United States Patent

Vrancken et al.

[15] **3,661,579**

[45] **May 9, 1972**

[54] **METHOD FOR RECORDING AND REPRODUCING GRAPHIC INFORMATION ON PROCESSED PHOTOGRAPHIC MATERIAL**

[72] Inventors: **Marcel Nicolas Vrancken,** Hove; **Louis Achilles Meeussen; Daniel Alois Claeys,** both of Mortsel, all of Belgium

[73] Assignee: **Gevaert-AGFA N.V.,** Mortsel, Belgium

[22] Filed: **May 13, 1968**

[21] Appl. No.: **728,574**

[30] **Foreign Application Priority Data**

May 12, 1967 Great Britain.....22,221/67

[52] **U.S. Cl.**.....**96/36,** 96/27, 96/35, 96/38.1, 96/38.2, 96/42, 96/43, 117/65.2, 250/65.1, 352/55, 352/90, 355/39

[51] **Int. Cl.**.....**G03c 5/00,** G03c 5/44

[58] **Field of Search**.....352/55; 96/27, 36, 35, 42, 96/43, 38.1, 38.2; 250/65.1; 117/65.2

[56] **References Cited**

UNITED STATES PATENTS

865,276	9/1907	Spitzer	96/36
2,051,603	8/1936	Hruska	96/43 X
4,915,581	12/1959	Pajes	352/55 X
3,121,162	2/1964	Roman et al	250/65.1
3,298,833	1/1967	Gaynor	96/27
3,427,161	2/1969	Laridon et al	96/38.1 X
3,310,403	3/1967	Bryan	96/36 X
3,476,937	4/1970	Vrancken	250/65

OTHER PUBLICATIONS

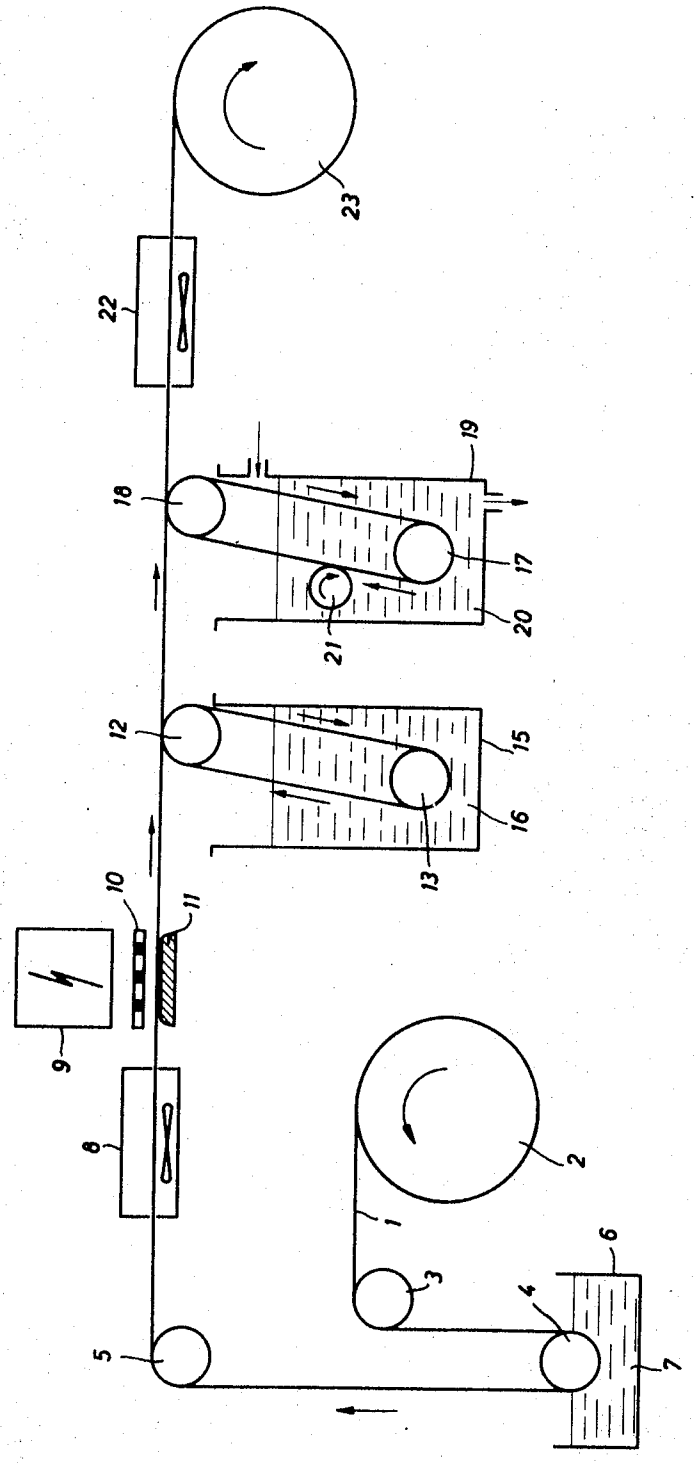
Van der Griten Bulletin, " Thermographic Writing and Copying Methods and Materials," No. 68, Aug. 1, 1963, pp. 1- 6.

Primary Examiner—George F. Lesmes
Assistant Examiner—R. E. Martin
Attorney—William J. Daniel

[57] **ABSTRACT**

Recording layers of the type disclosed in U.S. Pat. No. 3,476,937 are used for subtitling photographic film, particularly motion picture film. A heat and/or pressure sensitive layer of such type is applied as an over-coating on the film to be subtitled, exposed to a heat pattern according to the subtitle so as to reduce the water permeability of the heated areas thereof, contacted with an aqueous liquid chemically degrading the binder in such layers so that the layer is removed in the heated areas, after which the film which carries the developed photographic image in a conventional emulsion layer thereon is contacted with a liquid, which may be the same liquid used to chemically degrade the overlayer, which either degrades the binder of the conventional emulsion layer to permit removal thereof or bleaches the visible image-forming material, i.e., the developed silver image or colored dye image, in the emulsion layer, the degradation or bleaching effect taking place in the areas where the overlayer has been removed. The remaining areas of the overlayer can be finally removed by rubbing the same while wet with an aqueous liquid.

17 Claims, 1 Drawing Figure


23
22
19
18
17
20
21
12
15
16
13
10
11
9
8
2
1
3
6
4
5
7

METHOD FOR RECORDING AND REPRODUCING GRAPHIC INFORMATION ON PROCESSED PHOTOGRAPHIC MATERIAL

The present invention relates to a method for recording and reproducing graphic information on processed photographic material, more particularly to sub-titling of motion pictures.

Various methods for sub-titling processed silver halide black-and-white or color movies are known.

According to such known techniques a side part or the bottom part of photographic images produced by silver halide black-and-wite or color photography is provided with text.

According to one technique of sub-titling the emulsion layer is removed at the areas corresponding with the text characters, e.g. by tearing out. For this purpose printing blocks carrying the text in relief are pressed against the previously wetted emulsion layer and then separated therefrom, thus tearing out the emulsion down to the support in correspondence with the relief. However, such procedure is rather cumbersome and incurs the risk of bad reproducibility and damage to the film. A too strongly hardened emulsion cannot be torn out as deeply as the support, so that the text is not reproduced in a sufficiently white tone.

According to another technique, the emulsion side of a processed film is covered with a wax layer, which in accordance with the text markings is pressed back by means of metal letterpress dies to allow the binder of the emulsion, image silver or image dye(s) to be attacked locally. Subsequently the remaining parts of the wax layer are dissolved away. The manufacture of metal letterpress dies with minute characters needs great care, and the successive pressing steps wherein the emulsion layer is made free for local attack cannot be carried out at a high rate and without loss of sharpness of the characters. Moreover, the need to remove the remaining parts of the wax layer with an organic solvent, e.g., naphtha, makes that technique less attractive.

According to another technique, described in the United Kingdom Pat. specification No. 754,990, a varnish layer, which is resistant to an etching liquid containing an alkali metal and alkaline-earth metal hypochlorite, is applied to the image-containing emulsion layer and is then covered itself by a light-sensitive emulsion layer. The light-sensitive top layer is exposed by light transmitted through a support bearing transparent characters of the sub-titles, and then developed. Subsequently, the gelatin of the emulsion layer is degraded at the image areas containing silver, e.g. by means of a commonly used oxidizing solution containing bichromate. The varnish layer is then dissolved away at the areas, where the gelatin-containing top emulsion layer was removed. Subsequently the image silver or image dye in the subjacent emulsion layer(s) is etched or bleached away by means of an aqueous hypochlorite solution.

Alternatively, the top emulsion layer can be exposed by light transmitted through a support bearing the sub-titles as an opaque text, then can be treated in a tanning-developing bath and washed away at the unhardened areas, whereupon the above procedure of image-wise removing the varnish and etching the emulsion layer is applied.

Obviously, the application of a varnish layer and a light-sensitive emulsion layer to a processed silver halide material is extremely time-consuming. The coating of a light-sensitive silver halide emulsion can only be effected in the dark and the emulsion requires special care in its preparation. Furthermore, the cumbrous processing impedes the practical realization of this technique.

It has now been found that graphic information can be simply and effectively recorded on photographic materials containing black-and-white or color images, e.g., motion pictures by the steps of applying to the image side of a processed photographic black-and-white or color material a water-permeable over-layer, which by the action of heat and/or pressure becomes less permeable or impermeable to water, and information-wise heating and/or information-wise exerting pressure on said over-layer so that the information is recorded in terms of a difference in the water permeabilities of different

areas of said over-layer. Following the heating and/or pressurizing step, an aqueous liquid (treating liquid) can be caused or allowed to penetrate the still appreciably water-permeable or the most water-permeable areas of said over-layer, such liquid being composed so as to selectively remove the said water-permeable over-layer in the non-heated or non-pressure treated portions or to affect at least one underlying layer (which may also be water-permeable) in the coinciding areas, in such a way that a visible record is thereby formed or can be formed by a subsequent non-differential treatment of the photographic material. For instance an aqueous liquid may be used which causes the image silver or image dye in the or an underlying processed silver halide emulsion layer(s) to be etched or bleached away in the areas coinciding with the still water-permeable or most water-permeable areas of the over-layer.

The selective removal of the water-permeable layer may be promoted by softly rubbing the over-layer while wetting it with the said aqueous liquid.

So, depending on the composition of the photographic material and/or the over-layer, and of the treating liquid, the visible record may be formed by parts of the over-layer itself, or may be formed by virtue of a physical and/or chemical change effected in an underlying layer, e.g., a developed silver halide emulsion layer by the treating liquid. The image areas forming the developed record may be of higher or lower optical density than the surrounding areas.

A development involving physical and/or chemical attack of portions of the photographic material, e.g. portions of a developed silver halide emulsion layer, may be achieved by using as treating liquid, a liquid which has the property of etching, degrading, dissolving, bleaching, discoloring, or coloring some or all of the ingredients of the photographic material e.g. so that in the areas where such liquid penetrates to the photographic material, the optical density of an image-wise exposed and developed silver halide emulsion layer is increased or decreased. The liquid will only exert its influence on those portions of the photographic material which are not shielded by the portions of the over-layer which are still impermeable or only slightly permeable for the treating liquid. After the desired action by the treating liquid has taken place, the over-layer, or if portions of the over-layer have already been removed by the treating liquid then the still remaining portions of the over-layer, can be removed from the photographic material.

In general, positive motion pictures are sub-titled by reducing the optical density of the photographic material in correspondence with the graphic information to be reproduced. This can be achieved by using a treating liquid by which the silver metal particles constituting the silver image of a developed silver halide layer are bleached or etched away. Alternatively, the dyes of a positive color print obtained in developed silver halide color material can be bleached, degraded, and washed away in accordance with the sub-title to be produced. The binder of the recording layer, e.g., a proteinaceous binding agent, such as gelatin contained in common silver halide recording materials, can be degraded with liquids comprising hydrogen peroxide or alkali metal hypochlorites (ref. P. Glafkidès - Photographic Chemistry Vol. II - Fountain Press London, p. **668–669**).

Sub-title indicia of higher optical density than the surrounding areas can of course also be produced by the action of a treating liquid which affects the portions of the photo-graphic material from which the covering portions of the over-layer have been removed or which are covered by portions of such over-layer which remained permeable for the treating liquid after the information-wis heating step. Thus, a treating liquid can be used which is a dye solution. According to another technique, sub-title indicia of higher optical density than the surrounding areas can be formed by portions of the over-layer itself. Thus, the composition of the over-layer may be such that this layer is an opaque colored or black layer and the latent record of the heat pattern can be developed just by

using a treating liquid which washes away the portions of the over-layer which are sufficiently soluble in or permeable for the treating liquid, i.e., the portions of such over-layer which have not been heated or treated with pressure.

The formation of a sub-title in the form of dark or opaque markings is of special interest in the sub-titling of negative or duplicating negative motion pictures, which are used to print release prints.

Opaque graphic markings can be formed by introducing a silver salt or silver salt complex into the photographic material in areas where the over-layer has been removed or rendered permeable or more permeable, and by reducing the said salt or complex to silver metal or by introducing colorless color couplers, which react with ingredients absorbed in one or more layers of the material. A color-reaction can be catalyzed by a catalyst either present in said layer(s) or in an aqueous treating liquid. It is equally possible to produce colored or opaque image markings by introducing through the openings or still permeable portions of the over-layer a dye solution containing a dye or a mixture of dyes absorbing light of a part or the whole visible spectrum. In order to prevent lateral diffusion, said dye(s) is (are) preferably used in combination with mordanting agents, e.g., those known from the imbibition printing process, wherein acid dyes are applied. Suitable dyes and mordanting agents are described e.g. in the United Kingdom Patent specification No. 830,189, and the U.S. Pat. specification No. 3,234,025.

Reference is made to the "still water-permeable" and "most water-permeable" areas because the information-wise heating or pressurizing of the over-layer may reduce the water-permeability of the heated and/or pressed areas of such layer to nil or there may be some residual water-permeability in those areas.

The over-layer is preferably a top layer, i.e., it is preferably not covered by any subsequently applied layer. The expression "top layer" or "surface layer" is therefore hereafter occasionally used instead of "over-layer" but the covering of the over-layer is not excluded from the scope of the invention.

The invention includes any photographic material, and particularly any photographic motion picture film wherein there is a water-permeable over-layer on at least part of the film area, on its image or developed side, such layer being composed so that it can be rendered water-impermeable or appreciably less water-permeable by the action of heat and/or pressure.

According to a preferred embodiment of the invention:

a. the emulsion side of a processed photographic material is coated with an over-layer which comprises (preferably for at least **50** percent by volume) a dispersion of hydrophobic thermoplastic particles in a hydrophilic binder, the weight ratio of said polymer particles to said binder being at least 1:1,

b. the over-layer is information-wise heated and/or subjected to pressure except in the areas thereof that correspond with the graphic information to be reproduced, and thereby to bring about the action of required water-permeability differentiation,

c. the heated and/or pressed material is then treated with an aqueous liquid, which penetrates into the still appreciably water-permeable portions of the over-layer and consequently image-wise penetrates into the underlying emulsion layer(s), and by the action of said liquid a visible reproduction of the graphic information is formed or the conditions for obtaining such a reproduction are obtained.

The application of heat to the over-layer in correspondence with the graphic information to be reproduced can be achieved in different ways. Thus, it is possible to heat the over-layer by bringing it in contact with image markings of an original containing the graphic information to be reproduced and simultaneously exposing said markings to infrared or high-intensity visible radiation, which is absorbed by said markings and converted into heat. It is also possible to use for contact-heating heated relief printing blocks such as those used in letterpress printing.

When using metal letterpress dies, the heating may be carried out by means of a high-frequency alternating current passing through the parts of the overlayer brought into contact with the conductive relief parts of the die. In this case the backing of the processed recording material stands in contact with an electrode and the over-layer contains a sufficient amount of high-frequency heatable material, e.g., iron particles.

Selective internal heating of the over-layer used according to the present invention is, however, preferably realized by exposing an over-layer, containing infrared and/or visible light-absorbing substance(s) converting absorbed light into heat, to infrared radiation and/or visible light modulated according to the pattern to be reproduced.

Suitable compositions for preparing a heat-sensitive surface layer are described in the published Dutch Pat. application Nos. 6414226 and 6606719 and in U.S. Pat. No. 3,476,937 issued to one of the present inventors on Nov. 4, 1969.

Preferably the heat- and/or pressure-sensitive over-layer used in the present invention incorporates solid particles of hydrophobic thermoplastic polymeric material which have been applied as a latex. Recording layers as described in the specification of the published Dutch Pat. application No. 6414226 are suitable and as described in that specification the required information-wise heating can be achieved by placing the recording layer (in this case the over-layer) in heat-conductive contact with an original with infrared-absorbing indicia and irradiating the assembly with infrared radiation. It is much preferred however, in carrying out the present invention for the over-layer to contain a substance or a mixture of substances which absorb(s) electro-magnetic radiation and convert it into heat. Said substance(s) absorbing electromagnetic radiation preferably absorb visible light and infrared radiation, so that an information-wise exposure to such light or radiation provides the desired differentiation in water-permeability of the over-layer. Recording layers incorporating light-absorbing substance(s) and suitable for use as over-layers in carrying out the present invention are described in the specification filed in the published Dutch Pat. application No. 6606719. In such cases the exposure is preferably a short-duration-exposure not longer than 10^{-1} sec. The exposure must be sufficiently intense to effect the necessary decrease in water-permeability in the exposed areas. The sensitivity of the preferred surface layers is such that an exposure energy of only 0.3 Watt.sec/sq.cm is required for producing a practically useful differentiation in water-permeability.

Light-absorbing substances when used in the over-layer may, if desired be actually incorporated into the thermoplastic polymer particles as is per se described in the aforesaid published Dutch Pat. application No. **6606719**.

When using light-absorbing pigments in the heat-sensitive surface layer, the concentration of the pigment is preferably such that at least 80 percent of the copying light is absorbed.

A surface layer containing light-absorbing pigments converting the absorbed light into heat, may be easily removable after the etching or other "developing" step. The said layer may, e.g., be such that this removal can be effected by rubbing the whole layer while it is wet, e.g., by rubbing the layer with a sponge-like element soaked with water. The adherence of the surface or over-layer to the or an underlying emulsion layer or to a protective layer on the emulsion layer should not be such that the removal of the over-layer would impair the quality of the pictures. In order to acquire a sufficient but not too strong an adherence of the over-layer to an underlying colloid layer a choice can be made among different hydrophilic binding agents for the over-layer or a said underlying layer. Binding agents for the over-layer are preferably soluble in water at room temperature, e.g. poly(N-vinylpyrrolidone).

Details on the constitution and preparation of thermoplastic hydrophobic polymer particles especially suitable for use in the heat- and/or pressure-sensitive surface layer as well as in-

formation about the hydrophilic binding agents and light-absorbing substances can be found in the published Dutch Pat. application No. 6606719. The specification filed in this Pat. application is deemed to form part of the present disclosure.

The surface layer preferably contains at least 50 percent by volume of a dispersion comprising solid hydrophobic thermoplastic polymer particles dispersed in a hydrophilic binder as a continuous phase. It is coated and dried in such conditions that it is water-permeable at room temperature. The polymer particles being solid at room temperature preferably soften between 10° and 200° C above room temperature. It is very appropriate to use in the surface layer polymers having a melting point or glass transition point between 10° and 200° C above room temperature.

Latices, which are particularly suitable contain e.g., polyethylene and polyvinylidene chloride having a melting point of 110° and 190° C respectively, and the following polymers with their respective glass-transition temperatures : polystyrene (100° C), polymethyl methacrylate (comprised between 70° and 105° C), polyethyl methacrylate (50° C), polyvinyl chloride (near 70° C), polyacrylonitrile (near 100° C), poly-N-vinylcarbazole (200° C).

As is known, the glass-transition temperature can be lowered by the addition of plasticizers. Particulars about suitable plasticizers and the glass-transition temperature of homo- and copolymers can be found e.g., in Georges Champetier, Chimie Macromoléculaire - Généralitiés, Librairie Armand Colin - Paris Vème, p. 194–198. It appears therefrom that by copolymerisation or copolycondensation, a scale of glass-transition temperatures can be obtained according to the ratio of the monomer or condensation reagents used in the copolymerisation and copolycondensation respectively. Thermoplastic hydrophobic polymers covering a wise range of molecular weights may be used in materials according to the present invention both in the recording layer and in the interlayer. Polymers possessing a molecular weight ranging from 5,000 to 1,000,000 are preferred.

Polyethylene possessing a molecular weight of 15,000 to 50,000 was found to be very suitable. Of course, mixed dispersions of polymer particles may also be used.

Hydrophobic thermoplastic homopolymers and copolymers suitable for the manufacture of a top-coat to be used according to the present invention are preferably applied as an aqueous dispersion (latex) containing a hydrophilic binding agent. The aqueous dispersion of the homopolymer or copolymer is prepared preferably by radical polymerisation in emulsion of one or more polymerisable monomers according to known techniques, e.g., those described by W. Sörenson and T.W. Campbell, Preparative Methods of Polymer Chemistry, Interscience Publishers, New York, (1961). In this radical polymerisation use is made of dispersing agents such as those described by K. Laux, "Die Grenzflächenaktiven Stoffe" in Winnacker-Küchler's "Chemische Technologie" Carl Hanser Verlag, Munich (1960) p. 155–242.

Aqueous dispersions of polymers prepared by dispersing a solution of a water-insoluble polymer in a water-immiscible volatile solvent in an aqueous solution of a hydrophilic binding agent can also be used. Suitable solvents are, e.g., chlorinated hydrocarbons such as methylene chloride and trichloroethylene.

Further, polymer dispersions, which are appropriate for use in the said top coat can be obtained by mechanically dispersing in water finely divided polymer particles, preferably with the help of surfactants and/or hydrophilic protective colloids such as polyvinyl alcohol and gelatin. Latices obtained by emulsion polymerisation are preferred. In this polymerisation technique the monomer(s) is (are) dispersed by stirring it (them) to very fine droplets in the presence of water, emulsifiers such as soaps, ammonium oleate, sulphonated fatty alcohols and the like, protective colloids such as carboxymethylcellulose, polyvinyl alcohol and the like, a buffering system, a surfactant and a water-soluble catalyst, e.g., hydrogen peroxide or a persulphate. The polymer is obtained as a stable dispersion of polymer particles in water.

The size of the polymer particles in dispersion may, e.g. vary from 0.01 μ to 50 μ. However, in connection herewith it has to be noted that the larger the particles the less good the resolution is likely to be. Very good results are obtained with dispersions, the dispersed polymer particle size of which varies from 0.05 μ to 20 μ. Dispersions wherein the size of the dispersed particles varies from 1 μ to 0.001 μ are considered as colloidal systems. A colloidal system, the continuous phase of which is formed by water (dispersing medium) and the dispersed phase of which is formed by particles having a size varying from 1 μ to 0.001 μ, is called a hydrosol. Good results are obtained when using hydrosols, the hydrophobic thermoplastic polymer particles of which are not greater than 0.1 μ.

The ratio by weight of thermoplastic polymer particles to hydrophilic binder in the top layer is preferably greater than 1:1, more preferably greater than 3:2. The amount by weight of thermoplastic polymer particles comprised in the surface or top layer preferably varies from 0.5 g to 10 g/sq.m.

Surface layers used in the present invention preferably have a thickness from 0.5 μ to 10 μ.

The coating of the processed photographic material with the heat-sensitive surface layer can proceed in any way known for applying colloid layers from an aqueous medium e.g. by extrusion, roller coating, dip-coating or spraying. Processed recording materials whereon graphic information can be reproduced according to the principles of the present invention can be of any type although the technique of the present invention is especially adapted for use in combination with processed photographic silver halide materials of the black-and-white or color type. The said materials include mono- and multi-emulsion layer materials and can have flexible or rigid supports. The technique of the present invention is, however, particularly suited for high speed subtitling of motion pictures.

For high speed subtitling the surface layer used according to the present invention may contain preferably in water-insoluble state, substances that absorb copying light and transform said light into heat. Preferred substances absorbing visible light and infrared light and converting said light into heat are dark colored or black pigments, e.g., finely divided carbon black, graphite, prussian blue, oxides, sulphides or carbonates of heavy metals, particularly of those heavy metals having an atomic weight between 45 and 210, such as manganese or lead sulphide or these heavy metals themselves in finely divided state such as silver, bismuth, lead, iron, cobalt, and nickel.

According to a particular embodiment the heat-sensitive material can be made sensitive to light of a limited range of the visible spectrum. This can be done by incorporating into the heat-sensitive layer colored substances, which absorb light of a part of the visible spectrum and convert that light into heat as described in the published Dutch Pat. application No. 6606719 aforesaid.

It is to be understood that mixtures of said colored substances can be used too, so that light of the whole visible spectrum is absorbed. The said substances need not necessarily absorb in the range of the visible spectrum alone, they may also absorb to some extent infrared light, which light is normally produced to some extent by flash lamps.

When in dispersed form, the copying light absorbing substances have preferably a particle size not greater than 0.1 μ.

If the surface layer contains substance(s), which absorb(s) copying light (infrared radiation and/or visible light) and convert(s) it into heat, a contact exposure of high intensity and short duration (preferably less than 10^{-1} sec.) is applied preferentially. The original is preferably a positive transparency of the text to be recorded, which transparency during the exposure is held in intimate contact with the heat-sensitive surface layer. As a result of the short duration-exposure the heat accumulated in the image-markings of the transparency cannot diffuse into the surface layer, which is heated only internally by the light absorbed in the light-absorbing substances contained therein.

Suitable radiation sources producing copying light that can be converted into heat necessary for image-wise impermea-

bilizing the surface layer containing light-absorbing substances, which convert the copying light into heat, are so-called flash lamps. Good results are obtained with xenon gas discharge lamps with an exposure time of 10^{-5} to 10^{-2} seconds. These flash lamps emit a larger part of visible light than of infrared radiation. Details on a copying device containing such a discharge lamp can be found in the Belgian Pat. specification No. 664,868.

If the emitted energy is focused onto a relatively small heat-sensitive area, e.g., of the size of one picture on a motion picture film, a gas discharge lamp with a relatively low energy output can be used. For instance for copying a text on an area 19 mm × 35 mm of a motion picture film, a flash lamp with an energy output of 40 Watt.sec. will suffice. For heat-sensitive surface layers having an optical density of at least 1, resulting from the presence in the recording layer of light-absorbing substances, a light energy of at least 0.1 Watt.sec/sq.cm is required to produce the desired image differentiation. In practice, an exposure of 0.3 Watt. sec/sq.cm provides satisfactory results.

Self-evidently, the heat-sensitive surface layer can before or during the production of the image-wise heat differentiation be subjected to an overall heating to a certain temperature below the temperature at which a substantial decrease in permeability to water takes place. In this way, less image-wise supplied heat energy is required to produce the desired reduction in water-permeability.

After production of the image0-wise differentiation in permeability for water of the surface layer and said layer is preferably contacted with an aqueous liquid, which is e.g. active towards the binder of the emulsion layer, and/or the image silver or the dyes present in the underlying developed emulsion layer(s).

The desintegration of the binder of the emulsion layer and surface layer e.g. gelatin, the etching of image silver and/or the bleaching of dyes present in the processed silver halide emulsion layer(s) can be carried out by means of an aqueous solution of an hypochlorite of an alkali or alkaline earth metal.

As an illustration of the sub-titling process of a movie film according to the invention, a diagrammatic section, represented in the Figure, is given of a processing unit, which is suited for continuous sub-titling. In said diagram the movie film **1**, e.g. a positive black-and-white or a color movie film, is unwound from a take-off roll **2** and by means of the guiding roller **3**, **4** and **5** introduced into a coating tray **6** wherein the emulsion side of the movie film **1** is coated with a composition **7**, which on drying in the ventilated drying channel **8** yields a heat-sensitive surface coating of the type described hereinbefore.

The movie film coated with its heat-sensitive surface layer is exposed with a flash lamp **9** through a diapositive **10** of the text to be reproduced. A smooth flat backing plate **11** serves for securing a close adjustment with the diapositive. After the exposure the movie film is introduced by the guiding rollers **12**, and **13** into the etching bath **15** containing an etching solution **16** e.g. an aqueous sodium hypochlorite solution, removing the silver or dye occasionally together with the binder of the emulsion layer(s) and heat-sensitive coating in the areas corresponding with the non-flash-exposed portions of the heat-sensitive surface layer. The removal of the residual portions (the flash-exposed portions of the recording layer) proceeds by washing and rubbing in a rinsing bath **19**, containing the guiding rollers **17** and **18** and wherein water **20** continuously streams through and wherein a rubbing roller **21** rotates in rubbing contact with the surface layer in opposite direction to the motion direction of the film. Subsequently, the film is dried in a drying channel **22** and wound up on a take-up roller **23**.

When sub-titling negative pictures with an opaque sub-title as already described above, an opaque over-layer is heated or pressure-treated in correspondence with the image parts of the sub-title to be reproduced and the non-heated and non-pressure-treated portions respectively of the over-layer are removed so as to leave an opaque relief pattern of the opaque over-layer representing the desired sub-title information.

The following examples illustrate the present invention without, however, limiting it thereto.

Example 1

A coating composition according to the invention was prepared by mixing the following ingredients while stirring weakly:

40 % aqueous colloidal dispersion of polyethylene having a particle size less than 0.1 μ and an average molecular weight between 15,000 and 30,000	**1000** ccs
water	1500 ccs
10 % aqueous solution of polyvinyl pyrrolidone	500 ccs
aqueous carbon dispersion containing pro 100 g 16 g of carbon, 2 g of polyvinylpyrrolidone and 2 g of water	500 ccs
ethyl alcohol	750 ccs
hexylene glycol	50 ccs

This composition was dip-coated on the image-containing emulsion layer of a photographic material at a rate of 40 g/sq.m and dried.

The top layer was brought into intimate contact with a transparent positive image of the sub-title. The thus obtained sandwich was exposed through the sub-title-image to a flash lamp producing 0.6 watt.sec/sq.cm in 3.10^{-4} sec. After exposure the photographic material to be sub-titled and the positive sub-title image were separated. The photographic material was dipped for **15** sec. in a solution comprising 300 parts of potassium hypochlorite and 100 parts of water at 40° C, whereby a selective removal of the top coating and the emulsion layer in correspondence with the non-flash-exposed portions took place. The photographic material was lead into a water-bath at room temperature wherein the residual parts of the top coating were removed with a rubbing roller. After removal of said top coating parts the material was dried.

Example 2

The coating composition was the same as in example **1**, except for the polyvinyl pyrrolidone solution, which was replaced by an animal glue solution. The coating and exposure techniques were identical with those of example **1**. After exposure the photographic material was dipped into a conventional photographic bleaching bath and afterwards rinsed with tap water. The top coating was removed and the material was dried.

We claim:

1. A method of recording graphic information on a photographic emulsion layer in a photographic material bearing a visible developed photographic image comprising the steps of coating said photographic material on its emulsion side with a water-permeable overlayer, which by the action of heat and/or pressure undergoes a loss in permeability to water, applying a pattern of heat and/or pressure according to said information, said overlayer consisting essentially of a dispersion of solid hydrophobic thermosplastic polymer particles in a hydrophilic colloid binder in a weight ratio of at least about 1:1, said layer being removable by chemical degradation of said colloid binder in the unexposed water-permeable areas thereof upon treatment with an aqueous bleaching solution for said developed photographic image, contacting said overlayer with an aqueous bleaching solution which penetrates the areas of unchanged water-permeability of said overlayer and removes both said permeable areas of said overlayer and the developed image in said emulsion layer in the areas thereof corresponding to said water permeable areas of said overlayer, and thereafter rubbing the photographic material while wet with an aqueous liquid to remove the remaining areas of said overlayer.

2. The method of claim **1** wherein said emulsion layer includes a hydrophilic colloid binder and said bleaching solution chemically degrades the binder in both layers.

3. A method of recording and reproducing graphic information according to claim 2, wherein the said over-layer contains said dispersion in a ratio by volume of at least 50 percent.

4. A method of recording and reproducing graphic information according to claim 1, wherein said particles are synthetic polymer particles prepared by emulsion polymerization.

5. A method of recording and reproducing information according to claim 2, wherein the hydrophilic binder is soluble in water.

6. A method of recording and reproducing information according to claim 1, wherein the said over-layer contains an infrared and/or visible light-absorbing material converting absorbed light into heat.

7. A method of recording and reproducing information according to claim 6, wherein the said over-layer due to the presence of said light absorbing material absorbs at least 80 percent of the light to which it is exposed.

8. A method of recording and reproducing information according to claim 6, wherein said substance is finely divided carbon.

9. A method of recording and reproducing information according to claim 6, wherein said substance is present in dispersed state and has a particle size not greater than 0.1 μ.

10. A method of recording and reproducing information according to claim 1, wherein the said over-layer is irradiated with electro-magnetic radiation in accordance with the non-image parts of graphic information to be recorded and wherein the over-layer contains or stands in heat-conductive relationship with at last one substance which absorbs in the recording material at least some of the light which irradiates such materials, and consequently yields heat energy; and the intensity and duration of the light radiation with which said material is irradiated is such that in consequence of the said absorption of light and yield of heat energy in the recording layer, the areas of said overlayer undergo a substantial decrease in water-permeability in accordance with the non-image parts of graphic information to be recorded.

11. A method of recording and reproducing information according to claim 10, wherein the image markings of the original during the exposure are in contact with the said surface layer.

12. A method of recording and reproducing information according to claim 11, wherein the said over-layer is irradiated for a period less than 10^{-1} second and with an energy of at least 0.1 Watt.sec/sq.cm.

13. A method of recording and reproducing information according to claim 10, wherein the exposure is carried out with light composed entirely of or substantially entirely of light waves with wavelengths less than 700 μ.

14. A method of recording and reproducing information according to claim 1, wherein the photographic material which is coated with said over-layer is a positive black-and-white or positive color motion film and the graphic information to be recorded is a sub-title.

15. A method of recording and reproducing information according to claim 1, wherein the already processed photographic material is a black-and-white or color motion picture film containing negative images, and the over-layer is a black or colored opaque surface layer, which is exposed to heat and/or pressure in such a way that the parts of the surface layer that correspond to the image parts of the sub-title become less soluble in an aqueous liquid and the non-image parts are removed so as to leave a black or colored opaque relief pattern representing the sub-title on the said film.

16. A method of recording said reproducing information according to claim 1, wherein the binder of the over-layer is poly(N-vinyl-pyrrolidone) and the binder of a silver halide emulsion layer of the developed photographic material is gelatin.

17. A method of recording and reproducing information according to claim 1, wherein the aqueous liquid for treating the over-layer contains a hypochlorite of an alkali or alkaline earth metal.

* * * * *