

# PATENT SPECIFICATION

420,824

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Complete Left: May 17, 1934.

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PROVISIONAL SPECIFICATION.



## Improvements in or relating to Colour Photography.

We, THOMAS THORNE BAKER, a British Subject, of The Hut, Hatch End, Middlesex, and DURAYCOLOR 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 consists in improvements in or relating to colour photography. It has already been proposed (for example in Patent Specification No. 322,432) to produce a multi-colour screen on films or plates for use in colour photography or colour cinematography by a process in which a series of lines of greasy ink are applied to the film or plate by means of an engraved roller. It is found in practice, however, that such a roller is difficult and expensive to make and particularly so if more than 20 lines and 20 intervening grooves per millimetre are required. The screen produced by the process using an engraved roller consists of regular lines or squares of coloured elements, and it is found difficult to engrave a roller of sufficient fineness having the lines and grooves or other pattern of non-regular formation. It is, however, desirable that the colour screen shall consist of irregularly arranged elements in order that the eye may not easily discern the elements and in order to minimise interference effects between the colour screens when printing. It is among the objects of the present invention to provide a method for producing a colour screen having fine elements, and, if desired, of non-regular shape or in non-regular formation.

It has already been proposed to use printing surfaces having mercurial ink repelling areas, and it has now been found that such a method is particularly applicable to the production of colour screen films or plates.

The present invention provides the process of making a multi-colour screen for colour photography or cinematography which comprises applying one colour, or coloured layer, to the surface of a film or other suitable base, applying a pattern of greasy resist to the film by means of a printing surface (e.g., a roller) having

[Price 1/-]

mercurial ink repelling areas, bleaching the colour from the portions of the base unprotected by the resist dyeing the bleached portions a second colour and removing the resist. Preferably the steps of applying the resist by means of a printing surface having mercurial ink repelling areas, bleaching the colour from the portions of the base unprotected by the resist, dyeing the bleached portions and removing the resist are repeated to form a three or four-colour screen.

When it is desired to produce a screen having the elements in non-regular formation or non-regular shape, the ink repelling areas of the resist applying roller are non-regular in form or arrangement, but are, of course, so proportioned as to provide the desired ratio between the total areas of the several colours in the finished screen.

The invention includes a photographic film or plate having a multi-colour screen when produced by the above described method.

A description of one method of carrying the invention into effect in the production of cinematograph films for use in making pictures in natural colours will now be described by way of example.

A cellulose acetate film is produced in any known way, but, preferably, according to the methods described in Patents Nos. 301,439, 287,635, 281,803 or 243,032. The thickness of the film may be about 0.0055 inch, and the film is conveniently coated on a width of about 21 or 42 inches. The clean film, from a bobbin, is led through a coating apparatus, preferably of the type described in Patent No. 321,222. The object is to apply on one side of the film a fine layer of collodion of a definite and uniform thickness, which embodies one of the three primary colour dyes for example, the green dye. It is this collodion coating which is to receive the various dyes, and in determining the composition of the collodion and the thickness of the layer the determining factor is that the ultimate coloured portions shall give the correct spectrum absorption. Solutions of

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Price 2s 6d

industrial collodions of different nitro-cottons are mixed together in such quantities as to afford the required viscosity. The proportions have to be varied to suit the temperature, humidity, and similar conditions. The collodion mixture is dyed green with an alcoholic solution of malachite green and of auramine. The composition of the dye may be, for example, alcohol 100 parts, malachite green 4 parts, auramine 6.7 parts. The composition of the collodion mixture may be, for example, collodion mixture 30 cc. dye solution 2 cc. For instance, in practice it has been found convenient to apply this solution in such a thickness that an area of 100 c. long by 26 c. wide, takes 22 to 25 cc. Thus, the thickness of the layer is about .01 millimetre wet, i.e., .0002 to .0005 millimetre when dry. The collodion layer could be put on uncoloured and thereafter dyed.

The film dyed uniformly green all over is then led through a printing machine by means of which extremely fine parallel lines or a small fine irregular pattern of greasy ink (intended to act subsequently as fatty resists) are printed upon it.

The printing is effected by means of a steel or other roller having a chromium plated surface bearing extremely fine mercurial ink repelling areas. For example if the areas are in the form of lines then there may be 25 lines per millimetre. The roller is produced by the known method of plating the roller with silver and then with chromium and then coating the plated surface with bi-chromated gelatin, photographically printing onto the gelatin a series of lines (or other figures) and developing the lines with hot water, etching away the chromium from the parts of the roller unprotected by the hardened gelatin and treating such parts with mercury so as to form an ink-repelling amalgam with the underlying silver. It is found that the amalgam is strongly repellant to greasy ink, but that the chromium surface will retain the ink and transfer it to the film. When it is desired to print a resist in any particular pattern, it is only necessary to produce an enlarged model of the pattern and to reduce it photographically on to the bi-chromated gelatin. A roller bearing this pattern may then be produced as described.

The roller in this example has 25 or more chromium lines and 25 repellant mercurial spaces per millimetre at an angle of 23° to the axis of the roller and the film at this stage therefore 25 clear green lines and 25 opaque greasy lines (green underneath) per millimetre, both kinds of line being about the same width.

After an interval of about an hour, to let the ink dry, the film is led in succession (a) over a bath which bleaches and dissolves out the green dye from only the clear spaces, leaving unattacked the green lines protected by the ink. The composition of this bath is—

Alcohol 100 parts,  
caustic potash (10% aqueous solution) 2 parts,  
acetone 4 parts,

(b) over an inking roller which applies a red dye to the spaces between the ink line. In this example, the red dye is basic red N Extra (Kuhlmann) 8% solution in alcohol. The film is thoroughly washed with water to remove the excess of dye. (c) The film is passed through a solvent cleansing bath of benzene and is brushed by roller brushes within the benzene to remove the ink lines, leaving exposed the clear green lines.

The film is again led (when dry) through the printing machine which produces parallel lines of greasy ink, as before, but this time at right angles to those formerly made. Although in this example the sets of lines are at right angles they may, if desired, be at any specific angle. They should, however, be arranged on the negative and positive films in such manner that during printing the lines on the positive film are parallel to the lines on the negative in order to reduce the moire effect. After an interval for the ink to dry, the film is led in succession (a) over a bath which bleaches and dissolves out the red and green dye from only the clear spaces between the greasy lines, (b) over an inking roller which applies a violet dye which dyes the interlined spaces. The violet dye contains—

crystal violet (4% solution in alcohol) 80 parts, and malachite green (8% solution in alcohol) 20 parts,

(c) The film is again led through a solvent cleansing bath of benzene and is brushed by roller-brushes within the benzene to remove the ink lines. The film is then dried, is coated with a suitable substratum (such as a thin layer of gelatine and a thin layer of varnish) and is thereafter coated with a layer of a colour sensitive emulsion.

The bath referred to above under (a) conveniently comprises:

alcohol 100 parts,  
caustic potash (10% aqueous solution) 1 part,  
acetone 10 parts,  
water 6 parts.

Dated this 6th day of June, 1933.

BOULT, WADE &amp; TENNANT,

111 & 112, Hatton Garden, London,  
E.C.1,  
Chartered Patent Agents.

## COMPLETE SPECIFICATION.

## Improvements in or relating to Colour Photography.

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:—

10 This invention consists in improvements in or relating to colour photography. It has already been proposed (for example in Patent Specification No. 322,432) to produce a multi-colour screen on films or  
15 plates for use in colour photography or colour cinematography by a process in which a series of lines of greasy ink are applied to the film or plate by means of an engraved roller. It is found in practice, however, that such a roller is difficult and expensive to make and particularly so if more than 20 lines and 20  
20 intervening grooves per millimetre are required. The screen produced by the process using an engraved roller consists of regular lines or squares of coloured elements, and it is found difficult to engrave a roller of sufficient fineness having the lines and grooves or other  
30 pattern of non-regular formation. It is, however, desirable that the colour screen shall consist of irregularly arranged elements in order that the eye may not easily discern the elements and in order  
35 to minimise interference effects between the colour screens when printing. It is among the objects of the present invention to provide a method for producing a colour screen having fine elements, and,  
40 if desired, of non-regular shape or in non-regular formation.

It has already been proposed to use printing surfaces having mercurial ink repelling areas, and it has now been  
45 found that such a method is particularly applicable to the production of colour screen films or plates.

The present invention provides the process of making a multi-colour screen for  
50 colour photography or cinematography which comprises applying one colour, or coloured layer, to the surface of a film or other suitable base, applying a pattern of greasy resist to the coloured surface  
55 by means of a printing surface (e.g., a

roller) having mercurial ink repelling areas, bleaching the colour from the portions of the coloured surface unprotected by the resist, dyeing the bleached portions a second colour and removing the  
60 resist. Preferably the steps of applying the resist by means of a printing surface having mercurial ink repelling areas, bleaching the colour from the portions of the coloured surface unprotected by  
65 the resist, dyeing the bleached portions and removing the resist are repeated to form a three-or four-colour screen.

When it is desired to produce a screen having the elements in non-regular formation or non-regular shape, the ink repelling areas of the resist applying roller are non-regular in form or arrangement, but are, of course, so proportioned as to provide the desired ratio between the  
70 total areas of the several colours in the finished screen.

The invention includes a photographic film or plate having a multi-colour screen when produced by the above  
75 described method.

One method of carrying the invention into effect in the production of cinematograph films for use in making pictures in natural colours will now be described, by way of example, with reference to the  
80 accompanying drawings in which:—

Figures 1 to 6 are diagrams to a very greatly increased scale of the screen in various stages of its preparation,  
85

Figure 7 is a section of the printing roller employed, and

Figure 8 is a diagrammatic development of a portion of the printing roller used for the first resist applying step.  
90

A cellulose acetate film is produced in any known way, but, preferably, according to the methods described in Patents Nos. 301,439, 287,635, 281,803 or 243,032. The thickness of the film may be about 0.0055 inch, and the film is conveniently coated on a width of about 21 or of about 42 inches. The clean film, from a bobbin, is led through a coating apparatus, preferably of the type described in Patent No. 321,222. The object is to apply on one side of the film a fine layer of collodion of a definite and uniform thickness, which embodies one of the three primary colour dyes for  
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- example, the green dye. It is this collodion coating which is to receive the various dyes, and in determining the composition of the collodion and the thickness of the layer the determining factor is that the ultimate coloured portions shall give the correct spectrum absorption. In one example a 7% solution of "High Viscosity" nitro-cotton in a mixture of ether 60% and alcohol 40% (by volume) was mixed with a 5% solution of "Low Viscosity" nitro-cotton in a similar mixture of ether and alcohol in proportion of one volume of the "High Viscosity" solution to two volumes of the "Low Viscosity" solution—it is found necessary, however, to vary the proportion of the mixture to some extent to suit varying temperature, humidity and similar conditions. The collodion mixture is dyed green with an alcoholic solution of malachite green and of auramine. The composition of the dye may be, for example, alcohol 100 parts, malachite green 4 parts, auramine 6.7 parts and the composition of the collodion mixture may be, for example, collodion mixture 30 cc. dye solution 2 cc. For instance, in practice it has been found convenient to apply this solution in such a thickness that an area of 100 c. long by 26 c. wide, takes 22 to 25 cc. Thus, the thickness of the layer is about .01 millimetre wet, i.e., .0002 to .0005 millimetre when dry. Alternatively the collodion layer may be put on uncoloured and thereafter dyed.
- The film dyed uniformly green all over is then led through a printing machine by means of which an extremely fine irregular pattern of greasy ink (intended to act subsequently as fatty resist) is printed upon it. The film at this stage is as shown in Figure 1.
- The printing is effected by means of a steel or other roller having extremely fine chromium inking areas 1 and mercurial ink repelling areas 2 as shown diagrammatically in Figure 8,—the total areas of the ink-receiving and ink-repelling areas, in this example, being equal. The roller a section of which is indicated in Figure 7 is produced by the known method of plating a roller with silver as indicated at 3 and then with chromium as at 4 and then coating the plated surface with bichromated gelatin, photographically printing onto the gelatin a series of lines (or other figures) and developing the figures with hot water, etching away the chromium from the parts of the roller unprotected by the hardened gelatin and treating such parts with mercury so as to form an ink-repelling amalgam with the underlying silver. It is found that the amalgam is strongly repellant to greasy ink, but that the chromium surface will retain the ink and transfer it to the film. When it is desired to print a resist in any particular pattern, it is only necessary to produce an enlarged model of the pattern and to reduce it photographically on to the bichromated gelatin. A roller bearing this pattern may then be produced as described. After an interval of about an hour, to let the ink dry, the film is led in succession (a) over a bath which bleaches and dissolves out the green dye from only the clear spaces, leaving unattacked the green areas protected by the ink. The composition of this bath is—
- Alcohol 100 parts,  
caustic potash (10% aqueous solution) 2 parts,  
acetone 4 parts,
- (b) over an inking roller which applies a red dye to the spaces between the ink areas leaving the film as shown in figure 2. In this example, the red dye is basic red N Extra (Kuhlmann) 8% solution in alcohol. The film is thoroughly washed with water to remove the excess of dye. (c) The film is passed through a solvent cleansing bath of benzene and is brushed by roller brushes within the benzene to remove the ink areas, leaving exposed the clear green areas. The film at this stage has equal areas of red and green and is as shown in Figure 3.
- The film is again led (when dry) through the printing machine which produces areas of greasy ink, as before, but this time the areas of ink occupy about two-thirds of the area of the film as shown in Figure 4 and fall indiscriminately on the red and green areas previously formed.
- After an interval for the ink to dry, the film is led in succession (a) over a bath which bleaches and dissolves out the red and green dye from only the clear spaces between the greasy areas, (b) over an inking roller which applies a violet dye which dyes the spaces leaving the film as shown in Figure 5. The violet dye contains—
- crystal violet (4% solution in alcohol) 80 parts, and malachite green (8% solution in alcohol) 20 parts.
- (c) The film is again led through a solvent cleansing bath of benzene and is brushed by roller-brushes within the benzene to remove the ink areas and leave the completed screen as shown in Figure 6. The film is then dried, is coated with a suitable substratum (such as a thin layer of a synthetic resin varnish) and is thereafter coated with a layer of a colour sensitive emulsion.

The bath referred to above under (a) conveniently comprises:

alcohol 100 parts,  
caustic potash (10% aqueous solution)

5 1 part,  
acetone 10 parts,  
water 6 parts.

In the above example the ink areas applied and the resulting areas of colour on the film are irregular in shape and arrangement but if desired the invention may be applied to the production of a screen having regular areas (e.g. lines or squares). In one example of this form of the invention the roller has 25 chromium lines and 25 repellent mercurial spaces per millimetre at an angle of 23° to the axis of the roller and the same roller is used for both applications of the resist material—the lines of the second application being applied at right angles to those of the first. The last applied colour in this example occupies a total area on the screen equal to the sum of the areas of the first two colours whereas in the first example described the areas occupied by all the colours were substantially equal. It will be appreciated that the present invention provides a method whereby any desired relation between the total areas occupied by the several colours may be easily obtained, and thus any desired colour balance between the colours can be attained.

35 It will be seen that by the above process it is possible to produce a multi-colour screen having extremely fine elements of regular or irregular shape or having elements of irregular shape or arrangement

40 which need not in practice be so fine as those of regular shape.

Having now particularly described and ascertained the nature of our said inven-

tion and in what manner the same is to be performed, we declare that what we claim is:—

1. The process of making a multi-colour screen for colour photography or cinematography which comprises applying one colour to the surface of a film or other suitable base, applying a pattern of inky resist to the coloured surface by means of a printing surface (e.g. a roller) having mercurial, ink-repelling areas, bleaching the colour from the portions of the coloured surface unprotected by the resist, dyeing the bleached portions a second colour, and removing the resist.

2. The process according to claim 1, characterised in that the steps of applying the resist by means of a printing surface having mercurial ink-repelling areas, bleaching the colour from the portions of the coloured surface unprotected by the resist, dyeing the bleached portions and removing the resist are repeated to form a three colour screen.

3. The process according to claim 1 or claim 2, characterised in that the ink-repelling areas of the resist-applying printing surface are non-regular in form or arrangement.

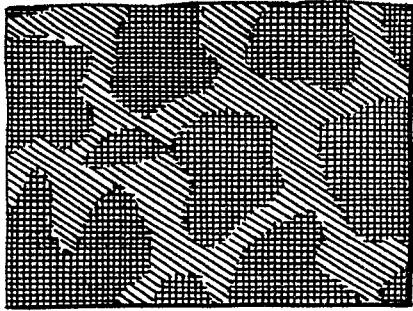
4. A multi-colour photographic screen when produced by the process according to any one of the preceding claims and comprising a transparent film dyed with a plurality of colours in contiguous, irregular, non-overlapping figures.

5. A photographic film or plate having a multi-colour screen produced by the process according to any one of claims 1 to 3.

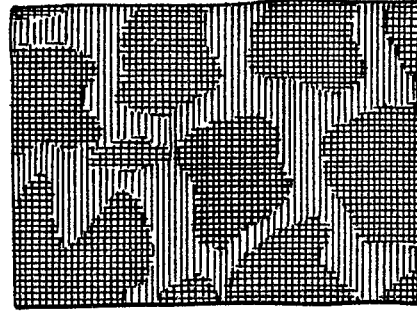
Dated this 17th day of May, 1934.

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

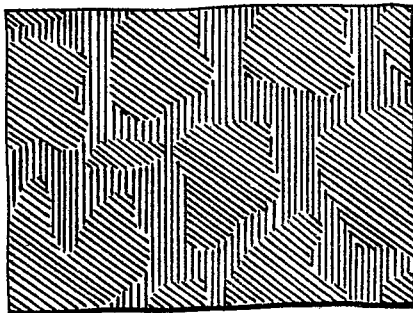
*Fig. 1.*



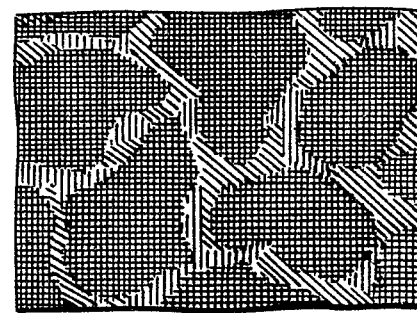
*Fig. 2.*



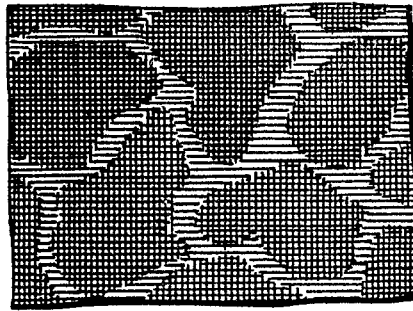
*Fig. 3.*



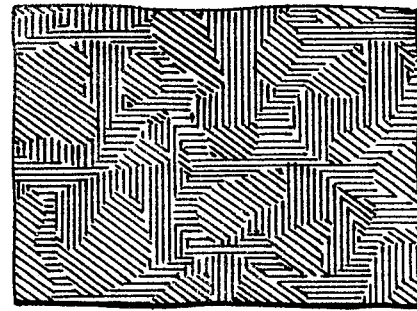
*Fig. 4.*



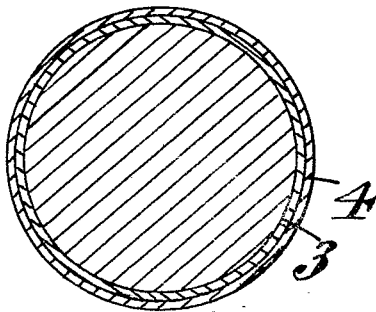
*Fig. 5.*



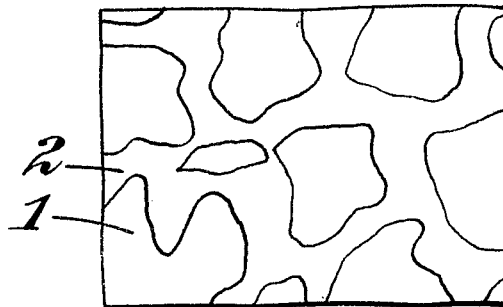
*Fig. 6.*



*Fig. 7.*



*Fig. 8.*



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