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PHOTOGRAPHY

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This invention relates to improvements in pho-
 tography, particularly color photography, and
 has for its principal object to provide a relative-
 ly simple process whereby superimposed silver
 5 images in multi-layer photographic material
 (film or plate) may be isolated in such a form
 that they can be employed as separation nega-
 tives. By the attainment of this object, it be-
 comes possible, in particular, to produce colored
 10 prints on paper from a multi-layer film exposed,
 with a single exposure, in an ordinary camera.

According to this invention, an image in a
 multi-layer material is isolated by transferring
 it from the material to a metal plate in the form
 15 of a metallic deposit. For the production of sepa-
 ration negatives, one or more images in a multi-
 layer (multi-color) material is or are transferred
 separately to metal and thence to a transparent
 support or supports.

For this purpose, use is advantageously made
 of steps of the process described in the specifica-
 tion of my patent application No. 28,572. Thus,
 the surface of a film containing the image to be
 separated, defined in a halide of silver, is applied
 25 in contact with a smooth metal plate in the pres-
 ence of a deposition agent, that is a partial sol-
 vent for the halide in the presence of which the
 said halide is reduced by the metal of the plate.
 By this means, a silver deposit corresponding to
 30 the image is obtained upon the plate.

In order to transfer this deposit to a transpar-
 ent support, firstly its adherence to the plate may
 be loosened as hereinafter set forth, by making
 the plate the anode of an electrolytic cell, and
 35 then the support may be applied to the plate un-
 der such conditions that the deposit remains ad-
 hering to the support when the latter is removed.

Although the invention may be applied to any
 multi-layer film of the nature referred to above,
 40 it has proved advantageous to employ a special
 film in which two of the active layers are sepa-
 rated not by the usual gelatine layer but by a
 weak adhesive such as glue or gum or by a wa-
 ter-proof varnish or wherein two active layers
 45 are separated by weak adhesive or a low-melting
 gelatine and two active layers by water-proof
 varnish or a higher-melting gelatine respectively.

In some cases also, it is advantageous to employ
 a film in which the front active layer is attached
 50 at the front to an additional transparent sup-
 porting layer.

Various manners of carrying the invention into
 effect will now be more fully described by way
 of example:

55 For a first example, it will be assumed that use

is made of a multi-layer tri-colour film of the
 type known by the trade-mark "Kodachrome."
 Such a film may comprise the following series of
 layers of gelatine: A first or uppermost active lay-
 er sensitive to blue, a thin inactive layer, a sec-
 5 ond active layer sensitive to green, a further thin
 inactive layer and a third active layer sensitive to
 red. Behind the last layer is a support of, for
 example, Celluloid. As far as the present ex-
 ample is concerned, it may be assumed that this
 10 film has been exposed, developed and fixed by or-
 dinary methods. The film then contains three
 developed negatives, one in each of the three ac-
 tive layers.

To facilitate later steps of the process, if the
 15 gelatine is not already sufficiently hard, the whole
 film may firstly be hardened to a definite extent,
 for example by immersing it for 15-20 minutes in
 a 5% solution of alum. It is then carefully dried.

The next step consists in bleaching the first ac-
 20 tive layer only, i. e., converting the silver of the
 image in that layer into silver halide. For this
 purpose, it is advantageous to use a bleaching
 agent, such as a strong solution of ferric chloride
 or a "loaded" bleacher, which penetrates gelatine
 25 relatively slowly but effects the bleaching relative-
 ly rapidly. The time required to bleach the first
 layer by this means depends upon the hardness of
 the gelatine and the strength of the solution used.
 When the predetermined time has elapsed, the
 30 film is immersed in a "stop-bath" to arrest the
 bleaching, for instance a weak solution of sodium
 carbonate.

After the film has been rinsed, it is immersed
 in a deposition agent. Several such agents are
 35 referred to in our aforesaid specification. In the
 present example, it is preferred to immerse the
 film for about 30 seconds in a 20% aqueous solu-
 tion of sodium chloride. Other preferred agents
 are potassium chloride and sodium sulphite. Hy-
 40 drochloric acid is not recommended and ammoni-
 um hydroxide and ammonium sulpho-cyanide are
 not suitable. The film is then pressed with its
 first active layer in contact with a clean copper
 plate for, say, 7-10 minutes. The silver chloride
 45 in the said first layer is converted into metallic
 silver which adheres to the copper plate in the
 form of a deposit when the film is peeled off from
 the said plate. The film is at once placed in wa-
 ter.

The copper plate is rinsed and is then made the
 anode of an electrolytic cell of which the cath-
 ode is a plain copper plate, the plates being pre-
 50 ferably disposed horizontally. Various electrolytes
 which do not attack silver may be employed, but

in this example use is made of a copper salt solution, for instance a copper sulphate solution containing a small quantity of sulphuric acid or a plain solution of sulphuric acid. Upon the pas-
 5 sage of a small current through the cell, for instance .6 ampere with an E. M. F. of 2 volts, it is found that the copper under the silver deposit is dissolved with the effect that the adherence of the silver is loosened. The plate is rinsed after
 10 removal from the cell.

The loosened silver deposit is now transferred to a transparent support, such as a sheet of Celluloid, which has been coated with a film of dry hardened gelatine. The plate has weak hydro-
 15 chloric acid poured over it and is then dipped momentarily in water. The transparent support, which may first be moistened, is laid with its gelatine film in contact with the slightly acid moist surface of the plate and light pressure is applied.
 20 In the short period for which the gelatine becomes "tacky," the silver deposit adheres strongly to it and, when the support is stripped off from the plate, the said deposit accompanies the gelatine.

25 The film containing a silver image thus obtained may be bleached in, say, a strong solution of copper chloride, redeveloped, washed and dried. The final product is the first separation negative, the yellow-printing negative, which was
 30 contained in the first, blue-sensitive, layer in the original film.

Now, while the above treatment of the silver deposit is being prosecuted, the film is available, after removal from the water, for the commence-
 35 ment of the second stage of the process. Before the second active layer of the film is dealt with, it is desirable to remove the layer of gelatine from which the deposition of the silver on the copper plate was effected in the first stage. This removal can be performed by the exercise of
 40 gentle friction upon the surface of the first layer of gelatine until a fracture is induced between it and the second layer, whereafter the first layer can be readily removed. The friction may be
 45 exerted by means of a small swab of cotton wool which may also be used to effect the removal of the gelatine. The intermediate inactive layer of gelatine may accompany the said first layer, but, owing to its thinness, it is not important if this
 50 does not occur. The film is then dried.

The procedure adopted in the first stage is repeated for the second active layer, commencing with its bleaching and terminating with the pro-
 55 duction of a second separation negative.

The procedure may then be repeated for the third layer in order to produce the third separation negative. However, the removal of the layer of gelatine from which the silver was deposited
 60 in the second stage actually leaves a third negative, on the original support, of the kind required.

From the "set" of tri-color separation negatives produced, color-prints on paper can be obtained by any of the known processes.

Various departures from the above-described example can be made. For instance, for some
 65 purposes, it may be convenient to commence by "reversing" the images in the multi-layer film. Furthermore, where the steps of the procedure have a counterpart in my above-mentioned ap-
 70 plication, alternatives described in the latter may be utilized in carrying steps of the present invention into effect. For instance, the electrolytic step may be replaced by treatment, described in the aforesaid application, whereby the silver de-
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posit is converted into silver iodide, the latter being then transferred to the separate support.

The invention can be applied to other kinds of multi-layer film. In particular, the process can be simplified by employing a special film of
 8 the following nature:

The uppermost or front layer is a layer of Celluloid similar to the usual rear supporting layer. The second layer is an active layer sensi-
 10 tive to blue and the third a layer of weak adhesive connecting the second layer to the fourth layer which is an active layer sensitive to green. This adhesive should be colorless and transpar-
 15 ent and may or may not be water soluble. The fifth layer is a layer of inactive gelatine, and connects the fourth layer to the sixth layer which is an active layer sensitive to red. The seventh or rearmost layer is the usual supporting layer of Celluloid.

After exposure, but before development, the
 20 film is placed in water or other appropriate solvent for the adhesive used. The blue-sensitive layer carried by the first or Celluloid layer then becomes detached from the other layers and can
 25 be developed and fixed for the production of a first separation negative. Next the rest of the film is also developed and fixed and the silver image in the green-sensitive layer is extracted and transferred to a transparent carrier by the pro-
 30 cess described in the first example. The red-sensitive layer is left on the rearmost supporting layer. It will be noted that this process calls for the extraction of only one silver image and does not necessitate the removal of a layer of
 35 gelatine.

Alternatively the film employed may comprise the following layers: Blue-sensitive layer, layer of transparent and colorless waterproof varnish, green-sensitive layer, gelatine layer, red-sensi-
 40 tive layer, Celluloid layer. On developing and fixing such a film, a negative image will be produced in the first layer only. This image is transferred to a transparent carrier as in the first example. The film is then immersed in acid, e. g., hydrochloric acid, or alkali, e. g., sodium
 45 hydroxide, and the gelatine of the first layer is removed by rubbing and washing. The exposed layer of varnish is next removed by immersing the film in a solvent for the varnish. On redeveloping and fixing the film, negative images will
 50 be produced in the two remaining sensitised layers. The green-sensitive layer is transferred to a transparent carrier as in the first example. In this example, the removal of a layer of gelatine is not obviated, but is considerably simplified.
 55 Alternatively or in addition a varnish layer may, if desired, be substituted for the inactive gelatine between the green and red sensitive layers in the above example. Also varnish may be substituted for the gelatine between the green and
 60 red sensitive layers in the previous example.

Yet a further alternative is to employ as the inactive layers, between the blue and green sensitive layers and between the green and red sensitive layers respectively, layers of gelatine
 65 which melt or dissolves in water at different temperatures, say 80-90° F. and 115° F. respectively. This alternative may be utilised with film having both a front and a rear supporting layer of Celluloid or with film having only a rear sup-
 70 porting layer of Celluloid. In the first case, the low-melting gelatine acts like a weak adhesive and the blue-sensitive layer or the front supporting layer may be separated from the other layers, without separating or dissolving the green
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and red sensitive layers, by immersing the film in water at an intermediate temperature, say 105° F. In the second case, dissolving the low-melting gelatine in water at the intermediate temperature allows of the easy removal of the gelatine left by the extraction of the image in the blue-sensitive layer in accordance with the first example.

I claim:

1. Process for the separation of superimposed images in multi-layer photographic material for the production of separation negatives for color printing, comprising the steps of isolating an image from the said material by transferring it therefrom, in the form of a metallic deposit, to a metal surface and thereafter removing the said metallic deposit from the said surface onto another support.

2. Process for the production of a separation negative from a multi-layer photographic material, particularly multi-color photographic material, comprising isolating and transferring an image as a metallic deposit from a layer of the said material to a metal surface and transferring the said deposit thence to a transparent support.

3. Process for the isolation of an image in a multi-layer photographic material in a layer of which the image to be isolated is defined in a halide of silver, comprising the steps of applying the surface of the said layer in contact with a smooth metal plate in the presence of a partial solvent for the halide in whose presence the said halide is reduced by the metal of the plate, whereby a metallic silver deposit is produced upon the said plate, and thereafter removing the said metallic deposit from the said plate onto another support.

4. Process for the isolation of an image in a multi-layer photographic material in a layer of which the image to be isolated is defined in a halide of silver, comprising applying the surface of the said layer in contact with a smooth metal plate in the presence of a partial solvent for the halide in whose presence the said halide is reduced by the metal of the plate, whereby a metallic silver deposit is produced thereon, and subsequently loosening the said deposit as a whole from the plate by making the latter the anode of an electrolytic cell and passing a current through the cell.

5. Process for the isolation of an image in a multi-layer photographic material in a layer of which the image to be isolated is defined in a halide of silver, comprising applying the surface of the said layer in contact with a smooth

metal plate in the presence of a partial solvent for the halide in whose presence the said halide is reduced by the metal of the plate and appears as a metallic silver deposit thereon, loosening the adherence to the said deposit to the metal plate and transferring the said deposit to a transparent support to whose surface the deposit has a greater adherence than to the plate, for example Celluloid coated with moistened gelatine, by placing the said surface in contact with the surface of the metal plate bearing the deposit.

6. Process for the separation of images in a multi-layer photographic material in which the images are contained in layers of gelatine, comprising extracting an image from the said material in the form of a metallic deposit, and removing the layer of gelatine left behind by the extraction of the said deposit before treating underlying layers of the material.

7. Process for the separation of images in a photographic material comprising front and rear supporting layers and three superimposed active layers of which two are connected by a more readily soluble agent than the others, comprising separating the material into two parts, each with its supporting layer, by dissolving the readily soluble agent, and isolating the image from the upper active layer, in the part containing two such layers, by transferring the said image in the form of a metallic deposit to a metal surface.

8. Process for the separation of images in a photographic material comprising several superimposed active layers whereof two are separated by a layer of water-proof varnish, comprising the steps of developing the active layer above the layer of varnish, isolating the image in that active layer by transferring it as a metallic deposit to a metal surface, dissolving and removing the varnish layer, and developing the active layer exposed by such removal of the varnish layer.

9. Process for the separation of images in a photographic material comprising three superimposed active layers whereof two are connected by a layer of low-melting gelatine and two by a layer of higher-melting gelatine, comprising the steps of isolating the image in the active layer above the layer of low-melting gelatine by transferring it as a metallic deposit to a metal surface, and removing the vacated gelatine of that active layer by dissolving the layer of low-melting gelatine in water at a temperature below the point at which the higher-melting gelatine would be dissolved.

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