film by mechanical means with a thin layer of hot liquid or plastic solution of a transparent emulsoid and a transparent pigment, cooling and setting the thin layer of colored colloid so that the surfaces of the two colloid layers become intimately interlocked or incorporated together, passing the coated film through a solution containing a bleaching agent to reduce the metallic silver of the silver image to a salt and hardening agent to harden the colored colloid layer on the bleached silver image, treating the bleached-hardened film with hot water until all surplus non-hardened gelatine not required in the bleached image has been dissolved and washed away, treating the film in a fixing bath to fix the bleached silver image and finally washing and drying the film.

2. Process for the production of positive-kinematograph films having relief images in colored colloid thereon which consists in producing metallic silver images in known manner in a layer of hardened colloid carried by a film base of transparent material, coating the surfaces of such film by mechanical means with a thin layer of hot liquid or plastic solution of a transparent emulsoid and a transparent pigment cooling and setting the thin layer of colored colloid so that the surfaces of the two colloid layers become intimately interlocked or incorporated together, passing the coated film through a solution containing a bleaching agent to reduce the metallic silver of the silver image to a salt and a hardening agent to harden the colored colloid layer on the bleached silver image, treating the film with a dilute alkali, treating the bleached-hardened film with hot water until all surplus non-hardened gelatine not required in the bleached image has been dissolved and washed away, treating the film in a fixing bath to fix the bleached silver image and finally washing and drying the film.

3. Process for the production of positive kinematograph films having relief images in colored colloid thereon which consists in producing metallic silver images in known manner in a layer of hardened colloid carried by a film base of transparent material, coating the surfaces of such film by mechanical means with a thin layer of hot liquid or plastic solution of a transparent emulsoid and a transparent pigment, cooling and setting the thin layer of colored colloid so that the surfaces of the two colloid layers become intimately interlocked or incorporated together, treating the colloid coated print with a mixed solution of an alkali bichromate, an alkali halide and a copper salt, treating the film with a dilute alkali, treating the bleached-hardened film with hot water until all surplus non-hardened gelatine not required in the bleached image has been dissolved and washed away, treating the film in a fixing bath to fix the bleached silver image and finally washing and drying the film.

4. Process for the production of positive kinematograph films having relief images in hardened colored colloid thereon which consists in producing metallic silver images in known manner in a layer of colloid carried by a film base of transparent material, forming a solution of a mixture of a transparent emulsoid and a transparent pigment, incorporating with the solution an agent for bleaching the silver image and an agent for hardening the colloid, coating the surface of the film by mechanical means with a thin layer of the colored colloid solution, cooling and setting the thin layer of colored colloid so that the surfaces of the two colloid layers become intimately interlocked or incorporated together, treating the film with a dilute alkali, treating the bleached-hardened film with hot water until all surplus non-hardened gelatine not required in the bleached image has been dissolved and washed away, treating the film in a fixing bath to fix the bleached silver image and finally washing and drying the film.

5. Process for the production of positive kinematograph films having relief images, in colored colloid thereon which consists in producing metallic silver images in known manner in a layer of hardened colloid carried by a film base of transparent material, applying a thin layer of a colloid solution upon the basic silver images, allowing the layer to dry, forming a solution of a mixture of a transparent emulsoid and a transparent pigment, incorporating with the solution an agent for bleaching the silver image and an agent for hardening the colloid, coating the aforesaid colored colloid layer, by mechanical means with a thin layer of the colored colloid solution, cooling and setting the thin layer of colored colloid so that the surfaces of the two colloid layers become intimately interlocked or incorporated together, treating the film with a dilute alkali, treating the bleached-hardened film with hot water until all surplus non-hardened gelatine not required in the bleached image has been dissolved and washed away, treating

the film in a fixing bath to fix the bleached silver image and finally washing and drying the film.

6. Process for the production of positive kinematograph films having relief images in colored colloid thereon which consists in producing metallic silver images in known manner in a layer of hardened colloid carried by a film base of transparent material, forming a solution of a mixture of a transparent emulsoid and a transparent pigment, coating the basic silver images with a thin layer of such colored colloid solution, allowing the thin layer of colored colloid to set or dry, incorporating an agent for bleaching the silver image and an agent for hardening the colloid with a similar solution of colored colloid, coating the aforesaid colored colloid layer, by mechanical means with a thin layer of the colored colloid solution, cooling and setting the thin layer of colored colloid so that the surfaces of the two colloid layers become intimately interlocked or incorporated together, treating the film with a dilute alkali, treating the bleached-hardened film with hot water until all surplus non-hardened gelatine not required in the bleached image has been dissolved and washed away, treating the film in a fixing bath to fix the bleached silver image and finally washing and drying the film.

7. Process for the production of positive kinematograph films having relief images in colored colloid thereon which consists in producing metallic silver images in known manner in a layer of hardened colloid carried by a film base of transparent material, mechanically applying a coating of a solution of a transparent emulsoid and a transparent pigment in liquid or plastic form over only such portion of the film which bears the silver image leaving an uncoated track at the side of the film to receive or already having a sound record, allowing the coating of colored colloid to set or dry, bleaching the silver image and hardening the colored colloid layer, developing the relief image on the film and finally fixing the bleached silver image.

8. Process for the production of positive kinematograph films having relief images in colored colloid thereon which consists in producing metallic silver images in known manner in a layer of hardened colloid carried by a film base of transparent material, forming a silver image sound record on said film, forming a mixture in liquid form of a transparent emulsoid, a transparent pigment and a bleaching agent for the silver image, applying a coating of such mixture to the film so that it does not overlie the sound track, allowing the coating to set or dry, developing the relief image in the film and finally fixing the bleached silver image.

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