

# UNITED STATES PATENT OFFICE

2,230,590

## COLOR PHOTOGRAPHIC PROCESS

John Eggert, Leipzig, and Gerd Heymer, Wolfen, Kreis Bitterfeld, Germany, assignors, by mesne assignments, to General Aniline & Film Corporation, New York, N. Y., a corporation of Delaware

No Drawing. Application December 30, 1938, Serial No. 248,520. In Germany January 22, 1938

### 1 Claim. (Cl. 95—2)

The present invention relates to a color photographic printing process.

In the production of multi-color photographic prints it has been proposed to employ a multi-layer photographic material which carries on one side of the support a silver halide emulsion layer provided with a yellow filter dyestuff; after exposure and development this layer is converted by a toning process into an iron-blue picture; on the other side of the support there are superimposed one upon the other a yellow colored layer and a purple colored layer which are sensitized for different regions of the spectrum, in such a manner that the sensitivity regions do not coincide with the absorption regions so that the lower layer obtains the light necessary for exposure through the superimposed layer. For example, the purple layer may be sensitive to red light which is permitted to pass through the superimposed yellow layer sensitized to green light. Such a material must be so exposed that the green component is copied by means of red light in the purple layer and the blue component by means of green light in the yellow layer. Correspondingly, the red component is copied by means of blue light in the single layer on the other side of the support. For printing on a film of this kind the usual black-and-white color separation pictures which, if desired, may be combined on a lenticular screen film, may be employed. The production of the color separation pictures by means of such material has, however, several disadvantages. For example, for producing the ordinary black-and-white components special exposure apparatus is necessary, while exposure on lenticular screen films produces pictures which lack in definition of the color values far removed from the objective. These disadvantages have been avoided in the modern multi-layer films in which the color pictures are produced by color forming development. In this case a color picture can be produced in various ways, for instance, with the aid of "controlled diffusion" in the color forming development or by addition of the dyestuff components to the several layers during the film production, and later development with the aid of a single developer. These latter films can be developed by a simple development to a negative and by reversal development directly to a positive.

The present invention is based on the observation that for the production of multi-color pictures it is of especial advantage to use for the exposure a multi-layer photographic material

having silver halide emulsion layers of different sensitivities in which the colored picture is produced by color forming development and to use as a printing material a multi-layer photographic element in which in a part of the layers a picture is produced by the silver bleaching-out process and in the rest by the toning method. This combination of exposure and printing processes is the more satisfactory because the exposure utilizes only a single film and therefore only an ordinary camera and because the copying process yields pictures of full color. It is thus possible to produce the sound track as an iron-blue image which is more impermeable for the infra-red rays corresponding with the sensitivity of the sound film photocell than are the dyestuffs normally used in color forming development. When producing the master picture in the usual manner, i. e., in its correct color values, it is necessary to first prepare a series of color separations, of which those for the yellow and purple layers must then be again produced as positives. This modification gives good results, but is comparatively complicated. The invention therefore contemplates an essentially simpler modification.

The multi-layer exposure film, as stated above, is subjected to reversal color forming development, but with the essential deviation that the dyestuff components are so interchanged in their relationship in the several layers that the color in the blue-sensitive exposure layer is complementary to the sensitivity region of the yellow layer of the copying film. The same holds for the color of the green-sensitive copying layer. In the example given above for the copying film in which the yellow layer is green-sensitive, the purple layer is red-sensitive and the third layer, intended for the blue tone, is in general sensitive to blue, the relationship of the color formers to the several layers in the master picture film is as follows:

1. Blue-sensitive layer which on account of the green-sensitivity of the yellow layer is provided with a dyestuff component for purple;
2. Green-sensitive layer which is provided with a dyestuff component for blue-green;
3. Red-sensitive layer which is provided with a dyestuff component for yellow.

The color picture is produced by reversal development, the first development by means of a black-and-white developer while only in the second development a developer is used which produces a color picture in the three layers. The color developed film naturally presents a peculiar interchange of the colors. This material is, ac-

ording to the invention, copied on the above-described multi-layer copying material in the following manner:

From the third layer of the exposure film the red component is copied with the aid of a blue filter on a black-and-white film which is developed to a negative; the latter is now copied in the usual manner on that layer of the copying material in which the picture is produced by iron-blue toning. On the two other layers of the copying film the original itself is copied, the film being copied either successively first with a red filter and then with a green filter or the reverse or simultaneously with a yellow filter which contains the necessary colors red and green. Furthermore, the operation may be performed with a copying apparatus which contains side by side a red and a yellow filter which has the advantage that the copying light for the two component colors can be better adapted by varying the passage of light by means of diaphragms.

Both for the exposure film and for the copying film regions of spectral sensitivity may be used other than those given in the above example. Correspondingly, the colors of the copying light must then be changed while at the same time the color formers of the exposure film must be so varied that they are again complementary to the copying filters.

For the master picture film layers are particularly suitable which contain dyestuff components fast to diffusion, such as are described in the British Patents Nos. 458,400 and 465,823, and in the U. S. patent applications Ser. Nos. 90,726, filed July 15, 1936, now Patent No. 2,178,612 of Nov. 7, 1939; 158,860 filed August 13, 1937, now Patent No. 2,179,244 of Nov. 7, 1939; 159,518 filed August 17, 1937, now Patent No. 2,186,732 of January 9, 1940; 164,499 filed September 18, 1937, now Patent No. 2,186,733 of January 9, 1940; 166,832 filed October 1, 1937, now Patent 2,186,851 of January 9, 1940; 171,701 filed October 29, 1937, now Patent No. 2,186,734 of January 9, 1940; 171,705 filed October 29, 1937, now Patent No. 2,186,735 of January 9, 1940; 175,285 filed November 18, 1937, now Patent No. 2,186,719 of January 9, 1940; 176,058 filed November 23, 1937, now Patent No. 2,186,852 of January 9, 1940; 191,952 filed February 23, 1938.

As a printing material a film such as is described in the British Patent No. 454,088 is especially suitable (see also U. S. patent application Ser. No. 51,029 filed November 22, 1935, now Patent No. 2,205,755, of June 25, 1940).

A modification of the arrangement of the color formers in the exposure film and of the printing film is as follows:

On the printing film the layer on the one side which is adapted to be toned blue remains the same as in the modification described on pages 1 and 2. On the other side of the support there is arranged a yellow layer which is red-sensitive

and on top of that a purple layer which is unsensitized and therefore blue-sensitive. The corresponding exposure film has the following arrangement of layers:

1. Blue-sensitive layer containing color former for blue-green,
2. Green-sensitive layer containing color former for yellow,
3. Red-sensitive layer containing color former for purple,
4. Support.

After reversal development a negative red color separation is produced by means of a green filter. This red color separation is printed onto the layer adapted for blue-toning in the printing film as before. The remaining layers of the exposure film are printed onto the two colored layers of the printing material in exactly the same manner as in the example previously described the only difference being that blue and red filters are employed respectively.

We claim:

A process of producing colored photographic prints in a photographic multi-layer printing material in which one layer is a colorless emulsion, another layer is a green sensitive emulsion containing a yellow dyestuff which is fast to ordinary photographic baths but is capable of being destroyed by reaction at the silver image portions, and another layer is an emulsion sensitive to red and containing a magenta dyestuff fast to ordinary photographic baths but capable of being destroyed by reaction at the silver image portions which comprises exposing to a colored object a color photographic multi-layer film containing in each layer a color forming development component fast to diffusion arranged as follows: a color forming development component for purple being arranged in the blue-sensitive layer, a color forming development component for blue-green in the green-sensitive layer, a color forming development component for yellow in the red-sensitive layer, developing said film first with a black-and-white developer and then with a color forming developer to a reversal picture, printing a color separation negative from said red-sensitive layer onto an ordinary black-and-white film, copying said negative onto the colorless layer of said photographic multi-layer printing material, copying the blue sensitive layer onto the layer of said photographic multi-layer printing material containing the yellow dyestuff, copying the green sensitive layer onto the layer of said photographic multi-layer printing material containing the magenta dyestuff, developing said printing material, toning said colorless layer blue and destroying the dyestuffs at the silver image portions of the yellow and magenta layers by the silver-dye-bleaching-out process.

JOHN EGGERT.  
GERD HEYMER.