PATENT SPECIFICATION

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No. 35099/38.

COMPLETE SPECIFICATION

Improvements in the production of Multi-layer Colour Photographs by Reversal

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 No. 12, Troppau (Silesia), Czechoslovakia, (formerly residing in Vienna, Austria), a Citizen of the Republic of Austria), 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 a method for the production of colour photographs by reversal in elements having three differentially colour sensitized silver halide emulsions on a single support.

The invention may be applied to a three-layer material, i.e. one in which three differentially colour sensitized silver halide emulsion layers are coated on a single support, or to a two layer material of the kind in which one emulsion layer contains a mixture of silver halide emulsions respectively sensitized for the red and green regions of the spectrum and a second emulsion layer consists of a not specially colour sensitized silver halide emulsion.

In the three layer material the upper layer is generally blue-violet sensitive, the middle layer yellow and green sensitive, and the lower layer red sensitive. In order to limit diffusion to a minimum, it is advisable to make the two upper layers as thin as possible, about 0.005—0.01 mm., requiring the use of very fine-grain emulsions, relatively poor in silver, for three-colour reversal development.

If filter layers are interposed, strongly-swelling gelatine must be used for these so that the individual layers are spaced away from one another during the chemical reactions. These filter layers are kept so thin, 0.01 and less, that no undesirable increase of light scattering ensues, despite the fact that they may swell up tenfold. The lower layer can have the normal thickness of 0.02 mm. or for reversal development 0.01—0.015 mm., so that the total thickness of the three layers is about 0.025—0.04 mm. While the two upper layers require developers which intensively dye the image, less intensity is required for the lower layer, since this layer may contain considerably more silver halide than the upper and middle layers.

In order to obtain a vigorous, well-graded blue image, which is of primary importance for the character of the colour photograph, coating of the lower red-sensitive emulsion (or infra-red sensitive for printing elements) of an average thickness of about 0.02 mm. using a highly sensitive emulsion of medium soft gradation, preferably sensitized only for red and orange, is recommended. Above this, a yellow and green-sensitive emulsion of medium sensitivity and a thickness of not more than 0.01 mm. is coated, and over that a not specially colour sensitized emulsion also of medium sensitivity and a thickness of 0.005—0.01 mm. For this purpose, a transparent, coarse-grain silver bromide emulsion can be used. Finest grain emulsions, are, however, to be preferred, because their blue and blue-green sensitivity can be strongly increased by modern sensitizers (see, for example, British Patent No. 376,746).

The order of the three layers just described can be changed, if a very sharp blue image is desired, by having the upper emulsion sensitive to blue-violet, the middle emulsion to red and orange (or infra red) and the lower emulsion to yellow and green; in which case they are developed lemon-yellow, green-blue and purple respectively. It is less desirable to arrange the layers so that the upper emulsion is red sensitive, the middle emulsion yellow-green sensitive and the lower emulsion blue sensitive, because although there are red sensitizers produced today, which in stronger concentration sensitize better for red than for blue, and this effect can still be increased by adding desensitizers for blue, nevertheless, there is, as a rule, an unavoidable greater increase in general sensitivity.

These variations have been made possible by the fact that red sensitizers which do not sensitize to green and yellow

but very strongly sensitize to the extreme orange red, in addition to the genuine red, for example 4:4¹-dichloro-2:2¹:8-triethylthiacarbocyanine chloride, can now be made.

The insertion of a yellow filter, transmitting also red rays, between the blue-sensitive and the middle yellow-green or red-orange-sensitive emulsion layers is generally necessary for exposure purposes, even if the blue rays are generally absorbed by a yellow filter layer, because there are no means at present permitting complete suppression of the blue-sensitivity of the two other emulsions. A green filter between the middle and lower layers is generally unnecessary for exposure purposes, and a red-orange filter is very seldom required, since many of the present-day red-orange sensitizers are without effect in the green and yellow parts of the spectrum.

If the filter dyes necessary for the division of the spectrum into three parts are added to the silver halide emulsion layers; namely, yellow to the blue-sensitive layer, red-orange or green to the middle layer, the true colour is to a certain degree affected, because, regardless of the thinness of the layers, formation of the latent image can take place only in the upper part of each emulsion layer; this effect is particularly noticeable in reversal development.

The use of intermediate layers as colour filters is recommended, because strongly-swelling gelatine layers between the silver halide emulsion layers appear necessary for reasons of development-technique. It is usually sufficient to colour the gelatine layer adjacent to the blue-sensitive emulsion yellow, or also the blue-sensitive emulsion itself. The other intermediate gelatine layer, if it is present at all, may remain colourless, or may also be coloured yellow instead of red or green.

The whole triple layer with one or two intermediate layers, or without them, may also be coloured yellow throughout; most simply, by subsequent bathing in dye solutions.

In the element having one layer composed of two kinds of grains and the other layer composed of not specially colour sensitized emulsion, the latter layer may be coloured yellow throughout or there may be a yellow filter layer between the two emulsion layers. In such an element the latter layer may be alone on one side of the support and the mixed grain layer on the other. In the three-layer element the red or yellow-green sensitive silver halide emulsion layer can be situated alone on the back of the support and the two others on the front.

In the production of three colour photographs by reversal in such elements, the latent images are first developed to silver and the residual silver halide (if desired after conversion in one or more layers into silver chloride in a fine state of subdivision as described and claimed in application No. 26472/38 of even date) is rendered developable in each layer and processed to the appropriate colour. Methods of individual exposure and colour processing of the layers are described in applications Nos. 13250/37, 33290/38, 26469/38, 26470/38, 26471/38, 34977/38 (Serial No. 498,874 and 34979/38) (Serial No. 500,611).

It has now been found that the character of the coloured reversed images in such elements having three differentially colour sensitized silver halide emulsion layers on a single support, can be improved by a very careful general exposure, or additional exposure through colour filters, of all or some of the layers.

We are aware that in specification No. 446,172 there is described and claimed a photographic reversal process comprising exposing a photo-sensitive silver halide layer in the usual manner, subjecting the exposed layer to a first development so that the layer then consists of a negative image in silver and light sensitive material unaffected by the original exposure, removing the negative silver image leaving the unaffected light sensitive material, exposing the residual light sensitive material to light, and subjecting the layer to a second development to obtain a positive image in silver wherein, in order to control the contrast in the positive image, the sensitive layer is exposed at any time prior to the first development to a uniform light to produce a general fogging action.

It will be seen that this process was designed to give a positive image in silver in a photo-sensitive silver halide layer.

According to the present invention there is provided a process of producing coloured reversed images in a photographic element having three differentially colour sensitized silver halide emulsions on a single support in which all or some of the silver halide emulsions are given a careful additional exposure, if desired through colour filters, before the first development of the latent images obtained by exposure.

The further processing for the production of reversed images can then be carried out, for example as described in the patent applications hereinbefore referred to.

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:—

A process of producing coloured reversed images in a photographic element having three differentially colour sensitized silver halide emulsions on a single support in which all or some of the silver halide emulsions are given a very careful additional exposure, if desired through colour filters, before the first development of the latent images obtained by exposure.

Dated this 1st day of December, 1938.

W. P. THOMPSON & CO.,
12, Church Street, Liverpool, 1,
Chartered Patent Agents.

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