

## AMENDED SPECIFICATION

Reprinted as amended in accordance with the decision of the Assistant Comptroller acting for the Comptroller-General, dated the thirtieth day of March, 1937, under Section 11 of the Patents and Designs Acts, 1907 to 1932.

## PATENT SPECIFICATION

Application Date: Sept. 15, 1934. No. 26523/34. **444,198**

Complete Specification Left: Sept. 16, 1935.

Accepted: March 16, 1936.

(Under Section 91, Sub-sections (2) and (4) (a) of the Patents and Designs Acts, 1907 to 1932, a single Complete Specification was originally left in respect of this Application and of Application No. 26524/34 and was laid open to inspection on March 22, 1935).



## PROVISIONAL SPECIFICATION

### Improvements in or relating to Photographic Sensitive Elements

We, KODAK LIMITED, of Kodak House, Kingsway, London, W.C.2, a British Company, do hereby declare the nature of this invention, which has been communicated to us by Kodak Aktiengesellschaft, of 27, Lindenstrasse, Berlin, S.W.68, Germany, a Company organised under the laws of Germany, to be as follows:—

5 This invention relates to a photographic element and more particularly to a film having superposed layers of differential colour sensitivity adapted for use in colour photography.

10 In the production of printing materials it is possible to utilise a layer or layers which is or are rendered sensitive to light outside the visible region of the spectrum, for example infra red sensitive layers, but this is not practical in the case of negative material in which all the layers must be sensitive to light in the visible region of the spectrum. In utilising superposed layers which are respectively sensitised to different regions of the visible spectrum, difficulty is encountered owing to the fact that red or green sensitised emulsions always have considerable sensitiveness to blue light.

15 According to the present invention, a sensitive element, especially a film, for colour photography has at least three differentially colour sensitive layers on one side of a support of which layers one is sensitive to blue but insensitive to light to which the other layers are sensitised and a yellow filter arranged between the blue sensitive layer and the other layers. Preferably the other layers are sensitised to red and green respectively, and they may have between them an unsensitised

[Price 1/-]

intermediate layer which may be constituted by a light filter layer.

A film so made is capable of recording colour sensations in the respective layers without the aid of special filters in conjunction with the camera. The avoidance of such special filters renders it possible to shorten the time of exposure.

20 The arrangement of the layers is such that the blue sensitive emulsion is nearest to the objective and there is arranged behind it a yellow coloured gelatine layer which sharply absorbs blue while allowing the red and green light components to pass with as little absorption as possible. Behind the yellow filter layer there may then be arranged a red sensitised emulsion layer and a green-sensitised emulsion layer in either order and with or without an intermediate layer, for example of colourless unsensitised gelatine. Preferably the red sensitised emulsion is arranged between the green sensitised emulsion and the blue sensitive emulsion but obviously the arrangement of the layers with reference to the support is immaterial, i.e. the blue sensitive layer may be nearest in the support or farthest from it.

25 The arrangement of a yellow filter layer behind the blue sensitive layer is of great advantage in contrast to known processes in which a yellow colouring matter was incorporated in the blue sensitive layer itself. The incorporation of such yellow colouring matter in the blue sensitive layer reduces the effective sensitivity and gamma of this layer, but such reduction in sensitivity and gamma is not required or desirable where highly sensi-

Price 2/6

tised red-sensitized and green-sensitized emulsion layers are employed.

The layers may be developed after exposure and coloured images produced therein by known technique and especially by the process of colour development. It is desirable, however, to make the different layers as thin as possible and to employ emulsions which are relatively poor in silver so that the layers are as transparent as possible. The total thickness of the layers is preferably not substantially greater than the thickness of an ordinary negative emulsion. It is thus easily possible to obtain sharp images in all of the layers and no special construction of the camera is required. As the blue-sensitive layer is nearest to the objective the image is sharply focussed on to this layer which is of advantage as the focussing of the blue light is most critical.

The invention will be more fully described with reference to the accompanying drawings figures 1 and 2 of which are diagrammatic sections of suitable films which will be described by way of example.

As shown in Figure 1 the negative film comprises a support 1 on which is coated a thin layer of green sensitised emulsion 2, a thin intermediate layer of clear gelatine 3, a red sensitised emulsion 4, a yellow coloured gelatine intermediate layer 5 and a blue sensitive emulsion 6. It is essential that the yellow dye used for tinting the intermediate layer 5 should permit the red and green light components to pass through with as little absorption as possible; on the other hand it should absorb the blue light component as completely as possible.

The green sensitised emulsion 2 may comprise a layer of a thickness of the order of .0002 of a very rapid emulsion sensitised to the green region of the spectrum between 510 and 590 $\mu$ . The sensitivity should be sharply limited towards 600 $\mu$ . Suitable sensitizers adapted to this are well known and erythrosin may be mentioned as suitable. The red sensitised emulsion 4 is of the same order of thickness and is a rapid emulsion sensitised in the region from 600 to 700 $\mu$ ; preferably with a maximum near 650 $\mu$ . It is preferably relatively insensitive to light of wave lengths around 520 to 530 $\mu$ . Sensitizers suitable for this purpose are also well known and naphtho-cyanol may be mentioned as an example.

As described, the red sensitised emulsion is preferably placed above the green sensitised emulsion as this facilitates subsequent processing, but the layers may be arranged in the reverse order if desired.

It is desirable, however, for the upper layer to be more dilute as regards its content of silver halide so as to give greater transparency, less density, less tendency to exhaust the developer diffusing through it, and less tendency to harden the gelatine where the image develops.

The intermediate layer 5 may be from 1 to 3 one thousandths of an inch in thickness and the amount of yellow dye employed will generally be between 0.25 m.gm. to 2 m.gm. per square centimeter, the exact amount depending upon the strength of the dye chosen and the efficiency of the filtering required. Suitable dyes are, for example, tartrazine (about 0.25 to 0.5 m.gm. per square cm.) which is removable or decolourised in water or the processing baths, quinoline yellow (about 1 m.gm. to 2 m.gm. per square cm.) or brilliant yellow (about 0.5 m.gm to 1 m.gm. per square cm.). When using such dyes as tartrazine, for example, which tend to diffuse into the adjacent layers, further clear gelatine layers may be coated between the emulsion layers and the filter layer.

Between the green sensitised layer 2 and the red sensitised layer 3 there is, as indicated, a layer of clear gelatine which prevents wandering of the sensitising dyestuffs and facilitates differential processing of the layers. Such intermediate layer 3 may, if desired, be suitably coloured to serve as a filter for the light falling on the under-layer.

The upper layer 6 which is exclusively blue sensitive is also preferably relatively dilute as regards silver halide.

As shown in Figure 2 the arrangement of the layers may be reversed so that the blue sensitive layer is coated directly on the support 1. Whereas in the arrangement described with reference to Figure 1 the sensitive layers were preferably composed principally of silver bromide, in the arrangement shown in Figure 2 it is possible to form the layer 6 of an emulsion consisting principally of silver iodide. This is an advantage in view of the pronounced sensitivity of the silver iodide to blue light.

The sensitivity of the various layers may be increased by the aid of known sensitizers. After exposure of the film with the blue sensitive layer nearest to the objective the layers may be selectively processed to colour by any suitable methods, for example by the process described in co-pending application No. 26084/33 (Serial No. 427,472).

Dated this 14th day of September, 1934.

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

70

75

80

85

90

95

100

105

110

115

120

125

130

## COMPLETE SPECIFICATION

**Improvements in or relating to Photographic Sensitive Elements**

We, KODAK LIMITED, of Kodak House, Kingsway, London, W.C.2, a British Company, do hereby declare the nature of this invention (which has been communicated to us by Kodak Aktiengesellschaft, of 27, Lindenstrasse, Berlin, S.W.68, Germany, a Company organised under the laws of Germany), 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 sensitized photographic element and more particularly to a film having superposed layers of differential colour sensitivity adapted for use in colour photography.

The object of the invention is to provide a photographic element, especially a film, of this kind suitable for direct exposure in the camera. Therefore it is desirable that the layers should be sensitive to colours substantially covering the whole of the visible spectrum. In the production of printing materials it is possible to utilise a layer or layers which is or are rendered sensitive to light outside the visible region of the spectrum, for example infra red sensitive layers, but this is not practical in the case of elements for exposure in a camera in which all the layers must be sensitive to light in the visible region of the spectrum. In utilising superposed layers which are respectively sensitized to different regions of the visible spectrum, difficulty is encountered owing to the fact that red or green sensitized emulsions always have considerable sensitiveness to blue light.

According to the present invention, a sensitive colour photographic element, especially a film, suitable for direct exposure in a camera, has successively coated on one side of a single support at least three differentially colour sensitive rapid gelatino-silver halide emulsion layers not containing colour formers of which layers the one to be hit first by incident light is sensitive to blue but insensitive to light to which the other layers are sensitized and between the blue sensitive layer and the other layers is coated a decolourable yellow gelatine filter layer. Preferably there are three differentially sensitive rapid emulsion layers not containing colour formers of which one is sensitive only to blue but insensitive to red and green while the other two layers are sensitized to red and green respectively. Preferably a clear intermediate gelatine layer or layers is or are coated between said other layers. Such intermediate

gelatine layer is preferably unsensitized and may be coloured to serve as an additional light filter.

Specification No. 245,198 describes a process of colour photography employing a film or other support being in a unitary and homogeneous body at the same side of a single support a plurality of sensitized emulsion layers to record respectively at a single exposure a plurality of superimposed latent images of different colour sensations so that after development the said images can be coloured in different colours. In a process employing more than two colours, for instance a three-colour process, three coatings of emulsion are employed. The transparent support is coated with an extremely rapid red sensitized emulsion, a second coating of a rapid orthochromatic emulsion is provided directly on top of that coating, and a slower emulsion of the ordinary type is coated on top of the ortho-chromatic emulsion. It is stated that the various emulsions are so constituted that when subjected to the action of light they will be exposed in the same length of time. The upper layer which records the blue-violet of the spectrum is preferably constituted with a yellow dye distributed throughout its body for the purpose of toning down the action of the blue-violet rays on the material of the upper coating and further serving as an efficient screen to exclude the blue-violet rays from the other emulsions. The intermediate layer records the green of the spectrum while the lower coating records the red.

Specification 15055 of 1912 describes a method of reproducing three-part-negatives on three selectively-sensitized halogen-silver emulsions in one operation in the following manner:—Three emulsions are made, one being sensitive only to blue light, another only to green light, and a third only to red light. In these emulsions are incorporated the substances necessary for the formation of each colour, i.e. the substances termed "colour formers" the latter being so selected, for example, that that colour is formed at any time which is complementary to the corresponding selective colour-sensitization of the halogen-silver. It is stated that when these three emulsions are poured out in three layers one on another, there is formed, for instance under the action of blue light, a yellow colour, and at the places acted on by red and green light the corresponding complementary colours. It is further stated that when practising the

process with three layers one may use a yellow colouring matter mixed with a binder as an intermediate layer for the purpose of reducing the sensitiveness to blue in the halogen-silver layers sensitive to green and red. It is further stated to be preferably not to pour the three emulsions directly one on another, but to interpose a colourless layer in order to prevent diffusion of the colour-producing substances.

For the production of latent images by direct exposure in the camera it is necessary to use rapid sensitized emulsions and it is undesirable to include in any of the emulsion layers themselves a dyestuff for the purpose of acting as a screen for an under layer since this has the effect of decreasing the sensitivity of the layer for the colour which it is desired to record therein. It is also just as important to avoid the presence in the emulsions of any other foreign bodies, such as colour formers, which would be detrimental to their sensitivities over the particular bands of wave-lengths for which they are respectively use. The incorporation of a yellow colouring matter in the blue sensitive layer reduces the effective sensitivity and gamma of this layer, but such reduction in sensitivity and gamma is not required or desirable where highly sensitized red-sensitized and green-sensitized emulsion layers are employed. As will be seen, therefore, in the film according to the present invention the yellow dye serving as a screen for the emulsion behind the blue-sensitive emulsion, e.g. the green and red sensitized emulsions, is incorporated in an individual coated layer between the blue-sensitive emulsion layer and the other emulsion layers, which are, as stated, rapid emulsions, i.e. free from foreign bodies which would be detrimental to their sensitivities over the particular bands of wave lengths for which the are respectively used. In the case of elements required merely for printing purposes (with which the present invention is not concerned) the rapidity of the emulsions is not so important. It will be apparent, however, that the elements prepared for exposure in the camera, according to the present invention, could be employed for printing although they are not primarily designed for this purpose. The sensitization of the layers is such that printing can be carried out with ordinary light.

A film made according to the present invention is capable of recording colour sensations in the respective layers without the aid of special filters in conjunction with the camera. The avoidance of such special filters renders it possible to shorten the time of exposure; but such filters may

be used if required more especially when printing.

In contradistinction to tri-packs, in which all the layers are not successively coated on one side of a single support, the processing of the layers in an element constructed according to the present invention can be accomplished without separating them from one another or from the support. In the case of tri-packs it is known to have three emulsion layers sensitive respectively to red, green and blue with a yellow filter layer between the layer sensitive to blue and the other layers. Tri-packs required separation of the layers before processing and therefore a plurality of carriers must be employed; the technique of processing is therefore entirely different. Employing layers which are successively coated on the same side of a single support and accomplishing the processing without separation of the layers makes colour fringing impossible. By employing a decolourable yellow gelatine layer applied as a coating between the blue sensitive layers and the other layers, there is a continuum of gelatine which enables processing baths to penetrate the upper layers and act upon the lower layers and this continuum is not broken by any further gelatine layers which may be similarly coated between the sensitized emulsions.

In an element constructed according to the present invention the arrangement of the layers in all cases is such that the blue sensitive emulsion is nearest to the objective and the yellow filter layer arranged between it and the other layers allows the red and green light components to pass with as little absorption as possible. Behind the yellow filter layer, in the case of a three-layer element, the red sensitized emulsion layer and a green-sensitized emulsion layer may be arranged in either order and with or without a clear gelatine intermediate layer. Preferably the red sensitized emulsion is arranged between the green sensitized emulsion and the blue sensitive emulsion but obviously the arrangement of the layers with reference to the support is immaterial when a transparent support is used, i.e. the blue sensitive layer may be nearest to the support or farthest from it.

It is desirable, however to make each of the emulsion layers as thin as possible and to employ emulsions which are relatively poor in silver so that the emulsion layers are as transparent as possible. The total thickness of all the coated layers together is preferably not substantially greater than the thickness of an ordinary negative emulsion. It is thus easily possible to obtain sharp images in all of the

emulsion layers and no special construction of the camera is required. As the blue sensitive layer is nearest to the objective the image is sharply focussed on to this layer which is of advantage as the focussing of the blue light is most critical.

The invention will be more fully described with reference to the drawings accompanying the provisional specification figures 1 and 2 of which are diagrammatic sections of suitable films which will be described by way of example.

As shown in Figure 1 the negative film comprises a support 1 on which is coated a thin layer of green sensitized emulsion 2, a thin intermediate layer of clear gelatine 3 clear enough to permit adequate exposure of the green sensitized emulsion therebeneath, a red sensitized emulsion 4, a yellow coloured gelatine intermediate layer 5 and a blue sensitive emulsion 6. It is essential that the yellow dye used for tinting the intermediate layer 5 should permit the red and green light components to pass through with as little absorption as possible; on the other hand it should absorb the blue light component as completely as possible.

The green sensitized emulsion 2 may comprise a layer of a thickness of the order of .0005 of an inch of a very rapid emulsion sensitized to the green region of the spectrum between 510 and 590  $\mu\mu$ . The sensitivity should be sharply limited towards 600  $\mu\mu$ . Suitable sensitizers adapted to this are well known and erythrosin may be mentioned as suitable. The red sensitized emulsion 4 is of the same order of thickness and is a rapid emulsion sensitized in the region from 600 to 700  $\mu\mu$ , preferably with a maximum near 650  $\mu\mu$ . It is preferably relatively insensitive to light of wave lengths around 520 to 530  $\mu\mu$ . Sensitizers suitable for this purpose are also well known and naphtho-cyanol may be mentioned as an example.

As described, the red sensitized emulsion is preferably placed above the green sensitized emulsion as this facilitates subsequent processing but the layers may be arranged in the reverse order if desired. It is desirable, however, for the upper layer to be more dilute as regards its content of silver halide so as to give greater transparency, less density, less tendency to exhaust the developer diffusing through it, and less tendency to harden the gelatine where the image develops.

The intermediate layer 5 may be from 1 to 3 ten-thousandths of an inch in thickness and the amount of yellow dye employed will generally be between 0.25 m.gm. to 2 m.gm. per square centimetre, the exact amount depending upon the

strength of the dye chosen, and the efficiency of the filtering required. Suitable dyes are, for example, tartrazine (about 0.25 to 0.5 m.gm. per square cm.), which is removable or decolourised in water or the processing baths, quinoline yellow (about 1 m.gm. to 2 m.gm. per square cm.) or brilliant yellow (about 0.5 m.gm. to 1 m.gm. per square cm.). When using such dyes as tartrazine, for example, which tend to diffuse into the adjacent layers, further clear gelatine layers may be coated between the emulsion layers and the filter layer.

Between the green sensitized layer 2 and the red sensitized layer 4, there is, as indicated, a layer 3 of clear gelatine which prevents wandering of the sensitizing dye-stuffs and facilitates differential processing of the layers. Such intermediate layer 3 may, if desired, be suitably coloured with decolourable colour to serve as a filter for the light falling on the under-layer. In the latter case additional thin, clear, colourless gelatine intermediate layers may be provided on each side of the filter layer to prevent wandering of the colour therein.

The upper layer 6 which is exclusively blue sensitive is also preferably relatively dilute as regards silver halide.

As shown in Figure 2 the arrangement of the layers may be reversed so that the blue sensitive layer is coated directly on the support 1.

After exposure of the film with the blue sensitive layer nearest to the objective the layers may be selectively processed to colour by any suitable methods, for example by the processes described in the specification of our co-pending applications Nos. 427,516, 427,518, 427,520 and 440,032.

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

1. A sensitized colour photographic element, especially a film, suitable for direct exposure in a camera having successively coated on one side of a single support at least three differentially colour sensitive rapid gelatino-silver halide emulsion layers not containing colour formers of which layers the one to be hit first by incident light is sensitive to blue but insensitive to light to which the other layers are sensitized and in which between the blue sensitive layer and the other layers is coated a decolourable yellow gelatine filter layer.

2. A sensitized colour photographic element, especially a film, suitable for

- direct exposure in a camera having successively coated on one side of a single support three sensitive layers of rapid gelatino-silver halide emulsion not containing colour formers of which layers the one to be hit first by incident light is sensitive to blue but insensitive to red and green while the other two layers are sensitized to red and green respectively and in which between said blue sensitive layer and said other two layers is coated a decolourable yellow gelatine filter layer.
3. A sensitized colour photographic film as claimed in claim 1 or 2, in which a clear intermediate gelatine layer or layers is or are coated between said other layers.
4. A sensitized colour photographic film as claimed in any of the preceding claims, in which the layer sensitive only to blue is remote from the support.
5. A sensitized colour photographic film as claimed in claim 2, in which the layer sensitized to green is nearest to the support, the layer sensitive to blue but insensitive to red and green is furthest from the support, and the layer sensitized to red is between said layer sensitized to green and said layer sensitive to blue.
6. A sensitized colour photographic film as claimed in claim 2, in which the layer sensitive to blue but insensitive to red or green is nearest to the support.
7. A sensitized colour photographic film as claimed in either of claims 5 or 6, in which an unsensitized clear gelatine intermediate layer is coated between the layers respectively sensitized to red and green.
8. A sensitized colour photographic film as claimed in claim 3 or 7 in which the unsensitized intermediate clear gelatine layer is a light filter layer.
9. A sensitized colour photographic film as claimed in claim 5, in which a decolourable red gelatine filter layer is arranged between the layers respectively sensitized to red and green.
10. A sensitized colour photographic film suitable for direct exposure in a camera, substantially as herein described with reference to the drawing accompanying the provisional specification.

Dated this 14th day of September, 1935.

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

*[This Drawing is a full-size reproduction of the Original.]*

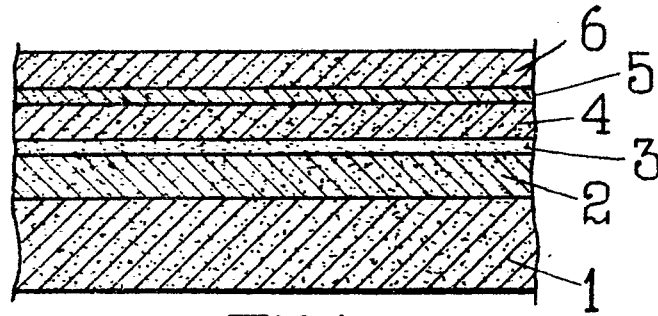


FIG. 1.

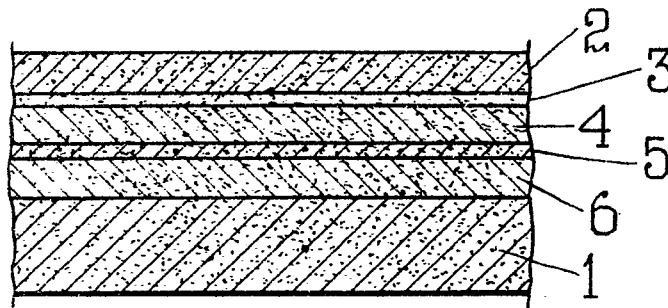


FIG. 2.