Patented Feb. 17, 1931

1,793,070

UNITED STATES PATENT OFFICE

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PHOTOMECHANICAL PROCESS OF PRINTING

No Drawing. Application filed September 3, 1926, Serial No. 133,513, and in Great Britain September 15, 1925.

This invention relates to a new or improved photomechanical process of printing.

In existing processes for obtaining collotype printing surfaces, either by using bichromated gelatine directly or by converting silver images into a printing surface by means of a bichromate or similar bath which hardens the gelatine in the presence of the silver image, a printing grain is produced.

In ordinary collotype, where the hardened image is obtained by light action upon gelatine impregnated with a bichromate salt, a large body of the gelatine is affected and considerable reticulation takes place, resulting in the breaking up of the gelatine into granular particles. Similarly, when a silver image in gelatine is treated with oxidizing agents, the gelatine adjacent to the silver is hardened, and in the case of the treatment of ordinary photographic positives or negatives where the developed silver image occupies a large proportion of the emulsion, it must follow that the disintegration of the particles is so great that appreciable grain results, because when gelatine is treated with chemical substances capable of hardening the gelatine, the hardening action causes a disintegration of the particles of the gelatine, resulting in what is known as reticulation. Further, when the silver salts are also removed from the gelatine by subsequent immersion in a solution of sodium thiosulfite, the gelatine becomes more porous and reticulation is greater. A like action results in other colloidal substances.

The object of the present invention is to produce from a silver image a grainless printing surface suitable for printing from as in collotype.

In a process of producing a printing surface according to the present invention, the image to be hardened is produced by a special method of developing, which is in direct contrast to the usual procedure in making photographic transparencies; in the latter the development is carried on until strength and vigour is obtained for viewing through transmitted light. The development in accordance with the present invention, obtains an image which is useless for ordinary photographic processes such as for viewing or projection, owing to the faintness, that is the insufficiency of density and depth, of the image, also it obtains an image without internal reactions within the gelatine such as would be produced by excessive quantities of retarding agents in the developer.

According to the present invention, the development of the exposed plate or film carrying the latent image is effected with a developer which reacts upon all the light-affected silver in the colloid proportionately to the amount of light to which the silver has been exposed but whose action is so feeble or restricted as to produce an extremely faint and tenuous image lacking density and depth which will be composed of very minute quantities of reduced silver held in suspension in the colloid, and chemically hardening the colloid in the presence of the silver.

The developed silver image is then preferably fixed and washed in the usual manner, and afterwards the plate or film is subjected to a chemical hardening treatment which results in the colloid being hardened in proportion to the tones of the image. To this end the plate or film may be treated with the silver image in the colloid. The plate or film is then washed and has only to be treated in the ordinary way of treating a collotype surface, to make it ready for printing from with greasy ink.

By reason of the fact that the faint image obtained by the process of development according to the invention, consists of very minute particles of reduced silver, only a small part of the colloid is occupied by the image, and consequently the chemical hardening treatment (which hardens the colloid

adjacent to the silver particles) leaves unchanged the bulk of the emulsion with the consequence that reticulation is slight, hence a minimum of granular particles.

A further and very important advantage, resulting from developing in accordance with the invention, is that the faint silver image can be retained after it has served its primary purpose of combining with the oxidizing agents to harden the adjacent colloid, with the result that a greater cohesion of the colloidal particles is obtained, which cohesion tends to still further check disintegration of the particles.

An image of the faintness required in processes according to the present invention, is obtained by using an ordinary photographic developer which has been diluted with water more than the normal, that is to say, a developer which has been diluted from 12 to 20 times that ordinarily employed in photographic processes. In this way the action of the developer is restricted which restriction results in the production of very minute particles of reduced silver and subsequent reactions in the gelatine avoided during development.

A suitable developer, when diluted as above stated, is a developer containing "amidol" (diamidophenol dihydrochloride $C_6H_8N_2O.2HCl$).

An important advantage of the invention is its application in the production of printing surfaces from ordinary commercial photographic plates or films. Other similar printing surfaces made to suit certain contingencies may, however, be utilized, for instance, a printing surface formed by coating a base plate of glass, metal, or like substance, not generally employed for the reception of a silver bromide emulsion in gelatine, a substratum being placed on the base so as to ensure the adherence of the emulsified gelatine thereto.

Generally speaking, however, the invention contemplates the use of an ordinary commercial film or plate, exposed under a photographic negative. It should be understood, however, that a negative silver image may be converted into a printing surface with equal success as a positive image. The application of the invention in such manner would prove very useful in many ways, as for instance, where it might be desired to produce the effect of white letters or drawings on a dark ground from ordinary copy drawn in black upon white paper.

In one practical embodiment of the invention, a plate or film, preferably one exposed under a photographic negative, after being developed in the manner hereinbefore referred to, is fixed, as for example, in a bath of sodium thiosulfite solution ("hypo"), or in an acid fixing bath including potassium metabisulphite to give a slightly acid reaction, and then washed and dried, though the hardening operation may proceed without drying.

The fixed plate or film is then treated with a hardening solution of the following composition, viz:—

10% solution copper sulphate	16 drams
10% solution potassium bromide	14 drams
10% solution potassium bichromate	30 minims
1% solution chromic acid	1½ drams
Distilled water	4 ounces

which solution reacts with the silver image and hardens the gelatine in proportion to the tones of the image.

This formula may be altered for the purpose of varying the printing properties of the plate or film, by modifying the proportions of the chemicals, or by adding or substituting other substances having a like action upon the silver compounds, comprising the photographic image. For instance, an increase of chromic acid would tend to cause an increase in the hardening of the colloid and a reduced amount would harden in a less degree. Copper chloride and sodium chloride might be substituted for copper sulphate.

If, when the hardening process has been completed and the film again washed, it is found that the colloid (gelatine) is not sufficiently hard to withstand the pressure of printing, the colloid coating of the plate or film may be further and finally hardened by subjecting it to a hardening solution such as, for example, a weak solution of chrome alum or other salt having a similar action.

If desired, the plate or film may be dried, and the printing operation carried out at any convenient time.

To prepare the reduced silver colloid image for printing with greasy ink, as in collotype printing, the surface is treated with a solution of glycerine and water, after which the inking and printing are effected, as in known collotype manner. Instead of glycerine and water, other known substances of a like nature may be used, or any of such solutions may be used with other chemical substances which will assist the colloid to accept or repel the greasy ink.

The inking up and printing are effected as in ordinary collotype printing.

The tone values of the image may be varied at will by manipulating the exposure and developing the photographic positive as herein described.

As a modification of the process just described, instead of washing the plate or film after the fixed image has been hardened, which results in the image being bleached, the bleached image may itself be subjected to the action of a solution of sodium thiosulfite ("hypo") to dissolve out certain of the silver

or other compounds to arrest chemical action, and then washed.

However, the best results have been obtained by retaining the bleached silver deposited in the colloidal coating of the plate or film.

By the present invention a substantially grainless printing surface is obtainable without any special previous preparation because ordinary photographic plates or films may be employed. The plates or films, after being treated as herein described, may be printed from in suitable flat-bed machines; the colloid coating may then be upon a base of glass, metal, celluloid, or other suitable substance, a flexible base being clamped to a suitable bed, or if printing is effected in fast-running rotary machines, a flexible base must be used.

Long strips or endless bands of film containing the prepared image may be inked and impressions taken on rolls of paper or the like in known manner, making it practical, by these means, to produce kinematograph pictures in printing ink on reels of paper or other suitable material. In such application, ordinary commercial positive kinematograph films may be employed, being exposed under or behind a series of kinematograph negatives, then developed and treated as herein described.

In such cases the printed picture will be in reverse as regards right and left, but this is advantageous, as by the means employed for projecting such printed surface, the picture appears correctly on the viewing screen.

The present invention can further be applied to the production of enlarged positives as printing surfaces, thereby dispensing with the usual process of making half-tone blocks, and also can be employed where a collotype surface has heretofore been used, in which case the plate, film, or the like to be utilized is exposed under a reversed photographic negative by any of the methods ordinarily employed on photo-mechanical work. The negative may be made by the use of a prism, when photographing, or the negative film may be stripped from its support and turned over, by well known means. Alternatively, the positive may be reversed during exposure by any known means, for example, the positive plate or film may be exposed in a camera to a negative which has been turned with its back towards the lens, or the exposure may be made through a prism. These methods are well known and are employed in many photo-mechanical processes.

I claim:

1. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the development of the exposed plate or film carrying the latent image with a developer which reacts upon all the light-affected silver salt in the colloid proportionately to the amount of light to which the silver salt has been exposed, but whose action is so feeble as to produce an extremely faint and tenuous image lacking density and depth which will be composed of very minute quantities of reduced silver held in suspension in the colloid, and chemically hardening the colloid in the presence of the silver.

2. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the development of the exposed plate or film carrying the latent image with a developer diluted so that the action thereof is restricted and subsequent chemical reactions in the gelatine are avoided during development, and chemically hardening the colloid in the presence of the silver.

3. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the development of the exposed plate or film carrying the latent image with a developer diluted from twelve to twenty times that ordinarily employed in photographic processes, and chemically hardening the colloid in the presence of the silver.

4. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the development of the exposed plate or film carrying the latent image with a developer consisting of a solution of amidol diluted from twelve to twenty times that ordinarily employed in photographic processes, and chemically hardening the colloid in the presence of the silver.

5. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the development of the exposed plate or film carrying the latent image with a developer which reacts upon all the light-affected silver salt in the colloid proportionately to the amount of light to which the silver salt has been exposed, but whose action is so feeble as to produce an extremely faint and tenuous image lacking density and depth which will be composed of very minute quantities of reduced silver held in suspension in the colloid, and chemically hardening the colloid in the presence of the silver by subjecting the developed image to a solution of the following composition:—

10% solution copper sulphate	16 drams
10% solution potassium bromide	14 drams
10% solution potassium bichromate	30 minims
1% solution chromic acid	1½ drams
Distilled water	4 ounces

6. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the development of the exposed plate or film carrying the latent image with a developer diluted so that the action thereof is restricted and subsequent chemical reactions in the gelatine are avoided during development, and chemically hardening the colloid in the presence of the silver by subjecting the developed image to a solution of the following composition:—

10% solution copper sulphate	16 drams
10% solution potassium bromide	14 drams
10% solution potassium bichromate	30 minims
1% solution chromic acid	1½ drams
Distilled water	4 ounces.

7. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the development of the exposed plate or film carrying the latent image with a developer diluted from twelve to twenty times that ordinarily employed in photographic processes, and chemically hardening the colloid in the presence of the silver by subjecting the developed image to a solution of the following composition:—

10% solution copper sulphate	16 drams
10% solution potassium bromide	14 drams
10% solution potassium bichromate	30 minims
1% solution chromic acid	1½ drams
Distilled water	4 ounces.

8. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the development of the exposed plate or film carrying the latent image with a developer consisting of a solution of amidol diluted from twelve to twenty times that ordinarily employed in photographic processes, and chemically hardening the colloid in the presence of the silver by subjecting the developed image to a solution of the following composition:—

10% solution copper sulphate	16 drams
10% solution potassium bromide	14 drams
10% solution potassium bichromate	30 minims
1% solution chromic acid	1½ drams
Distilled water	4 ounces.

9. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the sequence of three separate steps, viz., developing with a developer whose action is feeble, fixing, and chemically hardening the colloid in proportion to the tones of the image by utilizing an oxidizing agent.

10. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the sequence of three separate steps, viz., developing with a developer whose action is feeble, fixing, and chemically hardening the colloid in proportion to the tones of the image by utilizing a solution of the following composition:—

10% solution copper sulphate	16 drams
10% solution potassium bromide	14 drams
10% solution potassium bichromate	30 minims
1% solution chromic acid	1½ drams
Distilled water	4 ounces.

11. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the development of the exposed plate or film carrying the latent image with a developer which reacts upon all the light-affected silver salt in the colloid proportionately to the amount of light to which the silver salt has been exposed, but whose action is so feeble as to produce an extremely faint and tenuous image lacking density and depth which will be composed of very minute quantities of reduced silver held in suspension in the colloid, chemically hardening the colloid in the presence of the silver, and subjecting the chemically hardened colloid to a final hardening process to assure that the colloid withstands the pressure of printing.

12. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the development of the exposed plate or film carrying the latent image with a developer diluted so that the action thereof is restricted and subsequent chemical reactions in the gelatine are avoided during development, chemically hardening the colloid in the presence of the silver, and subjecting the chemically hardened colloid to a final hardening process to assure that the colloid withstands the pressure of printing.

13. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the development of the exposed plate or film carrying the latent image with a developer diluted so that the action thereof is restricted and subsequent chemical reactions in the gelatine are avoided during development, chemically hardening the colloid in the presence of the silver by subjecting the

developed image to a solution of the following composition:—

10% solution copper sulphate	16 drams
10% solution potassium bromide	14 drams
10% solution potassium bichromate	30 minims
1% solution chromic acid	1½ drams
Distilled water	4 ounces

and subjecting the chemically hardened colloid to a final hardening process to assure that the colloid withstands the pressure of printing.

14. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the sequence of three separate steps, viz., developing with a developer whose action is feeble, fixing, and chemically hardening the colloid in proportion to the tones of the image by utilizing an oxidizing agent, and subsequently subjecting the chemically hardened colloid to a final hardening process to assure that the colloid withstands the pressure of printing.

15. A method of producing a substantially grainless printing surface from a latent silver image in a colloidal substance, capable of being printed from as in collotype printing, comprising the sequence of three separate steps, viz., developing with a developer whose action is feeble, fixing, and chemically hardening the colloid in proportion to the tones of the image by utilizing a solution of the following composition:—

10% solution copper sulphate	16 drams
10% solution potassium bromide	14 drams
10% solution potassium bichromate	30 minims
1% solution chromic acid	1½ drams
Distilled water	4 ounces

and subsequently subjecting the chemically hardened colloid to a final hardening process to assure that the colloid withstands the pressure of printing.

16. A substantially grainless printing surface capable of being printed from as in collotype printing, in which the silver of the image is in such an exceedingly fine state of subdivision and held in suspension in the colloid, as to constitute an exceedingly faint and tenuous image lacking density and depth, the tone values being in true relation to one another, and the colloid hardened in proportion to the tones of the image.

17. A substantially grainless printing surface capable of being printed from as in collotype printing, consisting of an ordinary photographic plate or film in which the silver of the image is in such an exceedingly fine state of subdivision and held in suspension in the colloid as to constitute an extremely faint and tenuous image lacking density and depth, the tone values being in true relation to one another, and the colloid hardened in proportion to the tones of the image.

In testimony whereof I affix my signature.

EUSTACE BERNARD ELDRIDGE.