United States Patent [19]

Luebbe, Jr.

[11] **3,861,911**

[45] **Jan. 21, 1975**

[54] **IMAGE FIXING METHOD**

[75] Inventor: **Ray H. Luebbe, Jr.,** Rochester, N.Y.

[73] Assignee: **Xerox Corporation,** Stamford, Conn.

[22] Filed: **Sept. 28, 1972**

[21] Appl. No.: **293,225**

[52] **U.S. Cl.** ..... **96/1.4,** 117/17.5, 96/27 R, 96/35.1, 96/43

[51] **Int. Cl.** **G03g 7/00**

[58] **Field of Search** ..... 96/1.4, 50 PL, 43, 27 R, 96/35; 117/17.5

[56] **References Cited**

UNITED STATES PATENTS

2,751,315 6/1956 Staeble ..... 96/50 PL

3,443,946 5/1969 Grabhofer ..... 96/50 PL

Primary Examiner—Norman G. Torchin
Assistant Examiner—John L. Goodrow

[57] **ABSTRACT**

A method of fixing images and particularly images employed as film titles. Images are fixed by coating them with a tacky photopolymerizable layer which is substantially transparent to visible light when polymerized and then exposing the coating to actinic radiation whereby the coating polymerizes to form a non-tacky substantially transparent coating over the image.

8 Claims, 7 Drawing Figures

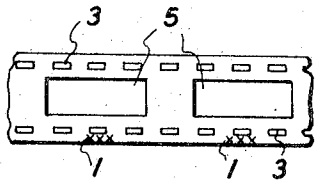


FIG. 1a

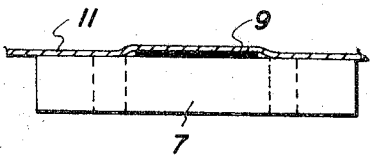


FIG. 2

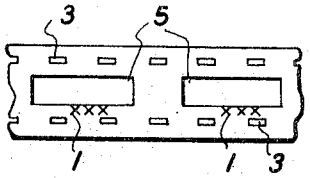


FIG. 1b

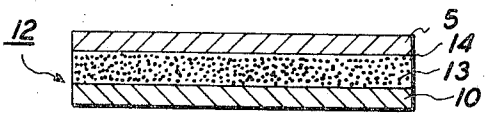


FIG. 3

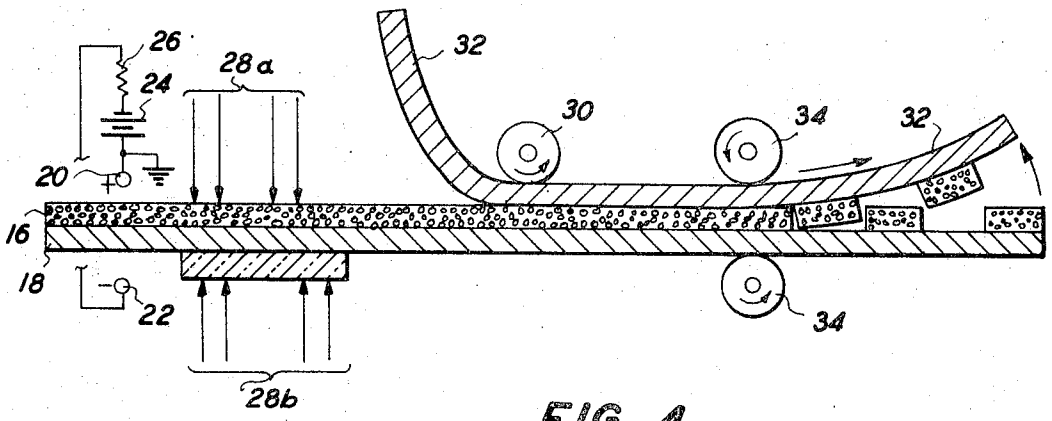


FIG. 4

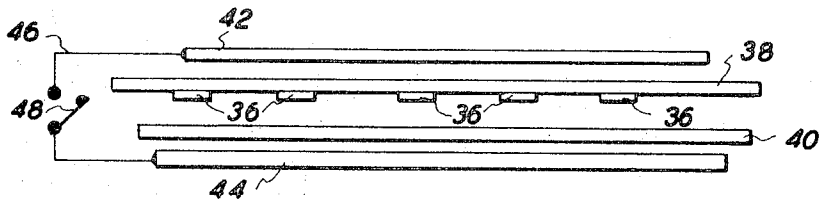


FIG. 5a

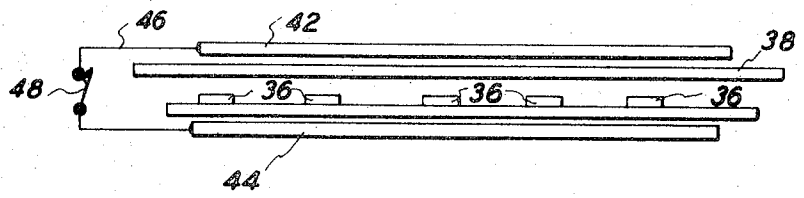


FIG. 5b

IMAGE FIXING METHOD

BACKGROUND OF THE INVENTION

The present invention relates to a method of fixing images and certain images so fixed. More particularly the invention relates to the method of titling motion picture film.

Various methods for titling processed silver halide and color films are known. In most techniques the titling is accomplished by the imagewise removal of the silver halide emulsion layer on the film. In some instances 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 their relief. Another method is to apply to the imaged side of a processed photographic film a water permeable overlayer which by the action of heat and/or pressure becomes less permeable or impermeable to water. By proper treatment the layer becomes imagewise differentiated and is selectively removed from the film to affect at least one underlying layer in such a way that a visible record is thereby formed or can be formed by subsequent non-differential treatment of the photographic material.

In recent years several imaging systems have been discovered which provide convenient methods for forming and transferring images produced thereby. Such recently discovered processes are described in the art as for example in U.S. Pat. Nos. 3,384,556 to Clark; 3,384,565 and 3,384,488 to Tulagin et al which patents are hereby incorporated by reference. These patents describe what is known as a photoelectrophoretic color imaging system whereby mono- and polychrome images can be produced through a single exposure of particles which migrate in response to light of specific wave lengths. Another imaging system generally known as a layer transfer method and termed the manifold imaging method is described in copending U.S. Application Ser. No. 708,380 filed Feb. 26, 1968 now U.S. Pat. No. 3,707,368 to Van Dorn. There is disclosed therein an imaging system which employs an imaging member comprising an electrically photosensitive imaging layer between a pair of sheets. The imaging layer is generally described as being structurally fracturable in response to the combined effects of an applied electric field and exposure to electromagnetic radiation to which the layer is sensitive. An electrical field is applied across the manifold sandwich while it is exposed to a pattern of light and shadow representative of the image to be reproduced. Upon separation of the sheets while under an electric field the imaging layer fractures along the lines defined by the pattern of light and shadow to which the imaging layer has been exposed. Part of the imaging layer is transferred to one of the sheets while one of the remainder retained on the other sheet so that a positive image, that is, a duplicate of the original is produced on one sheet while a negative image is produced on the other.

Yet another recently discovered imaging process involves the use of an imaging member having a substrate upon which is coated a softenable material which material is in contact with migration material. This migration imaging method is embodied in several different imaging members and methods and is generally described in copending applications Ser. Nos. 837,780

and 837,591 both filed on June 30, 1969. According to this method, migration material is caused to migrate in depth through the softenable layer to the substrate of the imaging member. For use in accordance with the present invention the unmigrated material is separated from the migrated material by various methods disclosed in said applications leaving an image pattern of migration material on the substrate. Such images are then employed herein. The migration imaging method described in the above two applications are particularly useful in microimaging.

Another imaging method well-known in the art is the xerographic method whereby an image is produced by selectively discharging a photoconductive member and developing the latent electrostatic image with particulate material. The developed image is then transferred from the photoconductive member and employed herein.

All of the above imaging methods produce desirable images for use in titling film but in some instances such images must be very securely fixed to the film substrate. The image fixing art generally employed has been found unsatisfactory in the certain film titling because the film is treated with a cleaning agent, which agent removes the fixative together with the image. For this reason the prior art of film titling has relyed upon the use of the image silver in the emulsion layer of the film to provide the subtitling as well as the image.

SUMMARY OF THE INVENTION

Accordingly it is an object of this invention to provide a novel method of titling motion picture film.

Another object of this invention is to provide a film titling method which does not rely upon the image emulsion of conventional silver halide film to provide the titling image material.

These and other objects of this invention will be apparent from the following description of the invention.

In accordance with the present invention there is provided film having at or near one of its margins an area clear of photographic emulsion and suitable for the application of titles. Images previously produced by one of the various imaging methods known in the art are transferred to said clear areas of the film. Subsequent to such transfer the image is fixed by means of applying thereto a coating of photopolymerizable material and then exposing such material to actinic radiation whereby the coating polymerizes thus fixing the image to the film.

Of course, the photopolymerizable material must be such that subsequent to photopolymerization the coating is at least partially transparent to visible light so that the image fixed thereby can be readily viewed in conjunction with viewing the image to which the title refers.

The method of forming images and transferring them to the film of this invention are readily discernable from the prior art. Thus if one desires to employ the photoelectrophoretic imaging method one merely prepares an imaging suspension as described in the above cited U.S. Pat. Nos. 3,384,566; 3,384,565 and 3,384,488 with respect to photoelectrophoresis and performing the imaging method also described therein. The transfer method is performed in accordance with the transfer methods described in said patents. For example images produced by the photoelectrophoretic method may be transferred by the method described in

U.S. Pat. No. 3,384,488 at column 11. It is therein desclosed that such images may be transferred by adhesive tape or by electrostatic transfer using an electrode held at a potential opposite in polarity to that of the electrode upon which the image was formed in accordance with the photoelectrophoretic process.

Similarly the images produced by the migration process of U.S. applications Ser. Nos. 837,780 and 837,591 may be transferred after formation by adhesive transfer or by known prior art methods for transferring particulate images such as in xerographic art. A particularly convenient method of transferring powder images is found in U.S. Pat. No. 3,004,860 to Gundlach. The aforementioned applications and patents are hereby incorporated by reference.

One particularly convenient method for forming and transferring images to be used in the present method and film are made by the layer transfer imaging method commonly termed the manifold imaging method described in U.S. Application Ser. No. 708,380 mentioned above and which application is hereby incorporated herein by reference. In addition the manifold imaging process described in U.S. Pat. No. 3,598,581 to Reinis, incorporated herein by reference, is advantageous in producing images for use in this invention. Images made in accordance with the manifold imaging process may be transferred by several methods such as by pressure transfer described in copending application Ser. No. 809,328 filed Mar. 21, 1969 which application is hereby incorporated herein by reference.

Other methods of transferring images as produced by the manifold imaging process are described in copending application Ser. No. 886,838 filed Dec. 22, 1969, now U.S. Pat. No. 3,706,553 to Menz, and in U.S. Pat. No. 3,658,519 to Menz. These transfer methods employ the residual electrostatic charges remaining in the images produced by the manifold imaging process and by rearrangement of the electrical forces the image is conveniently transferred with high fidelity. The aforementioned application and patent are hereby incorporated herein by reference.

All of the above transfer methods suitable for use to transfer the images made by the various processes mentioned above are useful in this invention to provide the placement of the image on the film of this invention. Once the film is provided with the graphic information making up the subtitle and title of the film. The images are then fixed by coating them with materials which photopolymerize to produce a substantially transparent coating which adheres to the image and the substrate thus protecting the images from the elements to which the film is exposed.

This invention is particularly useful in producing films which are microimages and require enlargement to an extraordinary degree. In such cases the films are treated or cleaned in solvents which would otherwise remove images not protected. Thus the images fixed in accordance with the method of this invention are capable of withstanding severe solvents such as trichloroethylene, a common solvent employed to clean photographic film. Thus in accordance with this invention the prior art methods of laboriously using the silver halide emulsion to provide not only the image but also the title for the film is avoided. Also a convenient and effective method is provided for employing images of many different materials which can be transferred to the film in proper form.

While any photopolymerizable compositions which provides an at least partially transparent film subsequent to the polymerization step can be employed, typical and easily obtainable compositions are ethylenically unsaturated compounds such as polyalkylene glycol diacrylates prepared from an alkylene glycol having two to 15 carbon atoms or a polyalkylene ether glycol of from one to 10 ether linkages, vinylidene compounds, the esters and amides of alpha-methylene carboxylic acids and substituted carboxylic with polyols and polyamines wherein the molecular chain between the hydroxyls and amino groups is solely carbon or oxygen-interrupted carbon. More specifically, polymerizable material useful in this invention are ethylene diacrylate, diethylene glycol diacrylate, glycerol diacrylate, 1,3-propanediol dimethacrylate, 1,4-cychohexanediol diacrylate, 1,4-benzenediol dimethacrylate, pentaerythritol tetramethacrylate, the bis-acrylates and methacrylates of polyethylene glycols of molecular weight 200–500 and the like; unsaturated amides such as alpha-methylene carboxylic acids, alpha, omega-diamines and oxygen interrupted omega-diamines such as methylene bis-acrylamide, methylenebis-methylacrylamide, 1,6-hexamethylene bis-acrylamide, diethylene triamine tris-methyacrylamide and the like. Many other such compounds are described in the art such as in U.S. Pat. Nos. 3,060,024; 3,060,025 to Burg et al. 3,060,026 to Heiart, 3,458,311 to Alles and 3,615,480 to Lamb; all of the above patents being hereby incorporated by reference.

Of course suitable polymerization initiators activatable by actinic light must be employed in the coatings of this invention. Such initiators must not render the coatings of this invention opaque subsequent to polymerization but otherwise the usual initiators known in the art to be useful with various photopolymerizable materials can be employed. Typical of such addition polymerization initiators are substituted and unsubstituted polynuclear quinones such as 9,10-anthraquinone, 1-chloroanthraquinone, octamethyl anthraquinone, 1,4-naphthoquinone, 9,10-pheneanthrenequinone, 2,3-dichloronepthalquinone, 1,4-dimethylanthraquinone, 2-phenylanthraquinone and the like. Other initiators include vicinal ketaldonyl compounds such as diacetyl benzil; alpha ketaldonyl alcohols such as benzoin, pivaloin; acyloin ethers such as benzoin methyl ethers and substituted aromatic acyloins including alpha-methyl benzoin, alpha-allylbenzoin and alpha-phenyalbenzoin.

In addition thermal polymerization inhibitors known in the art such as p-methoxyphenol is included for extended shelf life of the photopolymerizable materials.

The above mentioned photopolymerizable materials are usually contained in a vehicle such as a thermoplastic polymer having properties suitable for the intended use with respect to flexibility, thermostability and light stability. Typically suitable thermoplastic polymers include polyesters, copolyesters, polyamides, vinylidene chloride copolymers, ethylene/vinyl acetate copolymers, cellulose ethers, polyethylhene polyacrylate and alpha-alkyl polyacrylate esters, polyformaldehydes, polyurthanes, polycarbonates and polystyrenes. Of course such polymers must be selected on the basis of providing some degree of transparency of the coating such that the image material being protected by the coating is made visible suitably for use as the film is intended.

In the preferred embodiment of this invention the title or subtitle of a film, once having been transferred to the film, is protected by applying a strip of photopolymerizable material in a thermoplastic resin which material is resting upon its own substrate or base. Thus, a strip of the material can be placed over the titles to be protected and the polymerization process carried out by exposing the polymerizable material to actinic radiation through its own base. After the polymerization process is completed the base is easily stripped away from the coating leaving the film with a clear, flexible, transparent coating over the titling. A particularly preferred material is a product sold under the tradename Riston by the E. I. DuPont de Nemours and Company. The availability and the handleability of the Riston film makes it particularly advantageous for use in the present invention. The photopolymerizable material is easily handled in the same manner that transparent cellophane tape is handled thus the application is the image to be protected is accomplished without cumbersome mechanism. Subsequent to the polymerization process the photopolymer substrate is removed and discarded.

DESCRIPTION OF THE DRAWINGS

Having stated by reference to the accompanying drawings wherein:

FIGS. **1**, **1***a* are plan views of film strips which have been subtitled in accordance with the present invention.

FIG. **2** is a diagrammatical cross sectional view of a titled and fixed film in accordance with this invention.

FIG. **3** is a side sectional view of a photosensitive imaging member employed in the manifold imaging method for producing images which are to be employed as the titles on film in accordance with this invention.

FIG. **4** Is a side sectional view diagrammatically illustrating the process steps of the manifold imaging method whereby images suitable for titling are produced.

FIGS. **5**A and B are expanded side sectional views of an image transfer set prior to and after transfer of an image produced in accordance with the manifold imaging process.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a portion of a sprocket apertured film which has been subtitled along the edge thereof according to the present invention. The film may be of any conventional size as for example 16mm, 35mm and 70mm. Subtitling information **1** in the margin outside sprocket apertures **3** identifies each film frame image **5.** Thus the method of this invention provides subtitles as well as titles to film material.

FIG. **2** shows film base **7** carrying titling information **9** which has been coated with a layer of photopolymerizable material **11.** Layer **11** is easily converted to a tenacious, flexible protective coating over indicia **9** by exposing the layer to actinic radiation.

FIG. **3** in expanded view shows a manifold imaging member employed in the manifold imaging process to produce an image which can be transferred to film substrate **7.** In FIG. **3** there is shown a donor layer **10** supporting an imaging layer **12** comprising electrically photosensitive particles **13** dispersed in an insulating binder material **14.** Over imaging layer **12** is receiver **15.** This imaging member is employed in a process wherein the imaging layer is subjected to an electric field and is then exposed to electromagnetic radiation to which the imaging layer is sensitive.

In FIG. **4** there is shown a diagrammatical view of the manifold imaging method, one of the methods for producing images employed as titles on film. In FIG. **4** imaging layer **16** is residing upon donor layer **18.** An electrical field is applied across the imaging layer through electrodes **20** and **22** which are connected to potential source **24** through resistor **26.** Although FIG. **4** shows the manifold imaging layer not coming in contact with either electrode **20** or **22** they may contact one or both electrodes when the electrical field is applied. Preferably, the sandwich will contact at least one electrode to serve as a guide and be spaced 1 to 3 mills from the other electrode to prevent binding.

Alternatively, the charging electrode may be a corona discharge device or rollers.

The sign of the charge on the electrodes **20** and **22** may also be reversed, electrode **20** being the negative electrode on the coated surface of the donor sheet. After placing an electric field across the imaging layer the imaging layer is exposed to electromagnetic radiation **28***a* or **28***b*. That is the imaging layer may be exposed from either side providing donor layer **18** as transparent. After imaging, a receiver layer is placed in contact with the imaging layer by roller **30.** Alternatively, the imaging layer may be exposed to electromagnetic radiation **28***a* or **28***b* depending upon the convenience of the particular system. Subsequent to placing the receiver layer on the imaging layer. For example, if donor layer **18** is transparent to the electromagnetic radiation being employed, preferably the imaging layer is exposed to the donor layer **18.** If donor layer **18** is opaque to the electromagnetic radiation, the imaging layer may be exposed directly as shown or through receiver layer it is transparent. Also, as shown, the potential may be applied across both donor layer **18** and receiver layer **32**; and, the process is carried out as above described the electric field is extended across the manifold sandwich prior to the separation to the donor layer **18** from receiver layer **32.** This may be conveniently accomplished by grounding both rollers **34.**

To form the image, receiver **32** is separated from donor layer **18** whereby the imaging layer fractures an imagewise configuration forming a negative image on one of the sheets and a positive image on the other. In most cases a positive image forms on the donor layer. Imaging layer **16** fractures because of its cohesively weak structure. That is, layer **16** is cohesively weak such that the adhesive forces between the imaging layer and the donor and receiver layers overcome the cohesive forces of the imaging layer such that upon separation of the donor and receiver layers the imaging layer fractures in imagewise configuration. Stated a different way the imaging layer is described as being structurally fracturable in response to the combined effects of an applied electric field and exposure to electromagnetic radiation to which the layer is sensitive. The aperture described in my copending application Ser. No. 104,340 can be advantageously employed in the method of this invention and said application is hereby incorporated by reference.

FIGS. **5** and **5***a* are expanded side sectional views of an image transfer set. Although any image can be transferred by many known methods it is the preferred method of this invention to transfer images produced

by the manifold imaging method herein below described.

Images produced in accordance with the manifold imaging process retain electrostatic charges on both the substrate and the film which is to be titled with the image produced by the manifold imaging process.

While FIGS. 5*a* and 5*b* are expanded in order to facilitate the explanation of the process of this invention, it is to be understood that in actual operation the elements of the image transfer sandwich are in contact with each other in the order shown in FIGS. 5*a* and 5*b*.

In FIG. 5*a* there is provided releasable imaging material **36** sandwiched between electrically insulating image bearing medium **38** and electrically image receiving medium **40** which, in this instance, is the film to be titled. The sandwich resides between conductive layers **42** and **44.** Prior to being incorporated into the set, imaging material **36** and medium **38** have been electrically charged positive with respect to the upper surface of image bearing medium **38** which has been charged negative. Referring now to FIG. 5*b*, when image transfer is desired, an electrical connection is made between conductive layer **42** and conductive layer **44** by means of wire **46** through switch **48.** FIG. 5*b* illustrates the imaging material **36** adhering to the film **40** leaving image bearing medium **38** free of imaging material.

DESCRIPTION OF PREFERRED EMBODIMENTS

The following examples further specifically illustrate the present invention. The examples below are intended to illustrate various preferred embodiments of the image transfer process of this invention. The parts and percentages are by weight unless otherwise indicated.

EXAMPLES I–IV

There is first prepared images comprising a dielectric material which retains an electric charge by means of the manifold imaging process as follows:

A commercial, metal-free phthalocyanine is first purified by acetone extraction to remove organic impurities. Since this extraction step yields the less sensitive beta crystalline form, the x-form is obtained by the procedure described in Example I of U.S. Pat. No. 3,357,989. The x-form phthalocyanine thus produced is used to prepare the imaging layer according to the following procedure: 5 grams of Sunoco 1290, a microcrystalline wax with a melting point of 178°F. is dissolved in 100 cc. of reagent grade petroleum ether heated to 50°C. and quenched by immersing the container in cold water to form small wax crystals. Five grams of the purified and milled phthalocyanine produced according to the above procedure are then added to the wax paste along with one-half pint of clean porcelain balls in a 1 pint mill jar. This formulation is then ball milled in darkness for 3½ hours at 70 r.p.m. and after milling 20 cc. of Sohio Solvent 3440 is added to the paste. This paste is then coated in subdued green light on a 1 mil Mylar sheet with a No. 12 wire-wound drawdown rod which produces a 2.5 micron thick coating (Example I) after drying. The same paste is also applied on three other Mylar sheets with a No. 8 drawdown rod to produce a coating thickness of 1 ½ microns (Example II), with a No. 24 rod to produce a coating thickness of 5 microns (Example III) and a No. 36 rod to produce a coating thickness of 7 ½ microns (Example IV). Each of these coatings is then heated to about 140°F. in darkness in order to dry it. Then the coated donors are placed on the tin oxide surface of NESA glass plates with their coatings facing away from the tin oxide. A receiver sheet, also of 1 mil thick Mylar, is then placed on the coated surface of each donor. A sheet of black, electrically conductive paper is then placed over the receiver sheet to form the complete manifold set. The receiver sheet is then lifted up and the imaging layer is activated with one quick brush stroke of a wide camel's hair brush saturated with Sohio Odorless Solvent. The receiver sheet is then lowered back down and a roller is rolled slowly once over the closed manifold set with light pressure to remove excess activator. The positive terminal of an 8,000 volt d.c. power supply is then connected to the NESA coating in series with a 5,500 megohm resistor and the negative terminal is connected to the black opaque electrode and grounded. With the voltage applied, a white incandescent light image is projected upward through the NESA glass using a Wollensak 90 mm., f 4.5 enlarger lens with illumination of approximately 2.5 foot-candle applied 0.1 second for a total incident energy of 0.25 foot-candle seconds. After exposure, the receiver sheet is peeled from the set with the potential source still connected. The small amount of activator present evaporates within a second or so after separation of the sheets yielding a pair of excellent quality images with a duplicate of the original on the donor sheet and a reversal of the original on the receiver sheet in each case.

In the absence of actinic radiation each of the positive images produced as described above residing on the two mil Mylar imagebearing medium are placed on 1 mil thick Mylar film to be titled immediately after being produced. The film is resting upon a sheet of aluminum and a second sheet of aluminum is laid upon the Mylar imagebearing medium. A short length of **14** gauge copper wire equipped with spring clamps on each end is then attached one end to each aluminum sheet. Immediately after attaching the clips, the Mylar image bearing medium and the Mylar image receiving medium are separated by hand. Each of the four images produced as described above are transferred totally to the film leaving the original imagebearing Mylar sheet substantially free of image material. The images on the film receiver are fixed by heating the imaging material slightly to remove excess activator which was originally applied to the imaging material during their production by means of a manifold imaging process. All of the images thus transferred retain the density and resolution of the image originally produced on the Mylar imagebearing medium.

EXAMPLE V

The film bearing the image of Example I above is then processed by first cleaning the film with trichloroethylene. It is found that the solvent employed in the cleaning operation substantially destroys the image although it was for other purposes well-fixed.

EXAMPLE VI

The film bearing the image of Example IV is treated with a fixative by spraying it with a 20 percent solution of a styrene-vinyl toluene copolymer available commercially under the trademark Piccotex 100 from the Pennsylvania Industrial Chemical Company. After evaporation of the solvent the image is found to be

coated with the plastic and is very well fixed to the film. The film is then processed as in Example V. The solvent is found to have removed the plastic coating as well as the image from the film.

EXAMPLE VII

The films bearing the image produced in accordance with Examples II and III above are further processed by coating the titles with a photopolymerizable material as follows: The photopolymerizable material commercially sold under the tradename Riston as mentioned above, is placed over the titles much in the manner one would place cellophane adhesive tape over the titles as the product provides a tacky layer supported by a clear substrate. Sufficient material is positioned over the title images and the film is subjected to electromagnetic radiation actinic to the photopolymerizable material by exposing it through the Riston substrate to an ultraviolet light source which polymerizes the layer of Riston. The photopolymerizable material has hardened to a clear tenacious layer on the film and the substrate is removed. These films are then processed for viewing by cleaning them with trichloroethylene and, upon viewing, the individual frames are found to be provided with well-fixed titles.

Although specific components and proportions have been stated in the above description of the preferred embodiments of the invention, other typical materials as listed above if suitable may be used with similar results. In addition, other materials may be used to centergize, enhance or otherwise modify the properties of the materials described above.

Other modifications and ramifications of the present invention will occur to those skilled in he art upon reading the present disclosure. These are intended to be included within the scope of the invention.

What is claimed is:

1. A method of titling film comprising:

a. forming an image by means of the manifold imaging process;

b. transferring said image to said film;

c. providing an unpolymerized photopolymer residing on a substrate substantially transparent to actinic light for said photopolymer;

d. applying said photopolymer on said substrate to said image;

e. substantially uniformly exposing said photopolymer to actinic light through said substrate whereby said photopolymer substantially uniformly polymerizes; and

f. removing said substrate from said polymerized photopolymer.

2. The method of claim **1** wherein said image is tranferred from an insulating imagebearing medium to said film by charging the surface of said image and said imagebearing medium to a transfer voltage, contacting said image with said film, providing a conductive path between the exposed surfaces of said imagebearing medium and said film whereby said exposed surfaces are brought to the same potential while at said potential separating said film from said imagebearing medium whereby said image adheres to the film.

3. A method of claim **1** wherein the photopolymerizable material comprises (a) a thermoplastic polymer compound (b) a non-gaseous ethylenically unsaturated compound containing at least one terminal ethylenic group, being capable of forming a high polymer by free radical initiated, chain propagating addition polymerization and having a plasticizing action on said thermoplastic polymer said constituents (a) and (b) being present in amounts of from 3 to 97, and 97 to 3 parts by weight, respectfully.

4. The method of claim **1** wherein the substrate is polyethylene terephthalate.

5. The method of claim **1** wherein the photopolymerizable material comprises (1) about 15 – 90 percent by weight by at least one ester of an ethylenically unsaturated acid and pentarerythritol, dipentaerythritol, or a polypentaerythritol; (2) about 10 to about 85 percent by weight of aryl sulfonamideformaldehyde resin; and (3) about one to about 25 percent by weight of the photoinitiators selected from the group consisting of acyloin and acyloin derivative.

6. The method of claim **5** wherein the photoinitiator is benzoin methyl ether.

7. The method of claim **5** wherein from about 30 to about 70 percent of the photopolymerizable composition is dipentaerythritol hexacrylate.

8. The method of claim **1** wherein the photopolymerizable composition comprises (1) about 15 to 90 percent by weight of at least one ester on an ethylenically unsaturated acid and pentaerythritol, dipentaerythritol, or a polypentaerythritol (2) about 10 to about 85 percent by weight of cetyl vinyl ether; and (3) about 1 to about 25 percent by weight of a photoinitiator selected from the group consisting of acryloin and acyloin derivatives.

* * * * *