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[54] **PHOTOGRAPHIC DIFFUSION TRANSFER
PRODUCT AND PROCESS**
18 Claims, No Drawings

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ABSTRACT: A receiving layer for use in the silver salt diffusion transfer process comprises a silver precipitant, 2-methyl hydroquinone, p-N-methylaminophenol, an alkali metal bromide and a silver halide solvent.
A plurality of copies are obtained from a single negative by the silver salt diffusion transfer process by repeatedly contacting an exposed silver halide emulsion layer containing hydroquinone with this receiving layer in the presence of an aqueous alkaline processing solution containing a silver halide solvent.

PHOTOGRAPHIC DIFFUSION TRANSFER PRODUCT AND PROCESS

BACKGROUND OF THE INVENTION

The present invention relates to a method of obtaining a plurality of copies by the silver salt diffusion process.

According to the general principle of the diffusion transfer process described in U.S. Pat. No. 2,352,014 and in "Photography, Its Materials and Processes" by C. B. Neblette, 5th edition, pages 234-244, an imagewise exposed photographic silver halide emulsion layer (negative) is brought into contact with a nonlight-sensitive receiving layer (positive) containing development nuclei in the presence of a developer and a solvent for the silver halide. During the formation of the image in the emulsion layer, sufficient amounts of silver halide are complexed on the nonexposed parts of the negative by diffusion transfer in the nonlight-sensitive receiving layer to form a positive as a result of the reducing action of the developer which is catalyzed by the development nuclei present in the receiving layer.

The meaning of the terms "negative" and "positive" as used in this description is relative; if the emulsion layer is exposed to a negative image, a direct negative will be produced in the receiving layer; if the emulsion layer is exposed to a positive image a direct positive will be obtained in the receiving layer.

This principle of the diffusion transfer process is applied for quickly printing letters, documents and drawings. In general, only one usable positive print can be obtained with the printing apparatus suitable for this purpose, although the quantity of silver used therefor represents only a small part of the available amount of silver halide in the unexposed parts of the silver halide emulsion layer, so that theoretically there is the possibility of making several prints of one same negative.

It is, however, desirable to obtain several prints of the same original. If, however, one tries to make more than two copies of the same negative by bringing the latter into contact with a series of receiving layers in the presence of the appropriate developing or activating solution, a quite unsatisfactory result is attained.

BRIEF SUMMARY OF THE INVENTION

According to the present invention, a receiving layer comprises 2-methyl hydroquinone, p-N-methylamine phenol, an alkali metal bromide such as potassium bromide, a silver precipitant, and a silver halide solvent. A plurality of copies of a single negative are made by repeatedly contacting the exposed silver halide emulsion layer in the presence of an aqueous alkaline activator solution with this receiving layer. The silver halide emulsion contains hydroquinone and the aqueous alkaline activator solution contains a silver halide solvent.

DETAILED DESCRIPTION OF THE INVENTION

The silver halide emulsion layer is of the conventional type used in the silver salt diffusion transfer systems except that it includes hydroquinone. Suitable emulsions include silver chlorobromide emulsions, silver bromide emulsions containing silver chloride and silver chloride emulsions any of which can also contain small amounts of silver iodide. For obtaining a quick diffusion transfer of the complexed silver halide, preferably emulsions are used which mainly contain silver chloride. If, however, exposure time as short as possible is wanted, it is advantageous to use sensitive silver bromide emulsions which contain a small amount of silver chloride. The binder for the emulsion is conveniently gelatin, but may include other known binders, either alone or in admixture with gelatin. The amount of silver in the emulsion can vary widely and is generally present in an amount equivalent to from about 0.5 to about 5 grams AgNO_3 per square meter. The amount of hydroquinone in the emulsion layer can vary widely, but it is generally between about 0.1 to about 0.5 grams per square meter, e.g., 0.2 grams per square meter.

The positive, or receiving, layer includes a silver precipitant such as development nuclei for promoting development of dif-

fused silver salt to metallic silver, or a substance or substances capable of forming such nuclei in situ, e.g., by reaction with a compound or compounds present in a processing liquid. Suitable development nuclei include the sulfides of heavy metals, e.g., of antimony, bismuth, cadmium, cobalt, lead, nickel, silver and zinc. Selenides, polysulfides, polyselenides, mercaptans, stannous halides, heavy metals or their salts, and fogged silver halides are also suitable for this purpose. The complex salts of lead sulfide and zinc sulfide are effective either in themselves or mixed with thioacetamide, dithiobiuret and dithiooxamide. The development nuclei are provided in any conventional binder such as gelatin.

The receiving layer, which is provided on any convenient suitable support also contains 2-methyl hydroquinone, p-N-methylaminophenol developing agent and a small amount of silver halide solvent and an alkali metal bromide such as potassium bromide. The amount of 2-methyl hydroquinone in the receiving layer can vary widely but is preferably not less than 0.2 grams and can be within the range of about 0.2 to about 2.0 grams per square meter. The amount of p-N-methylaminophenol in the receiving layer can also vary widely, but is preferably not less than 0.5 grams and can be within the range of about 0.5 to about 2.0 grams per square meter. Preferably, the concentration of p-N-methylaminophenol is from about 0.5 to about 1.0 gram per square meter and the concentration of 2-methylhydroquinone is from about 1.0 to about 0.2 grams per square meter of the receiving material. These two developing agents can be used in substantially inverse proportions to each other, e.g., if the concentration of the p-N-methylaminophenol is doubled, that of the methyl hydroquinone can be halved. The alkali metal bromide, e.g., potassium bromide, is present in the receiving layer in a small amount, less than about 0.5 grams per square meter and preferably from about 0.03 to about 0.3 grams per square meter. The amount of silver halide solvent, preferably sodium thiosulfate, present in the receiving layer is also less than about 0.5 grams per square meter and preferably from about 0.03 to about 0.3 grams per square meter. The concentrations of the bromide and thiosulfate in the receiving layer are preferably substantially equal, e.g., about 0.1 gram per square meter.

The alkaline processing solution can include carboxymethylcellulose or other conventional thickening agent if desired and in the usual amount to achieve a desired consistency. The pH of the solution is preferably at least about 9.5. The amount of silver halide solvent, conveniently sodium thiosulfate, can vary widely and conventional levels, known per se in the art, can be used. In general, the concentration of sodium thiosulfate will be between about 2 and about 5 grams per liter. The activator solution is preferably substantially free of developing agents. Suitable bases for use in the processing liquid are inorganic bases such as sodium hydroxide, potassium hydroxide, lithium hydroxide, ammonium hydroxide, sodium carbonate and sodium phosphate, or organic bases such as organic amines such as diethanolamine. When using a weak alkali, e.g., sodium phosphate, it is appropriate to use an amount of the anhydrous salt of from, e.g., 50 to 200 gram per liter. In the case of a compound which imparts a high degree of alkalinity, e.g., sodium hydroxide, a lesser amount, e.g., from 5 to 20 grams, will suffice.

The processing liquid can further contain other usual ingredients such as sodium sulfite, e.g., in an amount of from 10 to 40 grams per liter, a calcium sequestering compound and a black toning agent, e.g., 1-phenyl-5-mercapto-tetrazole.

The following example is included for a further understanding of the invention:

EXAMPLE 1

A gelatino silver halide emulsion is coated on a support to provide an equivalent to 1.2 grams AgNO_3 per square meter. The emulsion contains hydroquinone in an amount sufficient to provide 0.2 grams per square meter. After exposure to an

image in the usual manner, the exposed original is pressed into contact with a receiving layer in the presence of an aqueous activator solution containing 5 grams per liter sodium thiosulfate and buffered to a pH of 10.5 with trisodium phosphate. The receiving layer is provided by coating, on a paper sheet, a gelatin layer containing nickel sulfide, 0.2 grams per square meter methyl hydroquinone, 0.5 grams per square meter of p-N-methylaminophenol, 0.1 grams per square meter of potassium bromide, and 0.1 grams per square meter of sodium thiosulfate. In this manner, six good copies of the original image are obtained from the single negative.

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 receiving layer for use in the silver salt diffusion transfer process comprising a silver precipitant, 2-methyl hydroquinone, p-N-methylaminophenol, an alkali metal bromide and a silver halide solvent.

2. A photographic element comprising a support having thereon said layer of claim 1.

3. A layer of claim 1 wherein said receiving layer comprises from about 0.03 to about 0.3 grams per square meter of alkali metal bromide.

4. A layer of claim 1 wherein said receiving layer comprises an amount of silver halide solvent within the range of about 0.03 to 0.3 grams per square meter.

5. A layer of claim 1 wherein said silver halide solvent is sodium thiosulfate.

6. A layer of claim 1 wherein said receiving layer contains an amount within the range of about 0.2 to about 4.0 grams per square meter of 2-methyl hydroquinone and about 0.5 to about 4.0 grams per square meter of p-N-methylaminophenol.

7. A layer of claim 6 wherein the amount of said hydroquinone is substantially inversely proportional to the amount of said p-N-methylaminophenol.

8. A layer of claim 3 wherein said receiving layer contains substantially the same concentration of silver halide solvent and alkali metal bromide in grams per square meter.

9. A method of obtaining a plurality of copies from an exposed silver halide emulsion by the silver salt diffusion transfer process which comprises contacting an exposed emulsion layer containing silver halide and hydroquinone with a first

receiving layer containing development nuclei, 2-methyl hydroquinone, p-N-methylaminophenol, an alkali metal bromide and a silver halide solvent, in the presence of an aqueous alkaline activator solution comprising silver halide solvent to form a first copy in said first receiving layer, separating the layers, and recontacting said exposed silver halide emulsion layer with at least one additional receiving layer containing development nuclei, 2-methyl hydroquinone, p-N-methylaminophenol, an alkali metal bromide and a silver halide solvent in the presence of said activator solution to form at least one additional copy in each of said additional receiving layers.

10. A method according to claim 9 wherein said emulsion layer contains from about 0.5 to about 0.1 gram per square meter of hydroquinone.

11. A method according to claim 9 wherein said receiving layer contains from about 0.03 to about 0.3 grams per square meter of alkali metal bromide proportionally to the bromide concentration, from 0.03 to 0.3 grams per square meter of said silver halide solvent.

12. A method according to claim 9 wherein said silver halide solvent is sodium thiosulfate.

13. A method according to claim 9 wherein said receiving layer contains an amount within the range of about 0.2 to about 4.0 grams per square meter of 2-methyl hydroquinone and an amount within the range of about 0.5 to about 4.0 grams per square meter of p-N-methylaminophenol.

14. A method according to claim 9 wherein said silver halide solvent of said aqueous activator solution comprises sodium thiosulfate.

15. A method according to claim 13 wherein said receiving layer contains an amount within the range of from about 0.2 to about 1.0 grams per square meter of 2-methyl hydroquinone and inverse proportionally, from about 0.5 to about 1.0 grams per square meter of p-N-methylaminophenol.

16. A method according to claim 11 wherein the substantially equal concentrations of silver halide solvent and alkali metal bromide in grams per square meter of receiving material are used.

17. A receiving layer of claim 1 in which said layer is substantially free from silver halide complex.

18. A method of claim 9 in which said first receiving layer and said additional receiving layers are substantially free from silver halide complex.

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