PATENT SPECIFICATION

Convention Date (Austria): May 9, 1936.

498,870

Application Date (in United Kingdom): May 10, 1937. No. 24630/38.

(Divided out of Application No. 13250/37).

Complete Specification Accepted: Jan. 10, 1939.

COMPLETE SPECIFICATION

Process of Colour Photographic Development

We, KODAK LIMITED, a Company registered under the Laws of Great Britain, of Kodak House, Kingsway, London, W.C.2 (Assignees of Karl Schinzel of Ottendorfergasse 12, Troppau (Silesia) Czechoslovakia, formerly residing in Vienna, Austria, a citizen of the Republic of Czechoslovakia), do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to improvements in processes of colour photography and in particular to the production of dye images from photographic silver salt images.

It is known that coloured photographic images may be formed by using a developer which forms a coloured compound on development.

In the production of three-colour photographs using elements having three differentially colour sensitive layers on a single support, there is often employed a process of coupling development in which a coupling component combines with the oxidation product of an aromatic amino developing agent. It has now been found that in three-colour reversal development and three-colour redevelopment (i.e. development of silver salt images obtained from developed silver images) the most favourable results are obtained with simple direct colour developers which are oxidised to insoluble or at least non-diffusing dye by silver halide which has been exposed or rendered developable in any other manner, e.g. by treatment with fogging agents.

According to the present invention, in a process of three-colour photography in which three colour component silver salt images on a single support are processed to different colours, a colour component image is converted into a dye image with a developing solution containing alkali, little or no sulphite and a developing agent consisting of a generator of a substituted lignone dye, the silver being subsequently removed without removing the dye associated therewith. Two or more colour component images may be so converted.

Substituted lignone dyes are obtained on development with α phenols having both ortho positions occupied by not readily oxidisable groups and with the para position free or occupied by an easily displaceable group, or (b) *p-p*-dihydroxydiphenyls having all four positions ortho to the hydroxyl groups occupied by not readily oxidisable groups or (c) α-naphthols or their higher ring homologues having the 2-(or 4-) position occupied by a not readily oxidisable group and the 4-(or 2-) position free or occupied by an easily replaceable group. The simplest lignone dye, diphenoquinone cannot be reduced, so far as we are aware, by development of a silver salt but the substitution products can readily be made.

Thus, for example, orange-yellow coerulignone is produced when a silver salt is developed with an alkaline solution of pyrogallol dimethyl ether or of hydrocoerulignone and a red-yellow image is left after removal of the silver with Farmer's solution. Alkaline solutions of pyrogallol dimethyl ether, including ammoniacal solutions are remarkably stable in comparison with solutions of hydrocoerulignone. Similarly coloured images, especially on developing fully exposed silver chloride, are obtained with *vic.-m*-xylenol.

Purple-red lignones are formed when silver salt images are developed with alkaline solutions of *o-o*-dichlor-, dibrom- or diiodo-phenol although these developing agents are soluble in sodium carbonate. Triiodophenol can also be used since one of the iodine atoms is readily displaced during the development.

The monoalkyl ether of 1:4-dihydroxynaphthalene (α - naphthhydroquinone) gives an intensely blue image. The 2-monoalkyl ether of 1:2-dihydroxynaphthalene yields a purple-red image. The mono-ethers of 1:4-dihydroxyanthracene yield a green image and the mono-ethers of 1:2-dihydroxyanthracene yield a brick-red image.

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Instead of alkoxy groups in the 2- or 4-positions of α-naphthol, other groups can be present such as the phenyl group. 2-phenyl-α-naphthol yields a purple image. Tetramethoxy-α-naphthol forms a blue image.

Monoethers prepared from 1:4 or 1:2-dihydroxy derivatives of higher aromatic ring systems, especially anthracene, can be employed, if desired with a heterocyclic ring attached or with a wholly or partially hydrogenated ring not containing the lignone-forming substituents.

Instead of etherifying one hydroxy group with methyl or ethyl radicals, this may be done with benzyl or phenyl-ethyl or other monovalent hydrocarbon radicals. Also the ether group may be replaced by a phenyl or other aryl group.

Etherification can be accomplished by first allowing ethylene oxide to react in the required amount with one hydroxyl group, followed by esterification of the hydroxyl groups in the hydroxyl-alkyl-ether by means of the chlorides of aliphatic or aromatic acids in the presence of tertiary bases; if necessary, the aromatic hydroxyl group may first be converted into the easily split carbethoxy-derivative. This object may often be attained in other ways, for example, by substitution of the halogen in 4-brom- or 2-brom-α-naphthol by the phenol residue by means of sodium phenate in the presence of copper bronze. One can allow *p*-toluene-sulphochloride to act on the ethers of 4-amino-α-naphthol in the presence of tertiary bases, whereby an aryl-sulphonylamine group of the same character as an aromatic hydroxyl group is formed. Red images are formed during developing in caustic alkali or sodium carbonate solution. The analogous derivative of 2-alkoxy-α-naphthylamine yields violet-red colour images. If the aromatic hydroxyl group is already alkoxylated by the hydroxethyl residue, esterification of the aliphatic hydroxyl group and aryl sulphonylation of the amino group can be accomplished together by using an excess of *p*-toluol sulphochloride. Amino and hydroxyl groups can be introduced into the phenyl residue or the second nucleus of 2-phenyl-α-naphthol or of the monoethers of 1:2- and 1:4-dihydroxynaphthalene mentioned, and these can be blocked by acylation, alkylation or arylation. This often brings about a far-reaching change of colour, as can be seen by comparison of the lignone from 2-phenyl-α-naphthol with that from its tetra-methoxy derivatives.

Substantially pure dyestuff images are left when the silver produced together with the colour during development, is removed by means of a silver solvent such as Farmer's solution.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. In a process of three-colour photography, in which three colour component silver salt images on a single support are processed to different colours, the step which consists in converting a colour component silver salt image into a dye image with a developing solution containing alkali, little or no sulphite and a developing agent consisting of a generator of a substituted lignone dye, the silver being subsequently removed without removing the dye associated therewith.

2. Process as claimed in Claim 1 in which two or more colour component images are so converted into dye images.

3. In a process as claimed in Claim 1 or 2, in which the developing agent is a naphthol derivative having an alkyl or alkoxy group in the 2- or 4-position.

4. Process as claimed in Claim 1 or 2 in which the developing agent is a naphthol derivative having an aryl or aryloxy group in the 2- or 4-position.

5. Colour photographic images whenever produced by the processes claimed in any of the preceding claims.

6. Process for the production of a dye image from a photographic silver salt image, substantially as hereinbefore described.

Dated this 20th day of August, 1938.

W. P. THOMPSON & CO.,
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Chartered Patent Agents.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1939.