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**PATENT SPECIFICATION**

**414,157**

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**PROVISIONAL SPECIFICATION.**



**Improvements in or relating to the Process of Photographic Reversal.**

We, THOMAS THORNE BAKER, a British Subject, of The Hut, Hatch End, Middlesex, and DUFAYCOLOR LIMITED, a British Company, of 19, New Bridge Street, London, E.C. 4, do hereby declare the nature of this invention to be as follows:—

This invention comprises improvements in or relating to the process of photographic reversal. It is well known that in certain photographic processes it is necessary or desirable to convert a negative image into a positive image or a positive image into a negative image without the usual step of printing onto a separate sensitised surface. This conversion is commonly known as "reversal" and is particularly desirable in the production of coloured pictures by the colour screen method.

The process of reversal as usually carried out in the preparation of a positive image comprises the steps of (a) Exposing a sensitised plate or film in a camera, (b) Developing the image, (c) The reversal step in which the developed image is dissolved out (for example in an acid bichromate bath) (d) Exposing the film to light, (e) Redeveloping.

The original negative is formed on only a part of the silver grains contained in the emulsion which part is dissolved away during the reversal step and the positive image is formed by exposing the remaining silver salts to light and then developing them. It has been found that in order to obtain the correct density for the positive it is necessary either to use exactly the correct proportion of the silver in the emulsion for the negative (i.e. to give exactly the right exposure) or to provide an excess of silver and to control the amount of silver utilised in the positive image to correspond with the amount used in the negative. It is extremely difficult in practice to give exactly the right exposure and it therefore becomes necessary to provide an excess of silver and to control the amount of silver used in the positive image to correspond with the amount used in the negative, and this invention is directed to a method of performing this control.

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The invention provides in the method of producing photographic images by reversal the steps of ascertaining the density of the original image, subjecting the film to a reversing bath, subjecting the material to light and controlling the time of development of the second image in accordance with the density of the original.

The following is an example of one way in which the invention may be carried into effect in the production of a coloured positive from a negative. A negative image is produced on a photographic film bearing a colour screen produced as described in Specification No. 322,432. This image is developed and the development stopped by washing, or by means of a stop-bath. Light of standard intensity is then passed through the image and focussed on to a photo-electric cell which gives a reading on a galvanometer or similar device corresponding to the total light passed by the image, i.e. corresponding to the average density of the whole image. The light used may be non-actinic if desired but this is not essential. The negative image is then dissolved out in an acid bichromate or other suitable reversing bath and washed. The film, which still contains sensitive salts is then exposed to light sufficiently long fully to expose the whole of these residual salts. This second latent image (a positive) is now developed in a standard developing bath for a time corresponding to the reading obtained, as above, for the original density and then immediately fixed to remove any undeveloped silver salts. If desired the transfer from the developer to the fixing bath may be performed automatically on the expiry of the desired time in the bath. This may be carried out for example by attaching each film to a carrier actuated to transfer the film from one bath to the other by apparatus set in motion by a time switch, the time period being itself automatically controlled by the photo-cell.

The time of development corresponding to a given density of the original of course depends on the particular developer used and may be found by experiment

for any particular developer. Its action may also be improved by giving the second exposure to both sides of the film.

Although the above example has been described with reference to the production of a positive the invention may be

equally applied to the production of a negative from a positive.

Dated this 13th day of February, 1933.

BOULT, WADE & TENNANT,  
111/112, Hatton Garden, London, E.C. 1,  
Chartered Patent Agents.

### COMPLETE SPECIFICATION.

#### Improvements in or relating to the Process of Photographic Reversal.

We, THOMAS THORNE BAKER, a British Subject, of The Hut, Hatch End, Middlesex, and DUFAYCOLOR LIMITED, a British Company, of 19, New Bridge Street, London, E.C. 4, 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 comprises improvements in or relating to the process of photographic reversal. It is well known that in certain photographic processes it is necessary or desirable to convert a negative image into a positive image or a positive image into a negative image without the usual step of printing onto a separate sensitised surface. This conversion is commonly known as "reversal" and is particularly desirable in the production of coloured pictures by the multi-colour screen method.

The process of reversal as usually carried out in the preparation of a positive transparency comprises the steps of (a) Exposing a sensitised plate or film in a camera (b) Developing the image (c) The reversal step in which the developed silver salts are dissolved out (for example in an acid bichromate bath) (d) Exposing the undissolved salts to light (e) Redeveloping.

The original negative is formed on only a part of the silver grains contained in the emulsion which part is dissolved away during the reversal step and the positive image is formed by exposing the remaining silver salts to light and then developing them. It has been found that in order to obtain the correct density for the positive it is necessary either to use exactly the correct proportion of the silver in the emulsion for the negative (i.e. to give exactly the right exposure) or to provide an excess of silver and to control the amount of silver utilised in the positive image to correspond with the amount used in the negative. It is extremely difficult in practice to give exactly the right exposure and it therefore becomes necessary to provide an excess of silver and to con-

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control the amount of silver used in the positive image to correspond with the amount used in the negative, and this invention is directed to a method of performing this control.

The invention provides a photographic reversal process for producing a positive photographic image from a negative or a negative from a positive wherein the density of the image after the first development is measured before or after the reversal step and the reversed image is developed under conditions (e.g. the time of development or the strength and/or temperature of the developer) determined from the density measurement. Preferably, the time of the second development is determined from the density measurement and it is preferred to ascertain the density of the image after it has been subjected to the reversing bath.

The following is an example of one way in which the invention may be carried into effect in the production of a coloured positive from a negative. A negative image is produced on a photographic film bearing a multi-colour screen produced as described in Specification No. 322,432. This image is developed and the development stopped by washing, or by means of a stop-bath and the negative image is then dissolved out in an acid bichromate or other suitable reversing bath. An acid bichromate bath is found in practice to give the best results if the original image has been under-exposed (the more usual conditions for multi-colour screen negatives in view of the light absorption of the screen) while an acid permanganate bath is found preferable for over-exposed images. Light of standard intensity is then passed through the image and focussed on to a photo-electric cell which gives a reading on a galvanometer or similar device corresponding to the total light passed by the image, i.e. corresponding to the average density of the whole image. The light used should be non-actinic but this is not essential. The film is next washed (preferably in a sulphite of soda bath) to remove undesired pro-

ducts of the bleaching bath, and the remaining sensitive salts are then exposed to light sufficiently long to expose the whole or major portion of these residual salts. This second latent image (a positive) is now developed in a standard developing bath for a time corresponding to the reading obtained, as above, for the original density and then immediately fixed to remove any undeveloped silver salts.

It has been found that for the best results the film or plate used in the above process should have approximately double the weight of silver salts normally provided on similar films or plates for use without reversal.

The standards for this second developing bath and for the light intensity referred to above may be chosen arbitrarily within practical limits to suit the convenience of the operator, and the relationship between the time of the second development and the ascertained density of the image depends on these standards and also on certain other conditions, such as the strength of the second developer. These other conditions may, however, also be standardised in practice and the galvanometer can then be calibrated to give the time for the second development direct or a curve giving the relationship between the reading on the galvanometer and the time for the second development may be found empirically.

It is found desirable to use a weak developer (say one-quarter strength) for the second development in order that the time of development may be sufficient for accurate control.

Although the above example has been described with reference to the production of a positive the invention may be equally applied to the production of a negative from a positive.

A suitable bath for the first development is:—

Hydroquinone 4 grms.  
Metol 13 grms.  
Sodium Sulphite crystals 200 grms.  
Ammonia .91 gr. 30 c.c.s.  
Potassium Bromide 5.5 grms.  
Water 2000 c.c.s.

and the time of development may be 3 to 4 minutes at 65° F.

The film may be reversed by treatment for 4 minutes in a bath of:—

Potassium bichromate 5 grms.  
Conc. sulphuric acid 10 c.c.s.  
Water 1000 c.c.s.

after which it is rinsed in a 5% sulphide of soda bath.

Any suitable developer may be used for the final development, for example a metol-hydroquinone developer used at one-quarter the normal strength, and the time of treatment in this developer of course depends upon the ascertained density of the image and the chosen development conditions (e.g. the strength and temperature of the developer). This time has in practice, been found to vary from 35 seconds to 13 minutes.

A suitable exposure for the residual salts is 10 secs. at  $\frac{1}{2}$  metre from a 100 watt-half-watt electric lamp.

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. A photographic reversal process for producing a positive photographic image from a negative or a negative from a positive, wherein the density of the image after the first development is measured before or after the reversal step and the reversed image is developed under conditions determined from the density measurement.

2. The method according to Claim 1 wherein the density of the image is ascertained by means of a photo-electric cell.

3. The method according to Claim 1 or Claim 2, wherein the time of the second development is determined from the density of the image.

4. The method of controlling the density of an image produced by reversal substantially as described.

Dated this 7th day of February, 1934.

BOULT, WADE & TENNANT,  
111/112, Hatton Garden, London, E.C. 1,  
Chartered Patent Agents.