United States Patent [19]

Anzai

[11] **3,918,970**

[45] **Nov. 11, 1975**

[54] **COLOR XEROGRAPHIC RECORDING METHOD**

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[73] Assignee: **Hitachi, Ltd.**, Japan

[22] Filed: **Sept. 10, 1973**

[21] Appl. No.: **395,442**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 203,143, Nov. 30, 1971, abandoned.

[30] **Foreign Application Priority Data**

Dec. 2, 1970 Japan 45-105852

[52] **U.S. Cl.** **96/1.2**; 96/1.5

[51] **Int. Cl.²** **G03G 5/12**

[58] **Field of Search** ..... 96/1.5–1.8, 96/1.2; 117/37 LE; 252/62.1 P

[56] **References Cited**

UNITED STATES PATENTS

2,907,674	10/1959	Metcalfe et al.	117/37 LE
3,121,007	2/1964	Middleton et al.	96/1.5
3,150,976	9/1964	Johnson	96/1.2
3,212,887	10/1965	Miller et al.	96/1.2
3,251,687	5/1966	Fohl et al.	96/1.7
3,281,240	10/1966	Cassiers et al.	96/1.5
3,376,133	4/1968	Roteman	96/1.2
3,531,195	9/1970	Tanaka et al.	96/1.2
3,723,113	3/1973	Goffe	96/1.2

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[57] **ABSTRACT**

A color xerographic recording method using a recording sheet which comprises a base sheet having a suitable resistance and a photo-conductive layer coated to said base sheet and including plural kinds of sensitive particles respectively having different spectral sensitivities and distributed in a panchromatic photo-sensitive body. The recording sheet is subjected to a required number of successive image forming cycles by charging and exposing it to an original image through respective color filters and developing the resultant charge image in inversion or reverse development with respective color toners.

6 Claims, 6 Drawing Figures

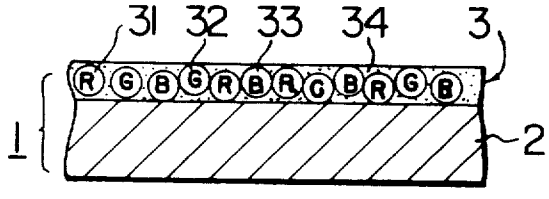


FIG. 1a

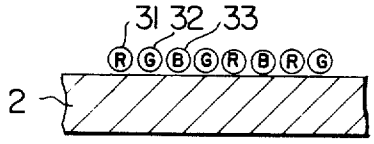


FIG. 1b

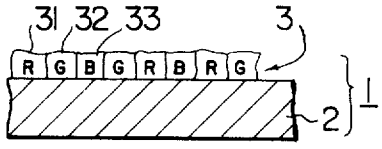


FIG. 1c

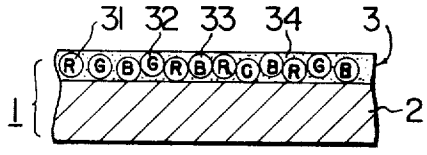


FIG. 2

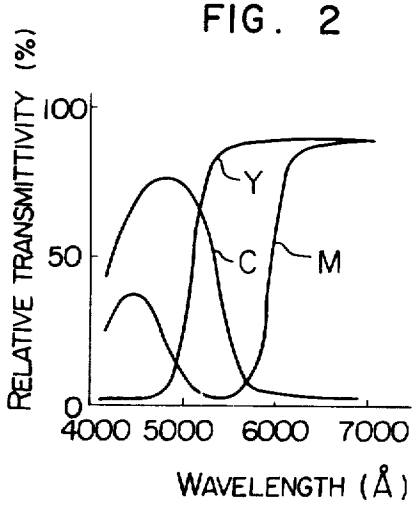


FIG. 3a

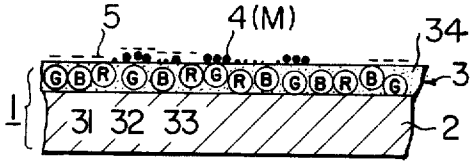
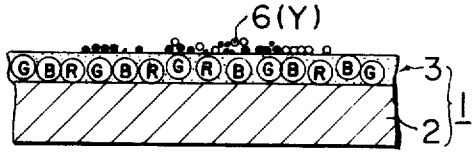


FIG. 3b



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COLOR XEROGRAPHIC RECORDING METHOD

This application is a continuation-in-part of application Ser. No. 203,143, filed Nov. 30, 1971, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to color xerographic recording methods.

2. Description of the Prior Art

The most handy color printing methods of today include the one in which a silver emulsion color film is used. Also, there are other methods, for example using a special multi-layer film or a film having a filter layer of a mosaic structure and a sensitive layer, as the recording medium. These recording media are still expensive and require complicated manufacturing processes, so that they are not still widely employed.

The usual color xerographic recording method uses a recording sheet having a photo-conductive layer formed on a base sheet having a suitable resistance, as indicated in U.S. Pat. No. 3,531,195, for example, said photo-conductive layer containing various dies dispersed in a resin composition such as zinc oxide (ZnO) to impart a panchromatic sensitivity. In this method, the sensitive layer face of the recording sheet is uniformly pre-charged and then subjected to a first image forming cycle of exposing it to an original picture through a first color filter and causing a first color toner to attach itself according to the resultant charge pattern. Thereafter, the sheet is again uniformly pre-charged and subjected to a second image forming cycle of exposing it to the original through a second color filter and developing the charge pattern with a second color toner.

A required number of the above image forming cycles are carried out using different color toners, thereby obtaining a colored replica of the original. Usually, the color toners consist of cyan, magenta and yellow toners as a set. Sometimes, a black toner is additionally employed. In such conventional recording methods, the effect of overlapping of different toners is an extremely important factor in the color reproduction of the original image. More particularly, the toner image formed in the development of the first image forming cycle affects the pre-charging and exposure in the second image forming cycle. Particularly, in case where the toner image formed in the first image forming cycle has high density, that is, where the toner has adhered to a greater extent, insufficient exposure in the second image forming cycle results. In this case, therefore, color reproduction with high fidelity cannot be expected.

Where a magenta image is first formed on the recording sheet, followed by uniformly pre-charging the sheet and exposing it through a blue filter for inversion, or reverse, development with a yellow toner, it is ideal that the yellow toner uniformly adheres to the discharged areas of the sheet. In other words, in the second and subsequent image forming cycles, the toner has to adhere in proportion to the extent of exposure irrespective of the presence or absence of the previously deposited toner.

Usually, however, in the second and subsequent image forming cycles more toner tends to be attached to edge portions of the image than the central portion thereof. This tendency is peculiar to xerographic printing and is termed edge effect. Also, in the second and succeeding image forming cycles insufficient exposure results due to the presence of the toner deposited in the previous cycles. Therefore, the reproduction of the color original with high fidelity is again difficult in this respect. Further, if the color hue of the toner that has been uniformly attached is wrong, clarity of the reproduced color image is often lost.

Meanwhile, it is well known to use a recording sheet having a sensitive body arranged in a mosaic structure, for example, as indicated in U.S. Pat. No. 3,212,887, in the color xerographic method of recording color pictures. The mosaic sensitive body itself, however, should have colors in complementary relation to sensitive spectral ranges. Also, it should have such spectral sensitivity characteristics that three colors are sharply separated. Besides, the mosaic structures for the respective colors should be independent of one another. Further, in the recording method using a mosaic sensitive sheet (mosaic method) it is an essential requirement that mosaics of the individual colors have the same sensitivity level. This is because since the recording sheet is divided into independent mosaics of the respective colors, each occupying one-third of the total area in case of a three-color mosaic structure, unless the mosaics of the individual colors have the same sensitivity level, inferior quality of the reproduced image will result from different concentrations of the individual toners attached subsequent to a single exposure step.

Such a mosaic method, therefore, is still not put to practical use because of the aforementioned difficulty of manufacture and extreme high cost of the mosaic sensitive sheet, lack in general-purpose utility and complications involved in the recording.

SUMMARY OF THE INVENTION

An object of the invention is to provide a novel color xerographic recording sheet suited to general purposes, which has a sensitive layer providing partially different spectral sensitivities.

Another object of the invention is to provide a novel color xerographic recording method, which uses a recording sheet having a sensitive layer providing partially different spectral sensitivities dispersed in a panchromatic layer or body, and in which reproduction of an original with high fidelity may be obtained through a series of image forming cycles without the toner deposited in previous cycles having any effect on the succeeding cycles.

A further object of the present invention is to provide a novel color xerographic method which by repeating the image forming cycle comprises charging, exposure with color separation and reversal development thereby to overlap colored images for producing a negative to positive reversed color image, whereby reproduction of an original with compensated color characteristics of color toners is obtained.

Another object of the present invention is to provide a novel color xerographic recording sheet having a sensitive layer providing at least in part different spectral sensitivities in contrast to the conventional one having a sensitive layer so adjusted as to provide a panchromatic sensitivity.

According to the present invention, the use of a recording sheet providing areas of different spectral sensitivities produces through the reversal development method a reproduced color image such that different color toners can only be present in certain, predeter-

mined areas of the recording sheet but also be present in overlapped states in other areas of the sheet. These areas differ from the uniformly overlapping color toners of the conventional techniques, so that sensitization discrepancy and color discrepancy due to the existence of color toners used in the previous image forming cycle during the overlapping step of image colors may be improved.

Furthermore, since the present recording sheet provides that the respective differently spectral sensitive areas are not adjacent to one another, because of an intervening area, no discrete changes in sensitivities occur between sensitive areas in close proximity to each other. Instead, area modulation of the sheet by charges in accordance with the color density of an original image picture in the exposure step occurs, so that hardness of tone of a reproduced color image which is peculiar to xerography or electro-photography is improved.

The present invention is advantageous in that no specific halftone screening means is required because of a sub-division effect of reducing an edge effect which is unavoidable in xerography.

BRIEF DESCRIPTION OF THE DRAWING

FIGS. 1*a*, 1*b* and 1*c* are schematic representations of the steps of manufacture of a xerographic recording sheet according to the invention.

FIG. 2 is a graph showing relative spectral transferency of various tonors, and

FIGS. 3*a* and 3*b* show states of a recording sheet in the recording method according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A recording sheet used in the present invention differs from one having a uniform panchromatic photosensitive characteristic as has conventionally been used in color printing of this type. This difference is one in which the sheet of the present invention has partially different spectral sensitivities although the same image forming process as that of the conventional recording sheet may be applied.

The size of the differentially sensitive areas of the recording sheet, particularly the surface diameters of the areas, may be arbitrarily selected in the range of from several microns to several hundred microns. The respective particular sensitive areas are particularly sensitive to, corresponding colors of red, green and blue much more than the other areas and as a whole constitute photo-sensitive particles of the recording sheet.

Thus, a sensitive layer of the recording sheet is substantially composed of such photo-sensitive particles having three color spectral sensitivities, whose color taken as a whole is substantially white. Particular sensitive particles, or areas, of the photo-sensitive layer are not necessarily disposed adjacent to each other, and preferably, a spacing is provided between the respective particular sensitive particles so as to exhibit gradually varying sensitivities of the boundary of closely disposed particular sensitive areas. The space between particular photo-sensitive particles is filled with a panchromatic emulsion, as will be discussed.

A considerable difference in sensitivity on the sheet is not necessary but the difference may be about 2 to 20 times in magnitude. In the present invention, since the recording sheet is exposed through different color filters to an original picture to be recorded during the exposure step, the difference in sensitivity is determined in accordance with the quantity of light having passed through these color filters.

For this reason, the charge characteristics on respective recording areas of the sheet are not very delicate and may be adjusted. Thus, the sheet may be substantially uniformly charged at a saturated charge potential of from one hundred to several hundred volts by means of a conventional corona charger.

When the recording sheet, thus adjusted, is charged uniformly and is exposed through respective color filters to an original picture, the latent charge image formed on the sheet is sub-divided into a number of dots, or the like, and the respective sub-divided dot images are subjected to area modulation and amplitude modulation in the process of exposure. The amplitude modulation is such that the charge quantity of a uniformly charged sheet is modulated with the color density of an original picture in the exposure step. The modulated charge dot images are developed with a developing agent containing tonor particles of the same polarity as that of the charged images, and consequently, a reversed image picture consisting of a number of dot images subjected to area modulation and amplitude modulation results.

Thus, in the ultimate image reproduced by successively overlapping respective color images on the sheet, there are overlapped areas and non-overlapped areas of different color tonors in co-existing relationship with each other. In this manner, color discrepancy of the reproduced image due to color difference from realistic colors of the respective tonors can be improved.

FIGS. 1*a*, 1*b* and 1*c* show the steps of manufacturing a recording sheet according to the invention. In accordance with the invention, light sensitive photo-conductive bodies, or particles **31, 32** and **33**, individually having different spectral sensitivities, are distributed over a base sheet **2** having a suitable resistance, as shown in FIG. 1*a*. Then, the distributed particles are bonded to the base sheet **2** by adding a solvent and subsequently heating the system or by rolling the system with thermal rollers in the presence of a solvent vapor, thus forming a photosensitive layer **3** on the base sheet **2** as shown in FIG. 1*b*. The diameters of the differently sensitive particles **31, 32** and **33** may be selected to be one to one-third times the thickness of the resultant photo-sensitive layer **3**.

Thus, the sheet may be prepared by, for example, printing a non-sensitizing zinc oxide photo-sensitive sheet with ink composed of dyes having sensitization to the respective colors, or overcoating a photosensitive sheet with particles which are preliminarily prepared so as to sensitize the respective colors. The former method is suitable for the provision of the aforementioned dots each having a diameter of 30 to 500 microns, while the latter is suitable for the formation of dots of 5 to 50 microns in diameter. It should be noted that, since areas sensitive to particular colors are not necessarily definitely bounded by one another, intermediate areas adjacent to the particular sensitive areas may be either of the same characteristics, of a panchromatic sensitivity, or of a non-sensitive characteristic.

Referring to FIGS. 1*a*–1*c*, there is shown an example of the steps of manufacturing a recording sheet having a photo-sensitive layer having partially different spectral sensitivities or, particular sensitive areas. The manufacturing steps are most suitable in the case where each of the particular sensitive areas, or particles, has a

diameter of from 5 to 50 microns.

Thus, one aspect of the manner of producing a photo-conductive layer of a recording sheet is explained with reference to FIG. 1*c*, in which photo-conductive particles sensitive to particular colors (red, green and blue) are prepared in the following manner.

First, a preparation of a red color-sensitive photo-conductive particle **31** is obtained of the following composition:

	Grams
Zinc oxide for electrophotographic use	400
Resin (polybutylemethacrylate)	100
Methylene blue	0.05
Solvent (toluene)	200

a green color-sensitive photo-conductive particle **32** is obtained of the following composition:

	Grams
Zinc oxide for electrophotographic use	400
Resin (polybutylemethacrylate)	100
Rhodamin B	0.05
Solvent (toluene)	200

and a blue color-sensitive photo-conductive particle **33** is obtained of the following composition:

	Grams
Zinc oxide for electrophotographic use	400
Resin (polybutylemethacrylate)	100
Uranine	0.05
Solvent (toluene)	200

Ingredients of each color-sensitive photo-conductive particle composition are kneaded in a ball mill for about one hour, and then after toluene is removed the kneaded ingredients are dried and solidified. Then, the solidified material is pulverized into particles and only particles whose particle diameter is in the range of from 10 to 20 microns are selected.

The remaining particles, whose diameters are other than 10 to 20 microns, and are not selected in the above selection, are mixed and dissolved again in a solvent of toluene so as to have a viscosity of about 50 centipoises, thus producing an emulsion for a panchromatic photo-conductive body, or layer, **34**, for bonding particles **31, 32** and **33** to the base sheet. On the other hand, the selected particles **31, 32** and **33** which have a particle diameter of 10 to 20 microns are mixed together to produce a mixture of these particles.

To use these prepared photo-conductive compositions, an emulsion for panchromatic photo-conductive body **34** is applied uniformly on the base sheet **2** to a coating thickness of about 10 microns. Immediately after this step, the above-mentioned mixture of particles **31, 32** and **33** is dispersed or dusted on the emulsion applied sheet by a hopper so that respective particles may not overlap with each other, but may be distributed densely. Then, the distributed particles are slightly pressed by a roller so as to be embedded into the emulsion, thereby producing a recording sheet as illustrated in FIG. 1*c*.

This photo-conductive layer disposed on the recording sheet has a thickness of about 15 microns, so that the mean diameter of each of the particular photo-sensitive areas becomes about 15 microns.

Each particular photo-conductive area has a gradation of spectral sensitivity in the periphery of such particular photo-conductive particle, since, when respective particles **31, 32** and **33** are dispersed and embedded into the emulsion of panchromatic photo-conductive body **34**, these particles **31, 32** and **33** whose peripheries are dissolved in a solvent of toluene contained in the emulsion are bonded to the base sheet with the portions interspersed between particles filled by the panchromatic photo-conductive body **34**.

In the section of FIG. 1*b*, different color-sensitive particles are at first glance orderly arranged adjacent to each other in a mosaic pattern. But, it should be appreciated that the particles are distributed randomly in distributed areas with the areas between the particles filled with the panchromatic photo-conductive composition in a plan view. This arrangement is different from the mosaic pattern of, for example, the above-mentioned U.S. Pat. No. 3,212,887.

As shown in FIG. 1*a*, the particular light sensitive particles, or bodies, **31, 32** and **33**, each has a particle diameter of, for example, 20 microns and are distributed on a base sheet **2** which has been treated to have a sheet resistance of 10^6 to 10^{11} ohms. The distributed particles may be also bonded to the base sheet **2** by adding a solvent, and subsequently, heating the system or by rolling the system with thermal rollers in the presence of a solvent vapor. A photo-sensitive (photo-conductive) layer **3** is formed on the base plate **2** as shown in FIG. 1*b*. The photo-conductive layer **3** is about 10 microns thick, and the dimensions of the resulting particular photo-sensitive areas, constituted by each of the sensitive particles **31, 32** and **33**, are from 20 to 50 microns.

The recording sheet **1**, thus formed, includes a photo-conductive layer having distributed areas providing different spectral sensitivities but exhibits substantially the same charge characteristic everywhere.

The photo-conductive materials of the above-mentioned particular photo-sensitive bodies **31, 32** and **33**, may also be composed of, for example, in the photosensitive body **31** sensitive to red, zinc oxide powder, a resin composition such as silicone, vinyl acetate and acrylic plastics and a sensitizer such as methylene blue and dihydroxynaphthofluorane. Also, the sensitive body **32** sensitive to green may be composed of a resin composition, such as silicone, and a sensitizer such as rhodamine B and rose Bengal. The sensitive body **33** sensitive to blue may be composed of the silicone resin composition mentioned above and a sensitizer such as uranine and piperidine. The content of the individual sensitizers is preadjusted at a small amount to avoid extreme coloring of the body.

Thus, the resultant photo-conductive layer **3** shown in FIG. 1*c* consists of photo-conductive particles **31, 32** and **33** having different color sensitivities, for instance, respectively sensitive to red, green and blue, which are distributed in a panchromatic photo-conductive body, or layer **34**. In this manner, a xerographic recording sheet is formed in which the photosensitive characteristics of a particle or photo-sensitive area, such as **31** in FIG. 1*c*, gradually vary increasingly from the panchromatic layer **34**, surrounding the area, to the center portion of the area.

In the use of the recording sheet **1** of the above structure, it is uniformly pre-charged and then subjected to

successive exposure steps through different color filters to an original picture to be recorded. The latent images thus formed are successively developed by inversion, or reverse, development with corresponding color toners. In this manner, it is possible to obtain an excellent copy with superior fidelity of color reproduction compared to copies obtainable by the conventional methods, since the areas where toners of different colors overlap are reduced.

It is well known that the relative spectral transferency of usual color toners is particularly inferior for bluish shades of magenta (M) and slightly inferior for blue and green components of cyan (C). Therefore, the toner that has been caused to adhere to a recording sheet in a previous image forming cycle will interrupt incident light when the sheet is exposed to red, blue or green part of the original. In such case, insufficient exposure results and fidelity is lost. Also, the usual developing toner (color toner) has an insulating character, so that it prevents discharging at the time of exposure (or has a so-called barrier effect). Therefore, complete discharging cannot be obtained, and some charge may remain on the photo-conductive layer.

Due to the afore-described inferior relative spectral transferency and barrier effect, exposure consistent to the original image is not obtained and charge remains where the toner in the previous image forming cycle has adhered. Where successively formed images overlap, the later the image forming cycle the less is the amount of toner attached. Therefore, reproduction of color original with high fidelity is difficult to obtain. Where the toner hue is incomplete, the reproduced color is darker than the original color in areas where different toners overlap. This tendency is particularly pronounced for the blue to green portion of the spectrum as shown in FIG. 2. In this respect, better color reproduction may be obtained by having planar distribution of different color toners rather than by having areas where different toners overlap.

According to the invention, the recording sheet 1 having photoconductive layer 3 with which different colors are partially stressed is exposed through a color filter to an original color picture and subjected to reverse development. Thus, unlike the usual method where toners of different colors are caused to overlap, it is possible to eliminate incomplete toner attachment and prevent the edge effect in later image forming cycles. Also, clarity of reproduced color may be enhanced.

Thus, in an image forming process using the recording sheet 1 of the above structure, the sheet is charged to a saturation charge potential by means of a usual corona charger. The charge potential is determined in accordance with the thickness of the photo-sensitive layer and the properties of the resin composition of the sheet. The potential may usually be several hundred volts, and may be rendered substantially uniform over the sheet containing particular photo-sensitive bodies.

Then, the charged sheet is subjected to successive exposure steps through different color filters to an original picture to be recorded. The latent images thus formed in the sheet are successively developed by reversal development with corresponding color toners. The reverse development is such that the latent images are developed with toners charged at the same polarity as that of the latent charge image. In the image thus developed, halftone areas are sub-divided into dot-like areas and the respective dots are subjected to amplitude modulation and area modulation.

The image forming cycle including the successive steps of charging, exposure with color separation and reversal development is repeated with respect to magenta, cyan and yellow respectively, and the step for forming a black image is added as required, thus completing the entire image forming cycles. The color toners used in the above-mentioned image forming cycles are electrically insulative and may be successively overlapped or may be subjected to trapping.

The color discrepancy of the image thus reproduced is reduced since the area where toners of different colors overlap are reduced and the unwanted edge effect is also reduced for the sub-division effect as compared to copies obtainable by the conventional methods. Furthermore, it is possible to obtain an excellent copy with superior fidelity of color reproduction for the area modulation effect of the present invention.

FIGS. 3*a* and 3*b* show the recording method according to the invention, utilizing a recording sheet having particular photo-sensitive areas in a panchromatic conductive body or layer. The recording sheet **1** shown in FIG. 3*a* has a first toner image **4** (for instance, magenta image) formed in the first image forming cycle. It also has a charge pattern **5**, which is formed in the second image forming cycle by uniformly pre-charging the sheet **1** and exposing it to the original through, for instance, a blue filter.

In the first image forming cycle, a green filter is used. Thus, it will be seen that the charge is totally lost in the exposed areas of green sensitive bodies **32** and generally sensitive photo-conductive body **34** forming a boundary between adjacent sensitive particles is lost, and it is slightly lost in the exposed areas of blue sensitive particles **33** and red sensitive particles **31**. In the subsequent reverse development of the sheet **1** in this state with magenta toner **4**, the toner **4** is caused to adhere to the discharge areas of the sheet **1**, such that much toner **4** attaches to the areas of the green sensitive particles **32** and panchromatically sensitive areas **34** and only slight toner attaches to the other areas. Microscopically, in the exposed zone, the charge is distributed in the form of dots, so that the edge effect that is peculiar to xerography will not result. Also, as a whole, the concentration of toner **4** attached to the sheet **1** is substantially uniform over the entire picture area.

In the next image forming cycle, the recording sheet **1** is again uniformly pre-charged and then exposed to the original through a blue filter. Microscopically considering the charge distribution over the exposed sheet **1**, charge **5** remains without being appreciably discharged in the areas of the green sensitive particles where the magenta toner **4** is present. In the areas of the panchromatic body **34** where the magenta toner **4** is also present, residual charge **5** remains due to insufficient exposure. On the other hand, in the areas of the red sensitive particles **31**, the charge is slightly lost.

The recording sheet **1** having a charge pattern as above is subjected to reverse development using a yellow toner **6**. As a result, the yellow toner **6** partly overlaps the previously deposited magenta toner **4** and partly adheres to blank areas of the sheet, as shown in FIG. 3*b*. Thus, microscopically, a uniform toner concentration is obtained in the development, and the edge effect does not result. Also, excellent color tone quality is obtained. This is achieved so because the yellow

toner 6 adheres to the areas of the blue sensitive particles 33 to a greater extent, while in the areas of the generally sensitive body 34 between adjacent particles where the magenta toner 4 is already present a lesser amount of yellow toner 6 is attached. The yellow toner attaches itself only slightly in the areas of the red and green sensitive particles.

In a particular example of image forming cycles, including the relation between the filters and the toner color processes, a recording sheet 1 produced as stated above is charged by a ususal corona discharger in a dark chamber at a voltage of −6 kilovolts until its saturated charge potential is reached. The charging is effected by shifting the discharger in parallel to the surface of the recording sheet 1 held horizontally, whereupon the sheet 1 is charged at about −500 volts.

Then a light source irradiates on an original (picture) and the image of the original is projected on the recording sheet 1 through a lens system and a color separation filter system (not shown). For example, a 150 W tungsten light source irradiates a negative color film of 35 mm size and an image on the film is enlarged four times and is focused on the sheet 1 by using a lens of F-4 (the aperture ratio) with an exposure time of about 10 seconds. A red color filter, "WRATTEN No. 25" (a tradename of KODAK) is used as this color separation filter.

The thus uniformly charged recording sheet produces thereon a charge latent image corresponding to that of the original. At this time, charges on red-sensitive areas or particles 31 and the panchromatic photoconductive body, or layer, filling the areas between the particular photoconductive areas or particles, of the recording sheet, almost vanish, while charges on the other photo-conductive areas or particles and on the peripheries thereof somewhat vanish. Thus, when the recording sheet having a charge latent image corresponding to the original is developed by a cyan reverse developing agent (toner), cyan toner is deposited on portions of the sheet at which the charges have vanished, in accordance with the vanishing quantity of charge. Therefore, the cyan toner is not uniformly deposited on the recording sheet, but may be deposited thereon so as to have a different density even within an area such as the particular photo-conductive area in accordance with the vanishing quantity of the charge.

After having been dried (which step may be omitted), the developed recording sheet is again charged at the saturated charge potential of about −500 volts by the corona discharger in a similar manner stated above. The recording sheet is then exposed to the original through a green filter for effecting color separation. When the green filter, "WRATTEN No. 58" (a tradename of KODAK) is used, the exposure time is about 25 seconds. The thus exposed sheet is subjected to reverse development by a magenta developing agent.

Subsequently, the sheet is again dried and charged at the saturated charge potential of about −500 volts and, successively, is exposed through a blue filter for color separation to the original. At this time, when WRATTEN No. 47 (a tradename of KODAK), is used at the blue filter, the exposure time is about 30 seconds. The exposed recording sheet is reverse-developed by using a yellow developing agent.

As described above, the successive image forming cycles are repeated three times with respect to cyan, magenta and yellow developing agents, whereby images of the respective colors are successively offset on the recording sheet to finally produce a reverse color image thereon.

The recording sheet according to the present invention is featured in that between distributed particular sensitive areas are disposed separation areas for possibly separating the particular areas from each other physically so that the spectral sensitivities do not change abruptly at the boundaries. In other words, the spectral sensitivity of the particular sensitive areas is about twice to 20 times that of the separation areas. Therefore, the areas where charge is lost vary in accordance with the amount of exposure, namely, an area modulation effect as mentioned above is provided, so that a wide range of reproduction of an image picture may be achieved.

As has been described, according to the invention, a photosensitive layer in which different colors are partially stressed is used in the reproduction of a color image, so that the different color toners can be present solely in some areas of the recording sheet 1 and also in the overlapped state in other areas of the sheet, whereby the incompleteness of the toner hue can be compensated and edge effect peculiar to xerography can be prevented.

What I claim is:

1. A recording sheet for color xerography comprising a base sheet and a photoconductive layer applied to said base sheet, said photoconductive layer comprising a photoconductive emulsion composition, said photoconductive emulsion composition being spectrally sensitive to at least three colors so as to be substantially white taken as a whole, and a plurality of photoconductive areas with respective ones of said photoconductive areas having different spectral sensitivities corresponding to said at least three colors, said plurality of photoconductive areas being randomly densely embedded in said photoconductive emulsion composition in non-overlapping relationship such that each respective photoconductive area has a gradation of spectral sensitivity in the periphery thereof, so that the spectral sensitivities over the layer are gradually varied between adjacent areas, thereby forming said layer.

2. A recording sheet according to claim **1**, wherein each of said plurality of photoconductive areas having different spectral sensitivities have a diametrical dimension of from 1 to ⅛ times the thickness of said photoconductive layer.

3. A recording sheet according to claim **1**, wherein each of said plurality of photoconductive areas having different spectral sensitivities have a diametrical dimension of from 5 to 50 microns.

4. A recording sheet according to claim **3**, wherein said photoconductive layer has a thickness of about 15 microns.

5. A recording sheet according to claim **1**, wherein said base sheet has a resistance in the range of 10^6 to 10^{11} ohms.

6. A color xerographic recording process using a recording sheet comprising a base sheet and a photoconductive layer applied to said base sheet, said photoconductive layer comprising a photoconductive emulsion composition, said photoconductive emulsion composition being spectrally sensitive to at least three colors so as to be substantially white taken as a whole, and a plurality of photoconductive areas having different spectral sensitivities corresponding to said at least three colors, said plurality of photoconductive areas being randomly densely embedded in said photoconductive

emulsion composition in non-overlapping relationship such that each respective photoconductive area has a gradation of spectral sensitivity in the periphery thereof, so that the spectral sensitivities over the layer are gradually varied between adjacent areas, comprising the steps of uniformly charging said recording sheet; exposing the charged recording sheet to an original image through a first color filter to produce a latent charge image on said recording sheet; developing said latent charge image on said recording sheet with a developing agent having charged color toners of the same polarity as that of said latent charge image, said color toners being in corresponding relationship to said first color filter; and repeating said steps of charging, exposing and developing for a predetermined number of different color filters, thereby producing a color image record of said original image.

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