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PACIFICATION OF IMAGE RECORDING MEDIA COMPRISING
APPLYING A THIN POLYMER FILM OVER THE
IMAGE SURFACE
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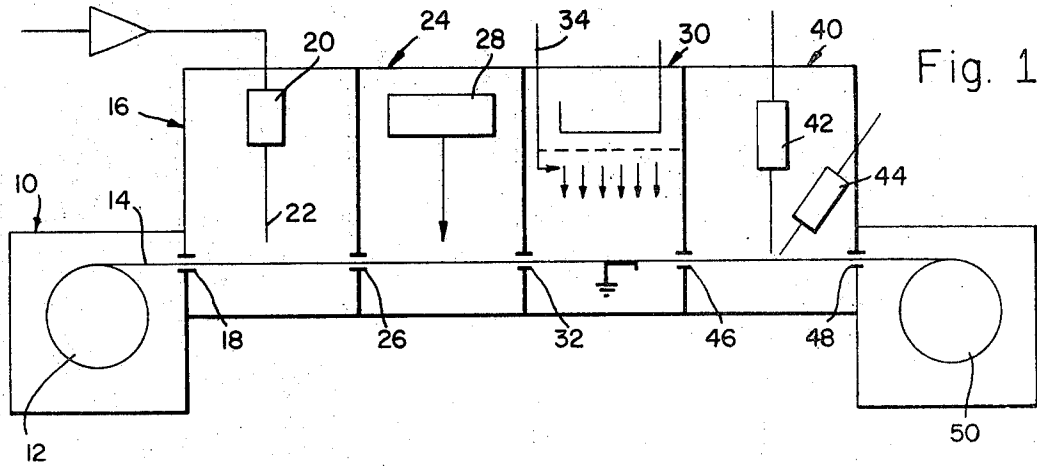


Fig. 1.

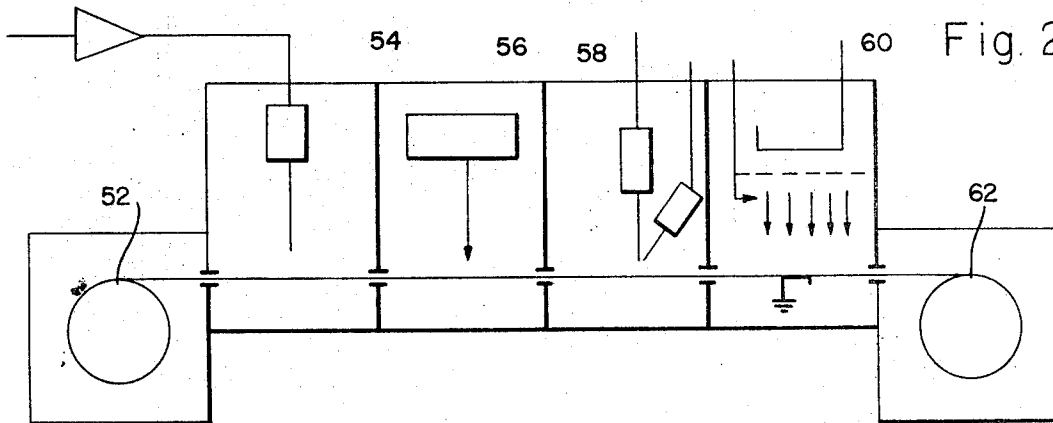


Fig. 2.

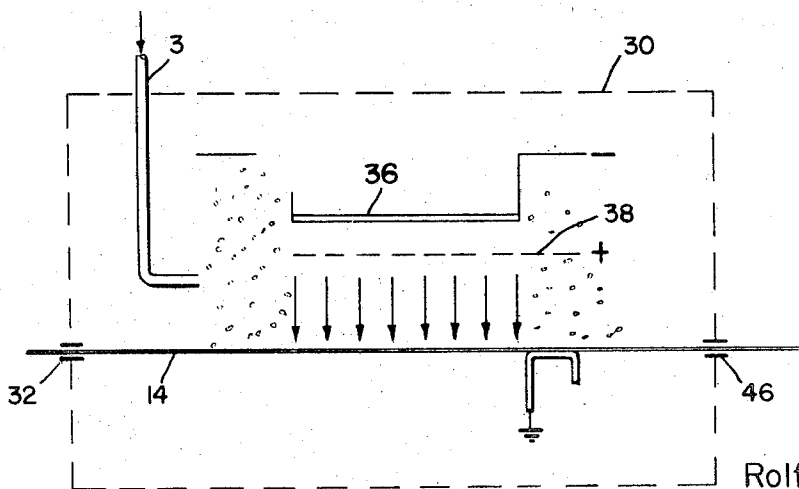


Fig. 3.

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1

2

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PACIFICATION OF IMAGE RECORDING MEDIA COMPRISING APPLYING A THIN POLYMER FILM OVER THE IMAGE SURFACE

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2 Claims

ABSTRACT OF THE DISCLOSURE

Photon, ion and electron sensitive image recording on nucleation medium acts primarily by surface effects. After exposure of such a medium by selective photon, ion or electron exposure, the image is developed by a metallic deposition from metallic vapor. Subsequent exposure to photons, electrons or ions exposes the balance of the medium, and it is subject to surface contamination. Such degrades the image and limits the useful life of the exposed and developed medium. Pacification of such images is accomplished by deposition thereon of a protective layer of such thinness as to be transparent to electrons and light, and yet is of uniform and non-porous character to protect the medium from material deposition. The preferred manner of deposition is the deposition of material from an organic vapor by means of a low energy electron beam which causes polymerization and deposition of the organic polymer and creation of a protective layer. The preferred organic material is silicone oil, and the polymerized layer is preferably in the order to two hundred to five hundred angstroms thick.

BACKGROUND

This invention relates to the pacification of the exposed surface of image recording medium where the image recording medium is of such nature as to be exposed by selectively activating nucleation sites therein and subsequently developed by selectively depositing material upon the activated sites, and particularly the protection of the developed surface from further deposition by means of depositing a protective layer thereon, which layer prevents further deposition but does not interfere with reading the developed material.

In the well-known photographic art, an activated silver halide grain in the gelatin photographic emulsion is developed by the attraction of silver atoms to the activated grain. This deposition occurs within the gelatin emulsion. Fixing of the emulsion is accomplished by removal of the silver which is not used in the exposure and development process. Since the silver image is within the gelatin emulsion, no additional protection is necessary after the emulsion has dried. No additional silver is present for further chemical reaction, and the dried emulsion is sufficiently mechanically strong to permit ordinary handling without danger to the future life of the developed image. Of a somewhat related nature to the present pacification of image recording medium is the deposition of photo resist materials upon a surface, with the subsequent exposure and removal of portions of the photo resist area, in accordance with the exposure image. Such materials are often used in processes where selective chemical etching is desired. The photo resist materials which remain in place protect the surface upon which they are layed. Normally these photo resist materials are not sufficiently thin to permit their usage as pacification materials for the present type of image recording medium.

SUMMARY

In summary, the pacification of image recording medium in accordance with this invention has for its purpose to apply a permanent, thin protective cover to a developed nucleation recording image without impairing the optical or electronic readout capability. This pacification is accomplished in accordance with this invention by means of the deposition of a layer of protective material on the image recording medium after the image is developed. In accordance with the requirement that the layer be of such nature that it does not impair the optical or electronic readout capability of the image recording medium, the layer is both optically and electronically transparent. Such a layer is preferably accomplished by the deposition of a polymer on the image recording medium by providing an organic vapor over the medium and providing a low energy electron shower through the organic vapor to the image recording medium. This electron shower causes polymerization of the vapor upon the image recording medium.

Accordingly, it is an object of this invention to provide for pacification of image recording medium after the development of such medium to protect the image upon the medium to give it a long life. It is another object of this invention to pacify the surface of image recording medium with a layer of protective material which is transparent to either or both optical or electronic read out devices so that the image protected by the pacification layer is clearly legible to read out means. It is a further object to provide a protective layer on the image recording medium which is formed by polymerization from an organic vapor so that the deposition can be carefully controlled and deposited to a very thin but continuous protective layer. It is still another object to polymerize a protective coating from an organic vapor by means of an electron shower so that deposition can be quickly accomplished with accurate control. It is a further object of this invention to apply a pacification layer onto image recording medium after development of the image on the recording medium and either prior to or subsequent to reading of the image on the layer, depending upon how quickly reading of the image is desired. Other objects and advantages of this invention will become apparent from a study of the following portion of the specification, the claims and the attached drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side elevational view, with the cover removed, of equipment for the employment of image recording medium, including a pacification step subsequent to development and prior to reading.

FIG. 2 is similar to FIG. 1 and includes the pacification step after image reading.

FIG. 3 is a side elevational view, with front cover removed, of equipment suitable for the application of a pacification layer to image recording medium.

DESCRIPTION

In order to fully understand this invention directed to the pacification of image recording medium, it is necessary to understand the character of the medium. First of all, it is within the purview of the image recording medium that it may be provided in at least two embodiments. In the first case, the recording materials may be incorporated in a film-forming vehicle to provide a self-supporting film. In another embodiment of the recording materials are similarly incorporated in a film-forming vehicle, and this is coated upon a support. The support may be optically transparent or opaque, depending upon the desired ultimate use.

For reasons not fully understood at this time, it appears

to be necessary to provide an electrically conductive member on the back of the sensitive material during recording upon the medium with electrons or ions. This can simply be provided by an aluminized layer upon the support, upon which the medium is deposited. In the case of self-supporting structures of the medium, backing can be in the form of a support table during the recording process.

The recording medium comprises a mixture of a material sensitive to impingement of electrons, ions or photons and a metallic compound which is a sensitization-enhancing agent, both of which are dispersed in a film-forming binder. A number of binders may be used, and those found to be particularly useful are of the butadiene and styrene types and copolymers thereof. The sensitive materials include those which are classifiable either as photoconductive or photoemissive. In general they are compounds formed by elements of Group II of the Periodic Chart with elements of Group VI thereof. More particularly, the sensitive materials include the oxides of zinc, titanium, tantalum, indium, magnesium, germanium, tin, and bismuth, as well as sulfides of calcium, zinc, cadmium, and indium. In addition to these it has been found that compounds such as boron nitride, calcium tungstate, beryllium aluminate, lithium carbonate, zinc carbonate, cadmium niobate, lithium niobate and certain phosphor compounds, such as calcium-magnesium silicate (cesium-activated) may also be employed. Mixtures of these compounds may also be used.

Furthermore, the sensitization-enhancing material includes, in general, any of the metallic or metallo-organic halides and metallic acetylacetonates, and particularly the copper halides, copper (II) acetylacetonate, or bismuth trioxide. The amount of this sensitization-enhancing agent used in the mixture is not critical, but ratios from about 10^{-3} to about 10^{-4} , by weight, have given excellent results.

The image recording medium has been disclosed in more detail in an application Ser. No. 582,079, filed Sept. 26, 1966, entitled, "Image Recording and Development," invented by Alfred F. Kaspaul and Erika E. Kaspaul, the entire disclosure of which is incorporated herein by this reference. Additionally, the exposure and development of the image recording medium is also disclosed therein in considerable detail.

Referring to FIG. 1, the image recording medium is stored in a light tight supply housing 10. It may be stored in the form of roll 12, or in any other convenient form of supply. Image recording medium 14 leaves supply housing 10 and enters recording station 16 through trap or seal 18. In the recording stage, electrons, ions or photons are formed into a relatively narrow beam and caused to scan the image recording medium 14 to establish the desired pattern of activated nucleation centers. In FIG. 1, beam source 20 is provided to generate a beam of ions, electrons or photons which are scanned onto the recording medium. Beam 22 is capable of being deflected orthogonally by means of well-known techniques. Recording station 16 is enclosed so that the requisite vacuum can be drawn when the medium is exposed by ions or electrons. However, in any case, the medium 14 is light sensitive so that recording station 16 must be totally optically enclosed.

As a result of the impingement of electrons, ions or photons upon the recording medium, the medium carries a latent image comprising a number of activated nucleation sites, the pattern of which corresponds to the exposure pattern and to the pattern to be reproduced. When the latent image is exposed to the vapor of a metal, for example, atoms or molecules from the vapor are selectively attracted to and retained in place only by the activated nucleation areas comprising the latent image.

Development is accomplished at development station 24 which is enclosed and is sealed with the respect to recording station 16 by means of trap or seal 26. Because of the controllable deposition by the vapor deposition process, it is the preferred development method. How-

ever, development can also be accomplished by immersing the exposed image recording medium in a plating solution, particularly of the electroless type. To accomplish development in the development station 24, a vapor beam is directed from vapor source 28 onto the exposed medium. The metallic vapor from the vapor source nucleates upon the activated nucleation sites of the exposed image recording medium and builds up a visible image.

Development or formation of a visible image takes place under the usual conditions governing the deposition of metals by vapor coating processes. This can be accomplished in a conventional vapor coating apparatus wherein a vacuum is employed so that the distance from the vapor source to the exposed medium does not unduly exceed the mean free path of the coating molecules. Pressures of about 10^{-1} to 10^{-4} torr may be used for this purpose. When a helium or argon atmosphere is used, the pressure may be one or two orders of magnitude higher. The material deposited for growth on the activated nucleation sites falls into the group of magnesium, zinc, cadmium and mercury. In some cases, these or similar metals can be deposited out of a vaporized compound containing the metal. Nickel carbonyl is a typical example for a vapor plating from a metal compound.

It is clear, however, that the unexposed portion of the medium will be exposed as soon as it is exposed to room light for examination of the now visible image. Random condensation will deposit on the newly exposed activated sites and will reduce the clarity of the image. This will limit the useful life of the medium with its developed image.

This invention is directed to the pacification of that developed image. Pacification chamber 30 is mounted adjacent to development station 24 and is sealed with respect thereto by means of seal or trap 32. As is best seen in FIG. 3, the medium 14 passes into the chamber through trap 32 for the pacification step. The purposes of the pacification chamber 30 is to apply a thin polymer film over the entire upper surface of the exposed and developed image recording medium to protect it from contamination and further development. This is accomplished by introducing an organic vapor into the chamber through inlet pipe 34. When introduced, the organic vapor is caused to condense or absorb upon the surface of the image recording medium, and is polymerized on the surface by means of a low energy electron shower.

A preferred organic vapor is the vapor of a silicone vacuum pump oil identified as DC704, a product of Dow Chemical Company, Midland, Mich. Another suitable vapor is butadiene vapor. Cathode 36 is positioned within pacification chamber 30 spaced from the medium 14. Grid 38 is positioned between the cathode and the medium. The cathode is negatively connected, while the anode is positively connected and the medium is grounded to cause a low energy electron shower to pass through the organic vapor from the cathode, through the grid and to the medium. This electron shower causes polymerization of a thin, continuous polymer layer. Preferred thickness is about 200 angstroms. Such thickness does not interfere with the extraction of data from the developed medium, but is sufficiently thick to provide continuous protection to the medium. Thickness up to 500 angstroms is satisfactory for data reading, but the thinnest continuous layer is preferable.

As is illustrated in FIG. 1, after pacification of the image recording medium, the medium passes to readout station 40. Readout can be accomplished either directly optically, such as by a direct inspection, or by other means. The other means include the bombardment of the image recording medium with electrons from a source 42 so that photons are emitted. The photons are read by detector 44 for further transmission. No secondary electrons are emitted through the pacification layer. The electron source 42 is scanned over the image upon orthogonal coordinates so that the image can be displayed at

5

a distance on a conventional cathode ray tube, or can be again recorded upon a distant image recording medium, such as is shown at recording station 16. Since the electron source 42 requires a substantial vacuum, readout station 40 is separated from pacification 30 by means of trap or seal 46. Similarly, the outlet for medium 14 from readout station 40 is provided by trap or seal 48. After such reading, the medium can be stored as at 50.

It is clear that the process described with respect to FIG. 1 is a continuous process with the image recording medium extending continuously from supply roll 12 to storage 50. It is equally clear, however, that the process can be discontinuous with each step being accomplished on an individual basis. Furthermore, there may be discontinuity between the pacification chamber 30 and readout station 40. It may be desirable to store the exposed, developed and pacified medium after the pacification step for later readout. It is principally for this purpose that the pacification step becomes significant. It is clear, however, that the amount of organic material deposited upon the developed medium must be sufficiently thin and transparent to the reading means that it does not interfere with the image reproduced in the reading step. For this reason, as thin a layer of organic polymer as can be deposited is preferred.

Furthermore, it is clear that reading may precede pacification, and pacification only accomplished before storage. FIG. 2 illustrates this arrangement of the process equipment. A supply of unexposed image recording medium is shown at 52. The supply is directed to recording station 54, which is identical to station 16. Next, after the exposure of the image recording medium at the recording station, it is developed at developing station 56. This station is identical to the station 24. In the process illustrated in FIG. 2, rather than next pacifying the exposed and developed image recording medium, it is read at readout station 58. This is identical to readout station 40. However, secondary electrons as well as photons are emitted, and can be read. After readout, the medium is pacified at pacification station 60, which is identical to the station at pacification chamber 30. Following pacification, the medium goes to storage 62, for storage until further reference thereto is desired.

This invention having been described in its preferred embodiment, it is clear that this invention is susceptible to numerous modifications and embodiments within the ability of those skilled in the art and without the exercise of the inventive faculty. Accordingly, the scope of this invention is defined by the scope of the following claims.

What is claimed is:

6

1. The process of pacification of an image recording medium comprising the steps of:

producing a sensitive material mixture by mixing together a material sensitive to the impingement of electrons, ions or photons selected from the group consisting of the oxides of zinc, titanium, tantalum, indium, magnesium, germanium, tin and bismuth, as well as sulfides of calcium, zinc, cadmium and indium, together with a sensitization-enhancing metallic compound selected from the group consisting of metallic or metallo-organic halides and metallic acetylacetonates, copper halides, copper (II) acetylacetonate and bismuth trioxide, in a film-forming binder;

forming the mixture into an image-recording medium having a surface;

imagewise exposing the surface of the image-recording medium to produce a latent image thereon;

developing an image on the image-recording medium by exposing the image-recording medium to the vapor of a metal selected from the group consisting of magnesium, cadmium, zinc, mercury and nickel so that the vapor deposits on the surface of the image-recording medium to form a metallic image, in accordance with the latent image; and

pacifying the image surface of the image-recording medium by exposing it to a polymerizable organic vapor and passing a low energy electron shower through the vapor so that an organic polymer layer is deposited thereon.

2. The process of claim 1 wherein said organic vapor is selected from the group consisting of silicone vacuum pump oil vapor and butadiene vapor.

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