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Goffe

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[54] **IMAGING METHOD**

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[52] **U.S. Cl.** ..... **96/1.1,** 96/1 R

[51] **Int. Cl.** **G03g 13/22**

[58] **Field of Search** ..... 96/1 R, 1.1, 1 M

[56] **References Cited**

UNITED STATES PATENTS

3,676,117	7/1972	Kinoshita	96/1 R
3,677,751	7/1972	Wasaburo Ohta et al.	96/1 R
3,719,482	3/1973	Goffe	96/1.1

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[57] **ABSTRACT**

A partially migrated migration imaged member comprising a softenable layer and migration marking material partially migrated in image configuration in depth in said softenable layer in response to an electrical latent image of a first polarity is uniformly charged to a low potential opposite the polarity of the electrical latent image of a first polarity, either with or without uniform, e.g., ambient exposure to electromagnetic radiation to thereby desensitize the partially migrated image to further softening development. Charging to low opposite polarity potential during softening development can be used to terminate the effect of development.

7 Claims, 4 Drawing Figures

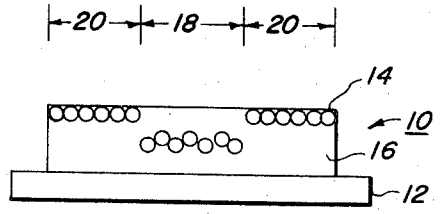


FIG. 1

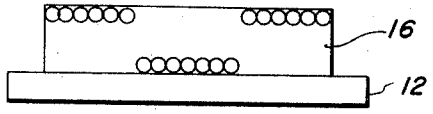


FIG. 2

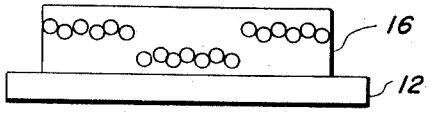


FIG. 3

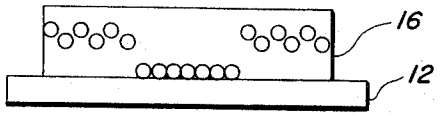


FIG. 4

IMAGING METHOD

BACKGROUND OF THE INVENTION

This invention relates in general to imaging, and more specifically to migration imaging and a process for stabilizing a partially migrated migration image.

Recently, a migration imaging system capable of producing high quality images of high density, continuous tone, and high resolution has been developed. Such migration imaging systems are disclosed in copending applications Ser. No. 837,780 and Ser. No. 837,591, both filed June 30, 1969 which are hereby expressly incorporated herein by reference. In a typical embodiment of the new migration imaging system an imaging member comprising a substrate with a layer of softenable material and electrically photosensitive particles is imaged in the following manner: a latent image is formed on the member, for example, by electrically charging the member and exposing it to a pattern of activating electromagnetic radiation such as light. Where the photosensitive marking material is originally in the form of a migration layer spaced apart from the substrate, material from the migration layer migrates imagewise toward the substrate when the member is developed by softening the softenable layer.

One mode of development entails contacting the member with a solvent which dissolves only the softenable layer. The photosensitive marking material (typically particles) which have been exposed to radiation migrate through the softenable layer as it is softened and dissolved, leaving an image of migrated particles corresponding to the radiation pattern of an original on the substrate with the material of the softenable layer substantially washed away. The particle image may then be fixed to the substrate. For many preferred photosensitive particles, the image produced by the above process is a negative of a positive original, i.e., particles deposit in image configuration corresponding to the radiation exposed areas. However, positive to positive systems are also possible by varying imaging parameters. Those portions of the photosensitive material which do not migrate to the substrate are washed away by the solvent with the softenable layer. As disclosed therein, by other developing techniques, the softenable layer may at least partially remain behind on the supporting substrate with or without a relatively unmigrated pattern of marking material complementary to said migrated material.

In another imaging member embodiment migration material is dispersed throughout the softenable layer in a binder layer configuration.

"Softenable" as used herein is intended to mean any material which can be rendered more permeable to migration material migrating through its bulk by softening said material as by contact with heat, softening vapors, softening liquids and combinations thereof.

"Fracturable" layer or material as used herein, means any layer or material which is capable of breaking up during development, thereby permitting portions of said layer to migrate toward the substrate in image configuration. The fracturable layer may be particulate, semi-continuous, or continuous in various embodiments of the migration imaging members so long as it is capable of breaking up into particles during development.

"Contiguous," for the purpose of this invention, is defined as in Webster's New Collegiate Dictionary, Second Edition, 1960; "In actual contact; touching; also, near, though not in contact; adjoining."

The term "electrical latent image" and any variant forms thereof used herein includes the images formed by the charge-expose mode hereof which cannot readily be detected by standard electrometric techniques as an electrostatic image for example of the type found in xerography, so that no readily detectable or at best a very small change in the electrostatic or coulombic force is found after exposure (when using preferred exposure levels); and electrostatic latent images of a type similar to those found in xerography which are typically readily measurable by standard electrometers, that is the electrostatic latent images show a surface potential difference reading over adjacent non-image area typically of at least about 5 to 10 volts.

In certain methods of forming the latent image, nonphotosensitive or inert, fracturable layers and particulate material may be used to form images, for example, wherein an electrostatic latent image is formed by a wide variety of methods including charging in image configuration through the use of a mask or stencil; first forming such a charge pattern on a separate photoconductive insulating layer according to conventional xerographic reproduction techniques and then transferring this charge pattern to the imaging member by bringing the two layers into very close proximity and utilizing breakdown techniques as described, for example, in Carlson U.S. Pat. No. 2,982,647 and Walkup U.S. Pat. Nos. 2,825,814 and 2,937,943. In addition, charge patterns conforming to selected, shaped, electrodes or combinations of electrodes may be formed by the "TESI" discharge techniques as more fully described in Schwertz U.S. Pat. Nos. 3,023,731 and 2,919,967 or by techniques described in Walkup U.S. Pat. Nos. 3,001,848 and 3,001,849 as well as by electron beam recording techniques, for example, as described in Glenn U.S. Pat. No. 3,113,179.

The characteristics of the images produced are dependent on such process steps as charging, exposure and development, as well as the particular combination of process steps. High density, continuous tone and high resolution are some of the image characteristics possible. The image is generally characterized as a fixed or unfixed particulate image with or without a portion of the softenable layer and unmigrated portions of the layer left on the imaged member.

Copending application Ser. No. 24,148, filed Mar. 31, 1970 now U.S. Pat. No. 3,720,513 discloses a method of completing migration of a partially migrated binder configuration member by electrically charging the surface of the imaging member while it is substantially uniformly exposed to activating radiation and then contacting the imaged member with a solvent for the softenable material to fully develop the migration image. It is found that the charging step creates an electrical latent image in the previously unexposed, i.e., migrated areas of the partially migrated binder image which upon development with a solvent which dissolves the softenable material causes the partially migrated material in the unexposed areas to complete migration to a substrate with substantially all softenable material and the unmigrated migration material being washed away in the solvent.

In copending application Ser. No. 692,336, filed Dec. 21, 1967 now U.S. Pat. No. 3,795,512 a migration imaging process is disclosed which creates a positive-to-positive or netative-to-negative imaging system out of one that is normally a positive-to-negative or negative-to-positive comprising the process steps of uniform charging with a charge of a first polarity, imagewise exposure, uniform charge with a charge of a polarity opposite said first polarity and uniform exposure to form a latent image which may then be developed to cause imagewise migration of migration material.

Copending application Ser. No. 184, filed Jan. 2, 1970 discloses the migration imaging process of erasing an electrical latent image of a first polarity and providing a migration imaging member with a new electrical latent image by charging with a charge of a polarity opposite said first polarity to bring said member in imaging area portions to at least about zero potential before forming a second, i.e., later electrical image. However, as in Ser. No. 692,336 now U.S. Pat. No. 3,795,512 this application is directed to changing or manipulating an electrical latent image prior to development.

Within the framework of the discovery of this basic new migration imaging system, the present invention has been discovered which permits softening development imagewise migration of particles to be stopped with the particles migrated to a position within a softenable layer and to desensitize such a migration image to further softening development influences and specifically heat, which may be encountered in the use of the migration image and may degrade the image.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide a method of stopping the softening development influence on a partially migrated migration image.

It is a further object of this invention to provide a method of stabilizing partially migrated migration images to further softening influences and specifically heat.

It is a further object of this invention to provide a method to stop the effect of migration imaging softening development to stop imagewise migration of migration material at a predetermined depth in a softenable layer.

The foregoing objects and others are accomplished in accordance with this invention as follows. A partially migrated migration imaged member comprising a softenable layer and migration marking material partially migrated in image configuration in depth in said softenable layer in response to an electrical latent image of a first polarity is uniformly charged to a low potential opposite the polarity of the electrical latent image of a first polarity, either with or without uniform, e.g., ambient exposure to electromagnetic radiation to thereby desensitize the partially migrated image to further softening development. Charging to low opposite polarity potential during softening development can be used to terminate the effect of development.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention as well as other objects and further features thereof, reference is made to the following detailed disclosure of this invention taken in conjunction with the accompanying drawings wherein:

FIG. **1** is a partially schematic, side view of a partially migrated migration imaged layer configuration imaging member with partially migrated portions **18** and unmigrated portions **20**, of the type that can be desensitized to further softening development influence according to this invention.

FIG. **2** is a partially schematic, side view of a partially migrated migration imaged layer configuration imaging member with completely migrated portions **18** and unmigrated portions **20**, of the type that can be desensitized to further softening development influence according to this invention.

FIG. **3** is a partially schematic, side view of a partially migrated migration imaged layer configuration imaging member with partially migrated portions **18** and partially, but relatively lesser (when compared with portions **18**) migrated portions **20**, of the type that can be desensitized to further softening development influence according to this invention.

FIG. **4** is a partially schematic, side view of a partially migrated migration imaged layer configuration imaging member with completely migrated portions **18** and partially migrated portions **20**, of the type that can be desensitized to further softening development influence according to this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. **1** there is shown partially migrated migration imaged fracturable layer configuration imaged member **10**. Substrate **12**, softenable layer **16**, migration material in fracturable layer configuration modes and dispersed in a binder and for example shown in FIG. **1** as a fracturable layer of particles **14** and the softening modes of developing softenable layers **16** are all amply described in the aforementioned incorporated by reference copending applications.

Electrically photosensitive and non-photosensitive migration material function in the desensitizing process of this invention.

Alternatively, the softenable layer **16** may be self-supporting to do away with the need for substrate **12.**

Partially migrated migration image, imaged member and similar terms as used herein means that in migration imaging wherein softening development is used (as distinguished for example from solvent wash-away development where the migrated particles are deposited directly on a substrate with removal of softenable material) at least one image configuration of migrated particles is only migrated to a position in depth in the softenable layer, not to a physical barrier to further migration, and remains capable when properly charged and developed of further migration in depth, or is still unmigrated and remains capable when properly charged and developed of migration in depth. For example, in FIGS. **1–4**, the interface between softenable layer **16** and the stable substrate **12** is a physical barrier to further migration.

In FIG. **1** area **18** is migrated to a position in depth and capable of further migration in depth and areas **20** are unmigrated but capable of migration. In FIG. **2**, areas **18** are completely migrated but areas **20** are unmigrated but capable of migration. In FIG. **3**, both areas **18** and **20** are migrated to different positions in depth in the softenable layer and capable of further migration in depth. In FIG. **4**, area **18** is completely mi-

grated and areas **20** are migrated to a position in depth and capable of further migration. Thus all the imaged members illustrated in FIGS. **1–4** are partially migrated migration imaged members as defined herein.

In some migration imaging modes it is desirable to obtain a partially migrated rather than a completely migrated migration image to obtain specific sensitometric and optical characteristics. One example of a case where it is desirable to form partially migrated migration images and where the instant invention may be utilized is a case where further original softening development would have caused some migration of the relatively unmigrated background particles which for example might have been exposed to a weaker version of the activating radiation used in the imagewise exposure.

Also, when splitting one migration image from another as described in copending application Ser. No. 784,164, filed Dec. 16, 1968 now abandoned the instant invention may be used to provide for positioning of the migration images in the softenable layer and relative to each other to provide for optimum splitting. Also, when using the wash-away mode of removing the background image as taught in aforementioned 784,164, usually maximum separation of the complementary migrated image configurations is desired and the instant invention can be used to ensure, e.g., a FIG. **2** situation by stopping the softening development of area **18** when completely migrated to ensure that unmigrated particles in areas **20** do not begin to migrate either during the initial softening development or due to being subjected to a subsequent inadvertent development environment.

However one of the problems involved with utilizing such a partially migrated image is that a further softening development influence may be encountered in the subsequent use of such a partially imaged member which would cause further development and change of the previous image characteristics. For example the partially migrated image may be used as a microfilm transparency in a microfilm projector with a sufficiently warm film transport mechanism and projection and gate station that the heat involved can heat soften the softenable layer and cause further and eventually complete development of the image thereby changing the character of the developed migration image.

In fact, it has been found that later heating long after, even days after an initial or first heat development will produce further particle migration which may be objectionable.

It has now been shown that in a partially migrated migration image both the migration material portions migrated in depth and capable of further migration in depth and even unmigrated background particles can be prevented from additional or any migration in depth by uniformly charging the partially migrated migration image to a low potential of a charge opposite to the polarity of the sensitization charge on the particles used to form the partially migrated migration image, the uniform charging either during or after development and with or without uniform exposure to activating electromagnetic radiation. For example in charge-expose modes of migration imaging with electrically photosensitive migration material, if the initial charge used to migrate is positive then the uniform charging step of the instant invention would be to a low negative potential. If the initial image sensitizing was by charging negatively through a stencil, then the uniform charging step of the instant invention would be to a low positive potential.

One of the most surprising aspects of the present invention is that the process hereof desensitizes the more deeply migrated particles without sensitizing the background, i.e., the relatively unmigrated or unmigrated background portions to migration even though migration material, e.g., particles is being charged in the uniform charge step to a polarity that can be a sensitizing polarity.

In the uniform charging step it is preferred that the low potential not be above the threshold potential for migration of either image configuration of migration material when subjected to a subsequent softening development. Practically the migration image threshold that almost always governs is that of the unmigrated or relatively lesser migrated image pattern.

In some modes hereof, where the charging step hereof is not applied during initial development, it is preferred, but not necessary, to follow the uniform charging step with a uniform softening. Heat softening is preferred where the later, potentially degrading softening influence is other than a heat softening influence. This additional heat softening step reduces the care involved in uniformly charging to a low opposite potential.

Normally, and specifically under normal migration image use and handling just uniform charging by itself is sufficient since the charge from the uniform charging step of the instant invention remains on the migration imaged member indefinitely and completes its desensitizing attachment to the migration image material when, if ever, a later softening influence is encountered. The uniform softening step hereof may also be employed where the migration image due to abnormal film handling, e.g., rubbing etc. or use in the presence of charge, e.g., corona charge, sources might cause the migration image to reacquire the original polarity since migration charge used to form the partially migrated migration image. This softening step causes the uniform charging step hereof and desensitization to be set against such further charge influences.

The following Examples further specifically define the present invention with respect to desensitizing a partially migrated migration imaged member to further migration or to new migration of an unmigrated image pattern of migration material by uniformly charging the member to a polarity opposite the sensitization charge on the particles used to form the original partially migrated migration image. The parts and percentages are by weight unless otherwise indicated. The Examples below are intended to illustrate various preferred embodiments of the partially migrated migration image desensitizing process of this invention.

EXAMPLE I

The following imaging member is provided: about a 3 mil Mylar polyester plastic film overcoated with about a 50 percent white light transparent film of aluminum is the substrate. On the substrate is coated about a 1½ micron thick softenable layer of a custom synthesized 80/20 mole percent copolymer of styrene and hexylmethacrylate. Completely embedded at the upper surface of the softenable layer is a fracturable, particulate layer of about ¼ micron diameter amorphous selenium particles deposited by the vacuum de-

position process described in Goffe et al U.S. Pat. No. 3,598,644.

The imaging member described above is partially migration imaged by uniformly electrostatically charging the member with a corotron to a surface potential of about −280 volts. The member is then exposed to a line copy image with exposure in the exposed areas being about ½ erg of 4,000 angstrom wavelength light. The member is heat developed by placing it in contact with a hot plate at about 110°C. for about 10 seconds to create a partially migrated migration imaged member as shown in FIG. 1.

This image however continues to develop when continuously heated for a longer initial development time or when heated further at a subsequent time under the heating conditions described above, in both exposed and unexposed areas of the image.

However, if the partially migrated imaging member is uniformly charged to a positive potential of about +30 volts it is found that subsequent subjecting of the partially migrated member to softening influences such as the heating as used above in development or for example for about 50 seconds, both in room light and without, at about 110°C. or vapor softening treatments for the softenable layer material (of the intensity which without the uniform charging step would cause migration) did not cause further migration of the image.

EXAMPLE II

Example I is followed except that the initial heat development is continued after 10 seconds but after 10 seconds initial heat development, the member is uniformly positively charged to a positive potential of about +30 volts. Despite the continued application of heat it is noted that migration of all particles is stopped by the positive corona charging step.

EXAMPLE III

Example I is followed except that after the uniform positive charging, the member is again contacted against a hot plate at about 110°C. for about 10 seconds to fix the member's desensitization especially against a later encountered softening vapor environment or abnormal handling conditions.

EXAMPLE IV

Example I is followed except that instead of a line copy image a step tone tablet target is used with about 0.3 density steps and the exposure is such that about 20 ergs of 4,000 angstrom wavelength light gets through to expose the imaging member in the most exposed areas to create a tone step migration image with five clearly observable steps.

With the desensitizing positive charging of Example I no tone charge in any step of the migration imaged member is observed when subjected to the subsequent heatings of Example I.

Without the desensitizing positive charging step, significant migration image density changes were observed especially in the lesser exposed areas of the migration image when subject to the subsequent heatings of Example I.

Although specific components and proportions have been stated in the above description of preferred embodiments of the partially migrated migration image desensitizing process of this invention, other suitable materials and process variations as listed herein may be used with similar results. In addition other materials which exist presently or may be discovered may be added and variations may be made in the various processing steps to synergize, enhance and otherwise modify the invention as described.

For example, while the description above is concerned with fracturable layer configuration migration imaging members; binder configuration migration imaging members wherein the migration material, and preferably particles, is dispersed in the softenable layer can also be desensitized in accordance with the description herein.

Also, it is to be noted that the uniform desensitizing charging step hereof may take place anytime during the period from during the initial softening development step until days or longer after the initial softening development has been completed.

When an original positive sensitizing charge and a later vapor environment is expected, the negative uniform charge hereof should be as low as possible since the combination of negative charge and vapor development can provide a very strong migration driving force.

If initial vapor development is used with a heat softening step according to an embodiment hereof (or the reverse) then the lowest heat and vapor softening possible should be used to prevent agglomeration of agglomerable migration particles such as amorphous selenium particles.

It will be appreciated that when a continuous tone exposure image is used to expose the migration imaging members hereof a partially migrated migration image of completely migrated, unmigrated and partially migrated portions (migration material migrated to a position in depth in the softenable layer and capable of further migration in depth) may result.

It will be understood that various other changes in the details, materials, steps and arrangements of parts which have been herein described and illustrated in order to explain the nature of the invention, will occur to and may be made by those skilled in the art upon a reading of this disclosure and such changes are intended to be included within the principle and scope of this invention.

What is claimed is:

1. An imaging process comprising the steps of:
   a. providing a partially migrated migration imaged member wherein imagewise migration of migration material was accomplished using sensitization charge of a first polarity;
   b. charging said member to a low potential opposite said first polarity sufficiently to desensitize the partially migrated migration imaged member to prevent further migration of migration material upon further softening development.

2. An imaging process according to claim 1 wherein said partially migrated migration imaged member comprises a softenable layer and migration material partially migrated in image configuration in depth in said softenable layer and a complementary background image configuration of migration material in layer configuration contiguous a surface of said softenable layer.

3. An imaging process according to claim 2 wherein said migration material is particles.

4. An imaging process according to claim 3 wherein step (b) is performed while said migration material is

being imagewise migrated during softening development, and is carried out to stop said migration.

5. An imaging process according to claim **3** wherein the potential in step (b) is below the threshold for migration of either image configuration of migration material.

6. An imaging process according to claim **3** wherein the process is carried out while being exposed to electromagnetic radiation which is activating for said migration material.

7. An imaging process according to claim **3** including the step of softening said softenable layer either during or after step (b).

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