

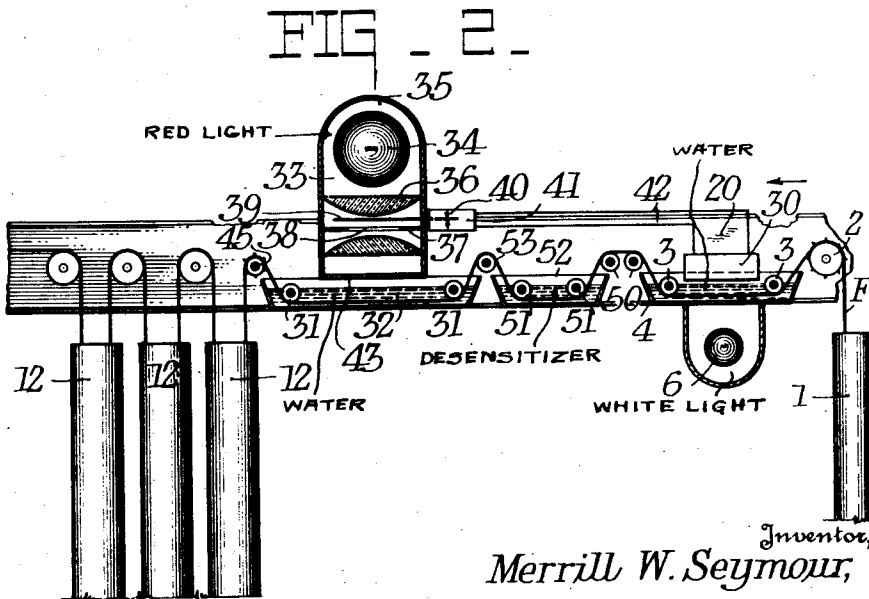
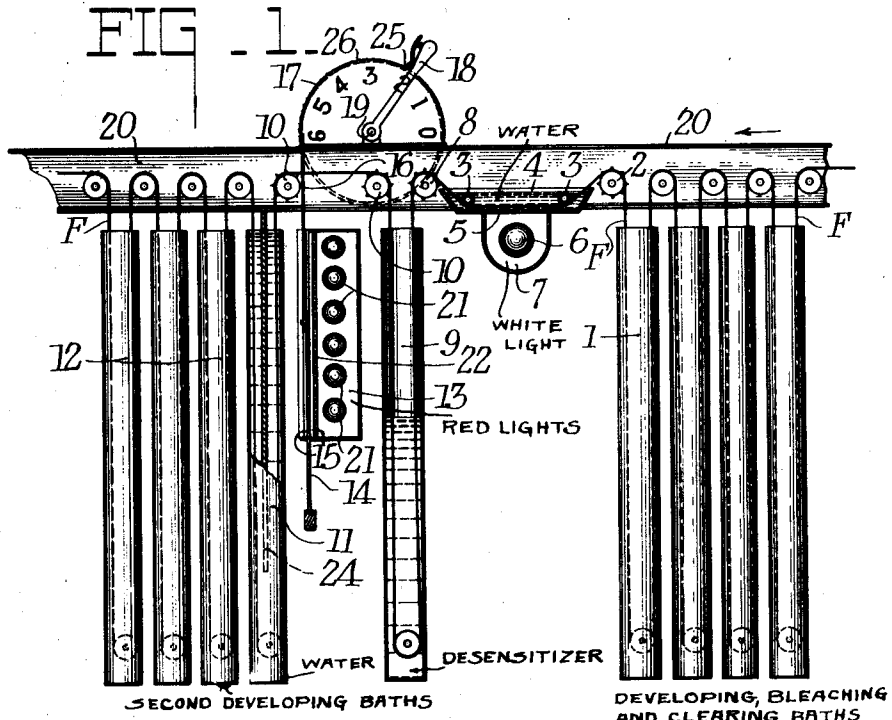
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PHOTOGRAPHIC REVERSAL PROCESS

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PHOTOGRAPHIC REVERSAL PROCESS

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This invention relates to an improvement in photographic reversal processes and particularly to such processes wherein the second exposure is controlled as in the patent to Capstaff, 1,460,703, July 3, 1923.

The specific procedure therein outlined involves the determination of the printing value of the image and the second exposure is to actinic printing light controlled in accordance with the determinations.

It is known, in general, that a latent image produced by a white light exposure may be removed or reduced by exposure to red light and that this action of the red light is accelerated if the film is bathed in a desensitizing dye before or during the red light exposure.

It has also been discovered that in a reversal process the sensitivity of the bleached image prior to the second development is lessened by the application of red light.

I have discovered that these photo chemical reactions may be applied to the control of the final or second image in a reversal process. My invention involves the use of these properties by the exposure of the sensitive bleached film to a source of constant actinic light and to a desensitizing red light controlled in accordance with the printing value of the image.

By the term "actinic light," as used herein, I mean light of such wave lengths as to render the emulsion developable. It has been found that the best results are obtained in the processes herein outlined if the red rays are excluded from actinic light so that instead of being white, it will be distinctly blue, since, as is described, the red light has a desensitizing effect. The bleaching or non-actinic light is that which tends to remove the latent image or reduce the sensitivity of the emulsion of actinic light.

In carrying out my improved process the various baths used and the order and manner of their use is identical with that fully

stated in said Capstaff patent except as herein noted and a repetition thereof is unnecessary.

The vital steps of a reversal process are the following:

- (a) First exposure, image printed;
- (b) Develop to a silver image;
- (c) Bleach, i. e. remove the silver image;
- (d) Clear, i. e. remove undesired products of bleaching bath;
- (e) Second exposure to printing light;
- (f) Redevelop.

It is of course understood that the other described steps may be and preferably are used but the above are essential.

I will now describe various typical procedures that illustrate the application of my invention.

The film or plate bearing a bleached image may be viewed or measured by a light, either actinic or non-actinic, between steps (c) and (d). As pointed out in the cited patent, it is not sensitive at this time. However the bleached image is present and may be examined. The film or plate is then cleared by the usual process, rendering it light sensitive, after which it is submitted to a red or non-actinic light, the intensity or duration of the exposure being varied or controlled to desensitize the film or plate by the desired amount. It is then submitted to actinic light of constant intensity and duration just sufficient to furnish the maximum exposure that would be desired,—that is, in case of gross over-exposure,—when the controlled exposure to red light would be reduced to zero and sufficient actinic light would be required to render all the remaining silver salts developable.

A second method is identical with the first except that the film or plate is measured or judged immediately after step (d) instead of before, this examination being by red light, the intensity or duration of which is under the control of the operator who thus

uses the same red light both for the examination and the desensitizing of the material. It is then submitted to a constant actinic light and developed.

5 A third method comprises the exposure after step (d) to actinic light of constant intensity and duration sufficient to render the sensitive salts fully developable, after which the film or plate is exposed to a red light, of
10 which the intensity, duration or both are controlled or varied to destroy partially the latent image produced by the actinic light. In this method, the image may be judged or measured by white light prior to step (d),
15 by a short red light exposure after step (d) and prior to the actinic light exposure, simultaneously with the controlled red light exposure, or simultaneously with the actinic light exposure.

20 I have discovered that the latent image-destroying effect of the third method is markedly increased by submitting the film or plate to a bath including a desensitizing dye prior to both exposures, the other steps of the method being as above described. The constant
25 actinic light exposure must in this case be much greater than when this step is omitted, but the differential effect obtained by the red light is greater.

30 I also consider as within the scope of my invention the use of such a desensitizing dye in the first and second methods prior to both exposures to augment the desensitizing effect of the red light.

35 A known desensitizing dye such as phenosafranin may be used, having a dilution of one part to 3000 parts of water, with 30 parts of potassium bromide by weight. The same effect has been obtained with the other known
40 de-sensitizing dyes, used at customary dilutions.

In carrying out the third method it is possible to use a desensitizing dye and still avoid the heavy exposure to white light by first
45 exposing to a constant actinic light, then bathing in a desensitizing bath, and then giving a controlled red light exposure. The image is preferably examined by the red light, although it may be judged by the
50 actinic light.

This is my preferred process and the vital steps of the complete reversal process involving the improved steps at the points when I consider them most desirable will be again
55 enumerated.

- I. Expose;
- II. Develop;
- III. Bleach;
- IV. Clear;
- 60 V. Expose to constant actinic light;
- VI. Bathe with desensitizing dye;
- VII. Expose to controlled red light, at the same time measuring or judging the image;
- VIII. Redevelop;
- 65 IX. Fix out remaining silver salts.

The details of these steps are as in the cited patent or as given in the above description. All of the accompanying claims cover this preferred method and certain of them are specific to it.

70 It is impossible to give definite light intensities or strength of desensitizing baths to secure the best results under all circumstances, since this varies widely with the emulsions and the particulars of the process
75 as actually carried out. In general it may be stated that considerably more exposure to red light is necessary for instance than merely passing a film over a small inspection red window. An appreciable effect is obtained
80 however with a moderate exposure, particularly if the film has been first submitted to a desensitizing dye bath.

As pointed out in the Capstaff Patent 1,460,703 the judgment or measurement of
85 the film may be an inspection dependent on the skill and experience of the operator, an instrumental comparison, or a developing test.

It is also possible to vary both the actinic
90 light and the non-actinic light, the respective exposures being such as to produce a final developable image as required by the ascertained printing characteristics of the film.
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Comparing this method with that of the Capstaff Patent 1,460,703, it might be said that in that patent a certain minimum second exposure is given such as would be necessary
100 for an original gross underexposure, and to this is added an exposure as required by the printing characteristics of the film up to a maximum which would be required for a gross over-exposure: while in the present process, there is given a maximum exposure
105 such as would be required for an original gross overexposure and from this is subtracted, by reducing the developable action by a controlled amount, an exposure as determined by the printing value of the image.
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It is obvious that any of the processes including my invention can be performed without special apparatus other than would be used for customary photographic operations and that in treating motion picture film continuously as in machines of the type shown
115 in the patent of J. G. Capstaff 1,690,616, granted Nov. 6, 1928, or the British patent of Kodak Limited 297,995, accepted October 4, 1928, modifications could readily be made to
120 adapt them to our process.

As an illustration of how such an adaptation may be made, reference is made to the accompanying drawing, in which Fig. 1 is a
125 diagrammatic showing of part of a continuous processing machine adapted for the carrying out of my process, and Fig. 2 is a similar showing of such a machine for automatically controlling the red light.

Only certain elements of the apparatus are 130

indicated diagrammatically, the complete machine being fully disclosed in the patents referred to above and not constituting my invention.

A continuous film F emerges from a tank or tube 1 which is one of a series of tubes through which it has been drawn in the processing operation. At this stage it has been developed, bleached, and cleared and is a film band carrying a layer containing a positive image of unexposed sensitive silver salts. The film passes over a sprocket 2, and guide rolls 3, the latter holding it submerged in a tray 4, containing water and having a transparent bottom 5 beneath which is a lamp 6 in lamp house 7. In use this lamp furnishes an even illumination and as the film moves at a constant speed the exposure of all points is the same. This lamp also furnishes light by which the film may be inspected, judged or measured. The film then passes over a sprocket 8 through a tube 9 containing a desensitizing bath to two sprockets or rolls 10 to a tube 11 containing water and thence to other tubes 12 containing baths for the completion of the reversal process. A lamp box 13 extends along the upper half of the tube 11, which is of glass. This lamp box contains a row of lamps 21 and a weighted shutter 14 sliding in guides 15 to which is attached a cord 16 passing over a graduated arcuate guide 17 on the main frame 20 of the machine. The cord is attached to a control handle 18 pivoted at 19 to the frame 20 and having a latch 25 engaging the ratchet teeth 26. The frame 20 also supports the other described elements of the machine. The lamp house carries a screen 22 extending its full length which transmits only red and infra red light. An opaque partition 24 is placed between the reaches of film in the tube 11 so that only one reach is exposed to the red light.

In practice the operator judging or measuring the printing value of the image as it passes the constant light sets the handle 18 at the proper time so that as the film passes the red light the extent of its exposure will be controlled as required. In each of the figures the arrow indicates the direction of movement of the film.

In Fig. 2 is shown an apparatus embodying the automatic features of the above mentioned British patent as applied to the carrying out of my process in a continuous machine. The film F passes up from a tube 1 as before, over sprocket 2, rolls 3, through tank 4, over the lamp 6 and beneath a radiation responsive element 30 such as a thermopile. It then passes over rolls 50, beneath rolls 51 directing it through a second tray 52 containing a concentrated desensitizing dye solution, then over roll 53 to rolls 31 which direct the film through tray 32 containing water, thence to the second sprocket

45, and to processing tubes 12. Above the tray 32 is a lamp house 33 containing a powerful light source 34 rich in red light, with a reflector 35 and condensing lenses 36. Between the condenser lenses is a fixed opaque diaphragm plate 37 having an opening 38 and across this moves an opaque vane 39 pivoted at 40 and controlled by a galvanometer or millivoltmeter 41 connected by wires 42 to the thermopile 30. At the bottom of the lamp house is a filter 43 transmitting only red and infra red light. This instrument is described in detail in said above mentioned British patent.

As the film passes beneath the thermopile the latter is controlled to operate the vane to cover or uncover the diaphragm opening more or less.

It is obvious, without further explanation, how the apparatus is used in the carrying out of the invention and that analogous apparatus can be designed for carrying out other modifications of my process continuously.

I contemplate as within my invention all such modifications and equivalents as fall within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a process of making photographic images by reversal from a photographic element containing an image and containing light sensitive salts, the steps of giving said element an exposure to an actinic light and an exposure to a non-actinic light capable of lessening the effect of the exposure to actinic light, the last named exposure being controlled in accordance with the printing characteristics of the element.

2. In a process of making photographic images by reversal in a sensitive photographic element containing an image, the steps of determining the printing characteristics of said image, submitting the element to a standard exposure to an actinic light, and to an exposure to a non-actinic light capable of lessening the effect of the exposure to actinic light, the extent of the last named exposure being controlled in accordance with the ascertained characteristics of the image, and developing an image in said element.

3. In a process of making photographic images by reversal from a photographic element containing an image and containing light sensitive salts, the steps of exposing said element to an actinic light, the exposure having a fixed standard value independent of the image, and to a red light the extent of the exposure to the red light being controlled in accordance with the printing value of the element and developing an image in said element.

4. In a process of making photographic positive images by reversal from photo-

graphic negative silver images in an emulsion containing light sensitive salts, the steps of removing the silver from the emulsion, determining the printing characteristics of the emulsion, submitting it to an actinic light and to a non-actinic light capable of lessening the effect of the actinic light, the exposure to the last named light being controlled in accordance with the ascertained printing characteristics and developing an image in the emulsion.

5. In a process of making photographic images by reversal from a photographic negative image in a light sensitive element, which process comprises rendering the negative image inert and differentially transparent, then exposing to actinic light, and then developing the sensitive image, the step after such rendering and prior to developing of submitting the element to a red light, the extent of the exposure to red light being controlled in accordance with the printing value of the element.

6. In a process of making photographic images by reversal from photographic images in a light sensitive element, the steps of measuring the printing characteristics of the element, giving the element a standard exposure to actinic light, and exposing the element to a red light, the extent of such last named exposure being controlled in accordance with the ascertained printing characteristics of the film.

7. In a process of making photographic images by reversal from a photographic element containing an image and containing light sensitive salts, the steps of giving said element an exposure to an actinic light, and an exposure to a non-actinic light capable of lessening the effect of the exposure to actinic light, the last named exposure being controlled in accordance with the printing characteristics of the element, and, prior to the exposure to non-actinic light, submitting the element to a bath having the effect of accelerating the action of the non-actinic light.

8. In a process of making photographic images by reversal in a sensitive photographic element containing an image, the steps of determining the printing characteristics of said image, submitting the element to a standard exposure to an actinic light and to an exposure to a non-actinic light, capable of lessening the effect of the exposure to actinic light, the extent of the last named exposure being controlled in accordance with the ascertained characteristics of the image and, prior to the exposure to non-actinic light, submitting the element to a bath having a tendency to desensitize the element to actinic light and to accelerate the action of the non-actinic light.

9. In a process of making photographic images by reversal from photographic images in a light sensitive element, the steps of meas-

uring the printing characteristics of the element, giving the element a standard exposure to actinic light, and exposing the element to a red light, the extent of such last named exposure being controlled in accordance with the ascertained printing characteristics of the film and, prior to the exposure to red light, submitting the element to a bath containing a desensitizer.

10. In a process of making photographic images by reversal from a photographic element containing an image and containing light sensitive salts, the steps of first giving said element a standard exposure to an actinic light and then giving it an exposure to a non-actinic light capable of lessening the effect of the actinic light, the extent of the last named exposure being controlled in accordance with the printing characteristics of the element.

11. In a process of making photographic images by reversal from a photographic element containing an image and sensitive salts, the steps of giving said element an exposure to an actinic light rendering the salts developable, and thereafter an exposure to non-actinic light capable of reducing the developability of said salts, the second exposure being controlled in accordance with the printing characteristics of the image, and at a point in the process prior to said second exposure treating the film to accelerate the effect of said second exposure.

12. In a process of making photographic images by reversal from a photographic element containing an image and sensitive salts, the steps of giving said element an exposure to an actinic light rendering the salts developable, and thereafter an exposure to non-actinic light capable of reducing the developability of said salts, the second exposure being controlled in accordance with the printing characteristics of the image, and at a point in the process prior to said second exposure treating the film with a desensitizing dye having the effect of accelerating the effect of said second exposure.

13. In a process of making photographic images by reversal from a photographic element containing an image and sensitive salts, the steps of giving said element a standard exposure to an actinic light rendering the salts developable, thereafter submitting the element to a bath normally having the effect of desensitizing sensitive salts to actinic light, and then exposing the element to a non-actinic light capable of reducing the developability of the salts, the extent of the last exposure being controlled in accordance with the printing characteristics of the element, and then developing an image in said element.

14. In a process of making photographic images by reversal from a photographic element containing an image and containing light sensitive salts, the steps of first giving

said element an exposure to an actinic light rendering the salts developable and then an exposure to a non-actinic light capable of reducing the developability of the salts, and
5 during the process determining the printing characteristics of the image, the extent of the second exposure being controlled by the ascertained printing characteristic.

Signed at Rochester, New York this 10th
10 day of August 1928.

MERRILL W. SEYMOUR.

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