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Roemer

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[54] PROCESS FOR THE PRODUCTION OF INTEGRALLY FORMED, RANDOM DOT PHOTOGRAPHIC IMAGES

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[58] **Field of Search** ..... 96/33, 45, 38, 91 D

[56] **References Cited**

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[57] **ABSTRACT**

Integrally screened, random dot images are prepared with no conventional screening by using grainy images as the exposure image for high-contrast, light sensitive elements. The resultant dot images can be used directly or advantageously, for example, as a lith type image for the preparation of lithographic plates.

11 Claims, No Drawings

PROCESS FOR THE PRODUCTION OF INTEGRALLY FORMED, RANDOM DOT PHOTOGRAPHIC IMAGES

This invention relates to the production of photographic images. In one of its aspects this invention relates to methods and materials for breaking continuous tone images into discontinuous photographic images. In another of its aspects this invention relates to methods and materials for the preparation of random dot discontinuous images. In still another of its aspects this invention relates to methods and materials for the production of lithographic, diazotype and/or silver photographic images wherein the images are random dot images.

The significant advances that have been made in the past few years in lithographic reproduction and generally in photographic reproduction have stimulated an ever increasing demand by the trade and the consumer for higher and higher quality at reasonable cost. One of the most significant considerations in systems for increasing quality of such reproductions is the extent to which the system will hold fine details of the original image.

In systems which include silver halide sensitized elements, one way of increasing the ability to hold fine detail has been to decrease the size of the silver halide grains used in the elements. Such elements can be developed to extremely high resolution and thus reproductions of extremely fine detail are rendered practical. However, when screening techniques (which are common in photographic, especially lithographic, systems) are utilized, even with such fine grain materials, fine details are lost.

Screens used in such systems normally comprise a meshwork of lines at right angles ruled on, e.g., glass. The screens are used to convert continuous tone images into discontinuous (halftone) images as a series of dots. These screens, although difficult and expensive to make and use, have been generally considered necessary for high-quality lithographic reproduction. Because of the difficulty, etc., associated with the use of such screens, extensive efforts have been undertaken to obviate the necessity of using screens. For example, some success has been reported using continuous tone systems. Also, tone-lining type techniques are reported to have been successfully employed in the lithographic systems. Such alternative systems, however, are often associated with rather narrow limitations on the materials, e.g., plate materials, that can be utilized with the system or involve a plurality of steps which must be carefully controlled. It is readily apparent that the art would be substantially advanced by methods and materials which tend to obviate the difficulties associated with conventional screening techniques and heretofore proposed alternative techniques.

According to the present invention I have found methods and materials for preparing integrally screened, random dot images by a relatively simple process which involves preparing a grainy light image from a continuous tone image and using the resultant grainy light image to prepare an image which comprises a series of hard dots. That is, although the random dot image may appear to be continuous, i.e., varying in a continuous fashion from white, very light gray to deeper gray and black, it is actually made up of a series of black dots varying in number and size. The dotted images are thus analogous to conventional halftone images but, according to the present invention, the dots are integrally formed and randomly disposed.

According to one embodiment of the present invention a high-contrast (i.e., gamma $\geq$ 4), light sensitive element is exposed directly to the grainy light image from a grainy photographic image. The high-contrast material, i.e., having a contrast of at least 4 and advantageously at least about 8, of course, picks up dense image areas but also picks up some of the grain of the grainy photographic image even in highlight areas and results in definition retention of extremely high quality and apparent sharpness. That is, by using grainy (therefore, often considered low quality) photographic images as an exposure image for the exposure of a high-contrast, light sensitive element, very high quality is obtainable as compared to the exposure of a high-quality (low grain) photographic element to the high-contrast material.

The grainy image can be obtained in any of a number of known ways such as using (1) an overexposed and overdeveloped negative; (2) a high temperature process; (3) a high-speed film; (4) a high-activity developer; or (5) image enlargement. It is desirable in some situations to utilize a combination of such methods such as high-speed film processed in a high-activity developer so that very large grain can be formed. The amount of graininess that will be desired will depend to some extent on the ultimate use to which the high-contrast material will be put. An image which is subjectively evaluated as grainy by artisans will normally produce the desired effect. It will, however, be realized that the graininess of the photographic image should be matched with the sensitivity of the high-contrast material so that the high-contrast material will sense the grains and upon development register them as sense dots. Although it is desirable to use as the grainy image a photographic image having a granularity of at least about 20 and advantageously about 30 (as considered under normal viewing conditions), it will be understood that often the graininess of an apparently very fine grain material can be considerably increased by image magnification, for example, by conventional methods of enlargement. It will be understood that although graininess is a relative expression, it has a meaning that is acknowledged and understood by artisans, i.e., the subjective appearance of non-uniformity of the image.

The high-contrast materials that can be employed according to the present invention vary widely. Accordingly, satisfactory results are achieved with such light sensitive materials as photoconductive elements (e.g., using standard electrophotographic techniques but using as the exposure image a grainy photographic image), diazotype elements, lithographic elements, high-contrast silver halide materials, etc.

In an especially advantageous embodiment the high-contrast material is silver halide sensitized photographic element, desirably a lith-type element, e.g., Kodalith Type III film, which exposed directly to a grainy light image and developed in an infectious, desirably lith-type, developer, e.g., Kodak D–85 developer especially with still development. The resultant image is a broken image which is an accumulation of hard (in the color sense) black dots which vary in size and frequency and are distributed in substantially random fashion. The reference to random distribution herein distinguishes the dots formed according to the present invention from those formed in conventional half-tone images. This takes into account that in my system an accumulation of the dots can represent an image, but otherwise the dots are arranged according to no predetermined pattern.

The processed lith element having the random dot image thereon may, of course, be viewed directly but is desirably then used as an exposure element for exposing other light sensitive elements. The other light sensitive materials may be lithographic plate materials, diazotype materials, or conventional silver halide sensitized materials. In each case surprisingly sharp images are obtained and fine details of the original exposure image are remarkably recognizable. With conventional silver halide materials the texture of the original exposure image is much more noticeable.

When a lith-type element is used as an intermediate, the general procedure which would be followed would be to expose a silver halide sensitized lith-type element, i.e., a silver halide gelatin emulsion containing at least 50 mole percent chloride and having a contrast greater than 4 desirably greater than 8, such as shown in Henn et al. U.S. Pat. No. 3,128,180 and Milton U.S. Pat. No. 3,294,537, directly to a grainy light image, for example, the light image from a grainy photographic image advantageously produced from a coarse grain (high speed), silver halide sensitized film, e.g., X-ray film or film having an average particle size, projected area, of more than about $0.8\mu^2$ and advantageously more than about $0.9\mu^2$.

(See Table 2.1 page 39, Mees and James, *The Theory of the Photographic Process*, The MacMillan Co., New York, 1966.) The imagewise exposed lith-type element is developed in a lith-type developer, for example, as disclosed in an article, "-Formaldehyde-Hydroquinone Developers and Infectious Development," J.A.C., Yule, *Journal*, Franklin Institute, March 1945, No. 3, Vol. 239. A second light sensitive medium is then exposed directly to a light image from the resultant hard dot image of the lith element by, for example, reflex exposure, by projection exposure, etc. The imagewise exposed second material is then developed conventionally to a sharp random dot image.

In a highly advantageous embodiment, the second mentioned light sensitive material is another high-contrast photosensitive element, for example, diazotype material, e.g., for mapping layouts, etc.; lithographic plate materials, e.g., those having light sensitive coatings on metal supports, especially as described in Houle and VanNorman U.S. Pat. No. 3,342,601 or U.S. Ser. No. 731,181, now abandoned; etc. Litho plate, etc. materials thus are desirably prepared and used substantially according to conventional techniques except that the lith-type element used would not be exposed by standard screening procedures but rather are exposed directly to a grainy light image and images of remarkable detail are produced. In exposing lith plates to light images from the lith element it is also desirable in many instances to use slightly less than conventional exposure times. (It should be noted that the reference to "directly to" and similar phrases used herein indicate that the exposures are made in the absence of a conventional screen.)

The following examples are intended to illustrate my invention and/or advantages thereof:

EXAMPLE 1 (Formation of a grainy image)

A film of the type generally used in medical X-ray having a coarse grained, silver halide sensitized gelatin emulsion coated at a low gel coverage on both surfaces of a transparent support is contact exposed (3 seconds) to the light image (6 watt lamp, 6 feet from the film) from a continuous tone negative film using a printing board to assure uniform contact of the films. The imagewise exposed film is processed according to conventional techniques using a developer having the following composition:

Sodium carbonate monohydrate	about	5.5 gm.
Sodium sulfite		0.5 gm.
Potassium bromide		1.9 gm.
Hydroquinone		1.5 gm.
p-methylaminophenol sulfate		4.6 gm.
Sodium tetraphosphate		4.0 gm.
Water to		1 liter

for 1 minute and 15 seconds at 68° F., and conventional hypo.

The resultant positive image has readily discernible grain.

EXAMPLE 2 (Formation of a grainy photographic image)

The procedure according to Example 1 is followed except that the coarse grained, silver halide sensitized gelatin emulsion is on one surface of the support only. Similar results are achieved.

EXAMPLE 3 (Formation of a grainy photographic image)

The procedure analogous to Example 1 is followed except that a conventional high-speed negative material is used in lieu of the X-ray type film. The processed positive image is grainy but less so than the image formed in Example 1.

EXAMPLE 4

A photoconductive element of a standard electrophotographic copying device is exposed directly to a grainy light image from the grainy photographic image formed in Example 1 and a copy of the image is produced in the normal manner. Random dot copies are produced which show substantially more detail than similar copies prepared by exposing the photoconductive element directly to the light image from a fine grain (high-quality) positive photographic image.

EXAMPLE 5

A lithographic plate material of the type described in U.S. Pat. No. 3,342,601 is exposed directly to a grainy light image from the grainy photographic image formed in Example 1. The plate is then developed, etc. in the conventional manner and run on the press. Random dot copies are produced which show substantially more detail than similar copies prepared in the same manner but by exposing the same type of lithographic plate material directly to a fine grain (high-quality) positive photographic image.

EXAMPLE 6

A lith film (a high-contrast, greater than 4, silver halide sensitized gelatin emulsion containing at least 50 mole percent chloride) is exposed (contact with a vacuum frame) to the light image (3 seconds to a 6 watt bulb at 6 feet) from the grainy photographic image produced in Example 1. The imagewise exposed film is processed conventionally using a fine line developer with approximately 30 seconds agitation and about 2½ minutes of still development. The developer containing hydroquinone, sodium formaldehyde bisulfite, sodium carbonate, sodium tetraphosphate, and boric acid (see, for example, Kridel U.S. Pat. No. 2,843,483) is advantageously agitated just until the image becomes apparent under safelight conditions and then agitation is stopped and the rest of the development takes place in still development. The resultant lith element contains a negative image comprising integrally formed, randomly disposed, hard dots.

EXAMPLE 7

The procedure according to Example 6 is followed except that the grainy image from Example 2 is substituted for the photographic image from Example 1. Similar results are achieved.

EXAMPLE 8

The procedure according to Example 6 is followed except that the grainy image from Example 3 is substituted for the photographic image from Example 1. Similar results are obtained.

EXAMPLE 9

A positive is made of the negative image of Example 6 using no screen and contact exposure of the same type of lith film and same type of processing used in Example 6. The resultant hard dot positive image is then used as an exposure image to expose a direct positive diazo paper material (Bruning Resolute diazo paper). Upon development of the diazo paper by conventional methods, sharp images of extremely fine detail are formed in the diazo paper.

EXAMPLE 10

A light sensitive lithographic material prepared as described in U.S. Pat. No. 3,342,601 is exposed to a light image from a negative material prepared according to Example 6. The litho plate is processed in accordance with standard procedures and run on a press. Copies having remarkably fine image detail are obtained.

EXAMPLE 11

The procedure according to Example 10 is followed except that the negative material of Example 7 is substituted in place of Example 6. Similar results are achieved.

EXAMPLE 12

The procedure according to Example 10 is followed except that the negative material of Example 8 is substituted for that of Example 6. Similar results are achieved.

EXAMPLE 13

A light sensitive, fine grain, silver halide portrait paper is exposed to a light image from a negative material prepared in accordance with Example 6. The imagewise exposed portrait paper is processed using a standard fine grain developer and conventional hypo. The resultant random dot image is very sharp and emphasizes the surface texture of the subject image.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

I claim:

1. A method for the preparation of integrally screened, random dot images comprising:

a. exposing a photographic element having a transparent support and a coarse grained, silver halide sensitized gelatin emulsion on at least one surface thereof directly to the light image from a continuous tone photographic image;

b. processing the imagewise exposed element to form a grainy image therein;

c. exposing a high-contrast photosensitive element directly to a grainy light image from said grainy photographic image; and

d. processing the imagewise exposed high-contrast element to produce random dot images.

2. The method of claim **1** wherein said photographic element has a silver halide sensitized gelatin emulsion on both sides thereof.

3. The invention according to claim **2** and wherein step (a) is accomplished by (i) exposing an element having a coarse grained, silver halide sensitized gelatin emulsion on at least one surface thereof directly to the light image from a continuous tone photographic image; and (ii) processing the imagewise exposed element to form a grainy image therein.

4. The invention according to claim **2** and wherein said high-contrast photosensitive element comprises a support having thereon a lith-type silver halide gelatin emulsion.

5. The invention according to claim **2** and wherein said high-contrast photosensitive element comprises a support having thereon a lith-type silver halide gelatin emulsion and further including the steps:

d. exposing another light sensitive element to a light image from the random dot image produced in step (c) and

e. processing the imagewise exposed element from (d) to form a second dot image.

6. The invention according to claim **5** and wherein said light sensitive element in (d) is a diazo sensitized material.

7. The invention according to claim **5** and wherein said light sensitive element in (d) is a lithographic plate material.

8. The invention according to claim **5** and wherein said light sensitive element in (d) is a silver halide sensitive photographic element.

9. The invention according to claim **5** and wherein said light sensitive element in (d) is a photoconductive element.

10. The invention according to claim **2** and wherein the grainy image in (a) has a granularity of at least about 20 and the high-contrast material in (b) has a gamma of at least about 4.

11. The invention according to claim **2** and wherein the grainy image in (a) has a granularity of at least about 20, the high-contrast material is a silver halide sensitized element having a gamma of at least about 8, and the processing of step (c) involves a lith-type developer.

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