June 26, 1973 T. A. CHRZANOWSKI ET AL 3,741,758

MIGRATION IMAGING EMPLOYING PRESSURE NIP DEVELOPMENT

Filed Dec. 14, 1970

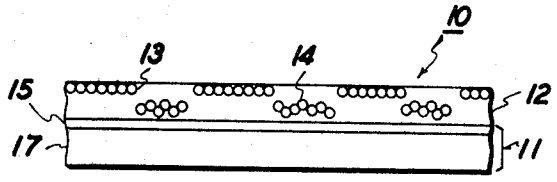


FIG. 1

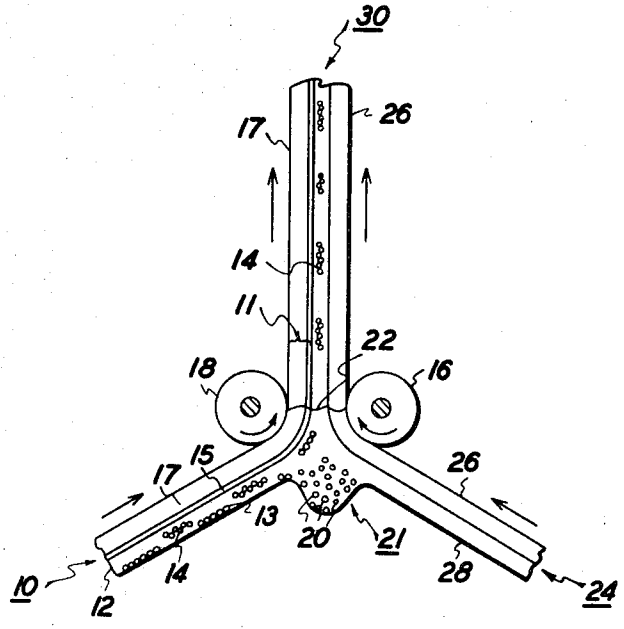


FIG. 2

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United States Patent Office 3,741,758
Patented June 26, 1973

3,741,758

MIGRATION IMAGING EMPLOYING PRESSURE NIP DEVELOPMENT

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Filed Dec. 14, 1970, Ser. No. 97,803
Int. Cl. G03g 13/12
U.S. Cl. 96—1 R 12 Claims

ABSTRACT OF THE DISCLOSURE

A process for removing background from a migration imaged member comprising a layer of softenable material and migration material selectively distributed in depth in said softenable material with some background material, by extruding away the background material and contiguous portions of softenable material, for example, by passing the migration imaged member through a pressure nip wherein some of the softenable material is extruded in front of the nip carrying with it the unmigrated particles.

BACKGROUND OF THE INVENTION

This invention relates in general to imaging, and more specifically to migration imaging and a process for increasing contrast density by removing background from migration imaged members.

Recently, a migration imaging system capable of producing high quality images of high density, continuous tone, and high resolution has been developed. This migration imaging system is 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: an electrical 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 (the layered configuration), 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 exposing the member to 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 in the incorporated applications by other developing techniques, the softenable layer may at least partially remain behind on the supporting substrate with or without a relatively unmigrated background 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. Conventionally, changing permeability is accomplished by dissolving, melting, and softening as by contact with heat, vapors, partial solvents 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 or semi-continuous in various embodiments of the migration imaging members.

"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."

In certain methods of forming the latent image, non-photosensitive 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 Pat. 2,982,-647 and Walkup Pats. 2,825,814 and 2,937,943. In addition, charge patterns conforming to selected, shaped electrodes or combinations of eelctrodes may be formed by the "TESI" discharge techniques as more fully described in Schwertz Pats. 3,023,731 and 2,919,967 or by the techniques described in Walkup Pats. 3,001,848 and 3,001,-849 as well as by electron beam recording techniques, for example, as described in Glenn Pat. 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.

As described in the aforementioned incorporated applications, one class of migration imaged members results in a background pattern of relatively unmigrated migration material at a different depth in the softenable layer of the imaged member from the image pattern of relatively more migrated material. This background pattern of migration material may lower contrast density wherein, for example, the imaged member is to be directly viewed or used as a projection transparency. Thus, there is a need for system to render imaged members as just described more readily viewable and otherwise more readily usable and specifically to remove this background of typically relatively unmigrated migration material to render the migration imaged member more viewable by increasing contrast density.

Copending application Ser. No. 784,164, filed Dec. 16, 1968 is a related case broadly directed to background removal. The instant invention, which may be a species of the 784,164 concept, is a discovery which permits removal of background material by a new simple process unobvious over any previously disclosed including those disclosed in 784,164.

SUMMARY OF THE INVENTION

It is, therefore, an object of this invention to provide a new process of removing background migration material from an imaged member comprising a layer of softenable material and migration material selectively distributed in depth in said softenable material in image configuration, with some background material.

It is a further object of this invention to provide a system for simultaneously removing unwanted background material and yielding an image which is still fixed.

The foregoing objects and others are accomplished in accordance with this invention, by extruding, shearing away the background particles and contiguous portions of softenable material, for example, by passing the migration imaged member with the softenable layer at the proper viscosity through a pressure nip wherein some of the softenable material is extruded in front of the nip carrying with it the unmigrated particles.

BRIEF DESCRIPTION OF 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 drawing of an embodiment of an imaged member hereof, of the type suitable to be processed by this invention.

FIG. 2 is a partially schematic drawing showing a migration imaged member being processed by an embodiment of this invention by passing the imaged member through a pressure nip comprising two opposed rollers.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, there is shown imaged member **10** comprising a background of relatively unmigrated particle portions **13** and migrated particle portions **14** which have migrated into said softenable layer **12**. It will be appreciated that in some embodiments of this invention the relatively more migrated particle portions **14** migrate completely through softenable layer **12** to the softenable layer **12**-substrate **11** interface. Substrate **11** comprises a supporting underlayer **17** which may be plastic and a thin overlayer **15** of white light transmissive conductive metal, for example aluminum. A detailed description of the various imaging members and imaged members and the various processing steps of this new migration imaging system may be found in the aforementioned incorporated applications.

Background as used herein refers to, in an imaged member comprising migration material selectively distributed in depth in a softenable material in a first image configuration, substantial amounts (such that, for example, removal of said amounts noticeably changes the optical character of said imaged member) of migration material also in said softenable material but spaced apart in depth from said first image configuration of migration material, which background may take the form of a second image pattern of migration material complementary to said first image configuration which migration material may be substantially unmigrated or relatively unmigrated compared to the migration of said first image configuration of migration material.

While this imaged member in its FIG. 1 form has many uses as described in the incorporated copending applications, in some imaging applications, it is found that the removal of background portions **13** of migration material eliminates the sometimes undesirable optical effect of this material. For example, when imaged member **10** is used as a projection transparency, assuming substrate **11** and the material comprising the softenable layer **12** are at least partially transparent to the projection light, a more distinctly visible projected image is produced by the effect of particles **14** on substrate **11** upon removal of background **13**, which provides for a sharper and more contrasty projected image.

Referring now to FIG. 2, there is shown opposed rollers **16** and **18** forming a pressure nip **22** therebetween with migration imaged member **10** advancing in the direction of the arrows wherein it is pressed against member **24** preferably being advanced at about the same rate of advancement as migration imaged member **10** into the pressure nip **22**.

As illustrated, a preferred member **24** as in the form of a web comprising a supporting substrate **26** and a softenable layer **28** of a material similar to the type used as the softenable material **12** in the migration imaged member.

In going through the roller nip, some of the softened softenable material both from layers **28** and **12** is extruded in front of the rollers forming a bead or puddle **21** across the width of imaged member **10** carrying with it particles **20** removed primarily from their previous positions **13**. The relatively unmigrated particles **13** are carried away as these particles are caught up in the softenable material flow which is predominantly confined to the upper surface of the migration imaged member **10**.

It has been found to be preferred to have the viscosity of softenable material **28** lower than that of softenable material **12** so that the shearing action on imaged member **10** is more confined to the upper part of the migration imaged member where it shears away the upper section of layer **12** with its unmigrated particles **13** while leaving the migrated particles **14** less disturbed. Having softenable material **28** at a lower viscosity is accomplished by having the pressure roller **16** more closely adjacent member **24** at a higher temperature than pressure roller **18**.

While a roller pressure nip has been illustrated it is appreciated that any suitable conventional pressure nip may be used including nips composed of opposed shoes and so on. Another example of a pressure nip within the scope of this invention is one where at least one of the pressure applying means is an air (or other fluid) knife which optionally may contain softening vapors (if the fluid is a gas) or be heated or both in order to accomplish both ends of applying pressure and softening softenable material.

It is to be expressly noted that binder member structures as described in aforementioned application 837,591 may also be employed in the present invention.

While the use of member **24** as described above is preferred, the invention may be practiced without a layer **28**, i.e., with just a mechanically stable layer **26**. Also, the invention may be practiced with no member **24** at all, i.e., with just roller **16** in direct contact with the top surface of the imaged member. A doctor blade or other suitable means may be used to scrape roller **16** free of softenable material during its operation.

For preferred results including optimum image quality it is presently believed that the viscosity of softenable material **12** should be below about 10^4 poises at the nip.

The following example further specifically defines the present invention of removing background from a migration imaged member by advancing it through a pressure nip according to the invention. The parts and percentages are by weight unless otherwise indicated. The example below is intended to illustrate various preferred embodiments of the background migration material removing system of this invention.

EXAMPLE

A layered configuration imaging member is made by forming about a 2 micron thick layer of a custom synthesized copolymer of polystyrene and hexylmethacrylate of a molecular weight of about 45,000 weight average on about a 3 mil thick substrate of Mylar polyester film

from Du Pont overcoated with a thin aluminum layer being about 50% white light transmissive. The migration layer contiguous the free surface of the softenable layer is about a ¼ micron layer of about ¼ micron selenium particles formed as disclosed in copending application Ser. No. 19,521, filed Mar. 17, 1970, now U.S. Pat. No. 3,598,644.

The member is uniformly electrostatically charged to a surface potential of about +150 volts, exposed to a light image through a step wedge with the maximum exposure being about 9 f.c.s. of white light and then exposed to vapors of trichloroethane for about 5 seconds by positioning the latent imaged member adjacent the top of a gallon bottle containing fluid solvent on the bottom to form a migration imaged member similar to that shown in FIG. 1 with relatively more migration taking place in areas of relatively more exposure.

A pressure roller nip arrangement is provided comprising steel rollers of about ⅛ inch diameter and about 35 millimeters long. Forces on these rollers may vary from about 5 to about 15 pounds per inch length of the roller for optimum results. These preferred forces increase for larger rollers or larger nip curvatures.

The roller corresponding to roller **18** is heated to about 90° C. and the roller corresponding to roller **16** is heated to about 140° C. Member **24** comprises a substrate of about 3 mil thick Mylar polyester film and about a 2 micron thick layer **28** of the same copolymer material used in the softenable layer of this example.

The migration imaged member and member **24** are advanced into and through the nip at a rate of about 0.1 inch/second. Higher speeds may be used especially if means other than roller heat are used to bring the softenable layer and layer **28** to the proper viscosity.

A migration imaged member **30** is produced where the only migration material left is that comprising imaging pattern **14** sandwiched between the two substrates **11** and **26** with an imaged member **30** resolution of greater than about 150 line pairs/mm. in the direction of advancement of the webs and resolution of about 50 line pairs/mm. in the direction transverse to the advancement of the webs.

Copolymer thicknesses of from about 1 to about 3 microns for the softenable layer and for layer **28** produce similar results.

Although specific components and proportions have been stated in the above description of preferred embodiments of the pressure nip background removing system of this invention, other suitable materials as listed herein may be used with similar results. In addition, other materials which exist presently or may be discovered may be used and variations may be made in the various processing steps to synergize, enhance or otherwise modify the properties of this invention. For example, a softenable layer **12** may be used comprising a double layer of softenable material wherein the upper layer is more readily softenable than the lower layer into which the migrated image particles have relocated, thereby extruding away the upper material with the background material. Also, this upper layer which roughly accomplishes the same effect as layer **28** may be layered on the imaged member **10** before it advances into the nip. It will be understood that various other changes in the details, materials, steps and arrangements which have been herein described and illustrated in order to explain the nature of the invention will occur too 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 method comprising the steps of:

(a) providing an imaged member comprising a layer of softenable material and migration material distributed in depth in said softenable material in image pattern configuration, and comprising in addition to said image pattern of migration material, a background of migration material in said softenable material and spaced apart, in depth, from said image pattern; and

(b) advancing said migration imaged member into and through a pressure nip whereby some of the softenable material is extruded at the entrance of the nip carrying with it and removing said background migration material.

2. An imaging method according to claim **1** wherein the upper surface of said imaged member is advanced into said pressure nip pressed against a second layer of softenable material advancing into said nip.

3. An imaging method according to claim **2** wherein said pressure nip comprises two opposed rollers.

4. An imaging method according to claim **1** wherein said layer of softenable material of said imaged member comprises a double layer of softenable material wherein the upper layer is more readily softenable than the lower layer into which the migrated image particles have relocated, and wherein the upper layer of softenable material is extruded away with the background migration material.

5. An imaging method according to claim **2** wherein the viscosity of said second softenable layer is lower than the viscosity of the softenable layer of said imaged member.

6. An imaging method according to claim **3** wherein the viscosity of said second softenable layer is lower than the viscosity of the softenable layer of said imaged member.

7. An imaging method according to claim **6** wherein the pressure roller adjacent said second softenable layer is at a higher temperature than the pressure roller adjacent said imaged member.

8. An imaging method according to claim **5** wherein the viscosity of the softenable layer of said imaged member at the nip is below about 10^4 poises.

9. An imaging method according to claim **7** wherein the viscosity of the softenable layer of said imaged member at the nip is below about 10^4 poises.

10. An imaging method according to claim **9** wherein said rollers are about ⅛ inch in diameter and are applying a force of between about 5 to about 15 pounds per inch of roller length at said nip.

11. An imaging method according to claim **10** wherein said imaged member and said second layer of softenable material are advanced into said nip at a rate of about 0.1 inch/second.

12. An imaging method according to claim **4** wherein said pressure nip comprises two opposed rollers, the roller adjacent said background migration material at a higher temperature than the roller adjacent adjacent said migration material distributed in depth in said softenable material.

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U.S. Cl. X.R.

117—17.5