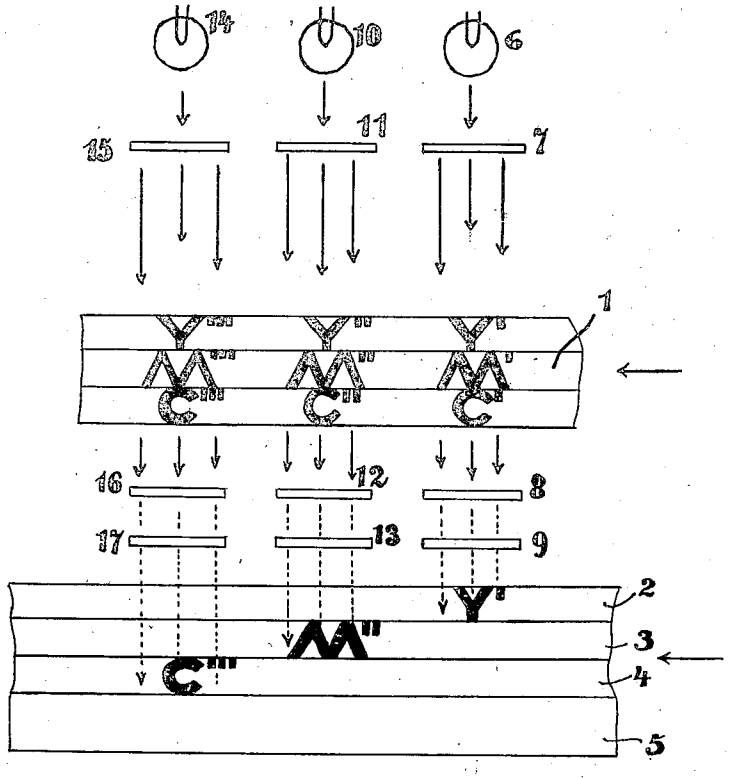
Dec. 14, 1943. W. MICHAELIS 2,336,560

PHOTOGRAPHIC PRINTING PROCESS

Filed July 15, 1939



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Patented Dec. 14, 1943

2,336,560

UNITED STATES PATENT OFFICE

2,336,560

PHOTOGRAPHIC PRINTING PROCESS

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Application July 15, 1939, Serial No. 284,771
In Germany July 18, 1938

14 Claims. (Cl. 95—2)

The present invention relates to a process for the manufacture of photographic prints.

The expression "printing prototype" hereinafter used is intended to connote any image from which a print is taken in a photogaphic printing process in which the same is disposed between the source of printing light and the printing layer whether said image be a black and white, monochrome or multi-color image and whether the same is an original or not.

If a dye-image is printed onto a light-sensitive printing layer by the known photographic printing processes, it is essential that the printing light be absorbed by the dye of the image to be printed, and that the same printing light influence a printing layer sensitive for this light. For example, a magenta dye-image transparent to blue light and red light can be printed onto a green-sensitive printing layer by means of green light which is absorbed by the magenta dye, but apparently it cannot be printed by the known process on to a layer which is non-sensitive to green light but sensitive to blue or red light.

For certain purposes of color photography, of which an example is given in the following, it would be a great simplification if an image could be printed with green light onto a layer non-sensitive to green, or more broadly, if the printing with colored printing light pre-determined by the kind of printing prototype used could be carried out on layers sensitive not for the same light but for differently colored light rays. It is one object of the present invention to render this possible.

To give an example of the cases where the above-described possibility would result in an important simplification of the process, the case should be considered wherein a print or an enlargement on paper is to be prepared from a three-color transparency, which may have been manufactured by any process. For the manufacture of color prints on paper, a three-layer material with three pre-dyed layers sensitized according to Bela Gaspar's U. S. Patent No. 1,985,344, dated December 25, 1934, is especially useful. In such a material, for instance, the top layer is dyed yellow and is green-sensitive, the following layer is dyed magenta and is red-sensitive, the rear layer is dyed blue-green and is sensitive to infra-red. If a print of a color-correct original is to be printed into such a material, the yellow part-image of the original must be printed into the yellow front layer of the printing material; but the yellow part-image of the original cannot be printed when illuminated with light other than blue light, because it is transparent to all other light. The yellow-dyed printing layer on the other hand is non-sensitive to blue light. The part-image dyed magenta in the original cannot be satisfactorily printed when illuminated with light other than green light, but the magenta-dyed printing layer into which this part-image has to be copied is non-sensitive to green light, and it is the yellow layer into which this part-image must not be printed that is sensitive to green light. In the same manner, the blue-green part-image of the printing prototype needs red light for printing, and in the printing material it is not the blue-green but the magenta layer that is sensitive to red light. Therefore, it appears that it is not possible to use the described material to obtain directly color-correct prints of color-correct originals. Hitherto, therefore, the prints in this material have been prepared with the aid of individual part printing prototypes or with the aid of multi-color printing prototypes whose colors differ from the natural colors, or according to Bela Gaspar's U. S. Patent No. 1,998,891 dated January 22, 1935, screen images are converted into suitable printing prototypes by changing the screen. A simple process for printing directly from a color-correct original into the three-layer material above referred to has appeared to be impossible till now, because every single part-image of the prototype requires a special light, whereas in the printing material the layer into which the part-image in question must be printed is non-sensitive to this light and requires a different light.

In the following I have described a new method whereby prints can be obtained even if the printing layer requires a different light from that required for the printing prototype. According to the invention, this object will be achieved by placing between the printing prototype and the printing layer a light-responsive device which, under the influence of the colored light transmitted by the transparent areas of the prototype and more or less absorbed by the opaque areas of the prototype, causes the light-sensitive printing layer to be influenced accordingly by light of a different spectral composition.

In the example to be described in the following, I use as the light-responsive device a transparent or reflecting screen in which, under the influence of the rays used for illuminating the printing prototype, there is produced a photo-luminescence phenomenon. One or more light filters may be arranged between the screen and the printing layer to absorb the rays stimulating

the luminescence and, if necessary, all other rays of the luminescent light except those required for influencing the printing layer.

A photo-electric device responding to variations of colored light and controlling the luminosity of another light source emitting light of a different spectral composition is another example of a suitable light-responsive device that may be used to bring about the change in the wave-length of the colored light, and this enables me to expose the printing layer to a light of a color different to that used to illuminate the printing prototype.

In order to explain the principle of the invention in an individual case, the printing of a color-correct diapositive—screen-image or subtractive three-color image—onto a light-sensitive three-layer material such as that mentioned above as an example, will now be described.

For this purpose there is arranged between the original and the printing layer a foil containing a substance, such as amino-fluoranthrene, which fluoresces green on exposure to blue light, and the whole is then exposed to blue light of a narrow spectral range. In this case the fluorescent rays appear at those places where the original is transparent to blue light and not at the places where the passage of blue light is prevented by the red and the green filter elements in the screen-image or by the yellow part-image in the subtractive three-color picture. All rays except the green fluorescent rays are obstructed by a green filter inserted between the fluorescent screen and the printing material, and in this manner a latent negative image of the blue screen part-image or of the yellow part-image of the subtractive three-color original is obtained in the yellow dyed green-sensitive printing layer. In the same manner a screen arranged between the original and the printing layer is used, which, on exposure to green light, fluoresces red. This screen may be produced by pouring a 7% aqueous gelatin emulsion, to which has been added 0.3% of acid rhodamine, on to a transparent carrier in the proportion of about 700 cc. of colored gelatin solution per sq. metre. The original is now exposed to green light of a narrow spectral range, and all light rays except the red fluorescent rays are excluded from the printing layer by a filter, such as Wratten filter No. 29. A latent negative of the screen part-image that is green in the original, or of the part-image that is magenta in the subtractive multi-color image, is obtained in the red-sensitive printing layer colored magenta. Finally, in the same manner a screen arranged between the original and the printing layer is used to produce a dark-red or infra-red fluorescence on exposure to red light; there may be used for this a cellulose nitrate lacquer dyed with "Zaponechtblau 3G"—for which there is no color index number, vide Sample No. 17, "Zaponechtfarbstoffe," I. G. 1330d by I. G. Farbenindustrie A. G. This time the original is exposed to red light of a narrow spectral range below about 650 mu, or even to the light of a sodium vapor lamp, if the blue-green dye of the original subtractive multi-color image is absorbent for such light and if the magenta dye transmits the yellow light of the sodium lamp. All light rays except the dark-red and infra-red fluorescent rays of more than about 660 mu are excluded from the printing layer by a filter, such as Wratten filter No. 88*a*. A latent negative of the screen part-image that is red in the original, or of the blue-green part-image of the subtractive three-color printing prototype is obtained.

The three latent silver images are thereupon developed and the printing material is then treated by the known method for dye destruction, for example, by using the baths described in Bela Gaspar's U. S. Patent No. 2,020,775 dated November 12, 1935, whereby positive dye-images are obtained which represent a reproduction of the original, and which are positives if the original was a positive.

For the accompanying schematic drawing I have chosen an example which is especially illustrative of the effect of different sources of light acting upon fluorescent screens correspondingly responsive. This example relates to the printing of three differently colored part-images of a three-color original **1** into a printing material comprising three light-sensitive layers **2**, **3** and **4** superimposed on a single support **5**. The original **1** carries a series of three-color pictures, each color picture of the series being formed of three superposed dye-images of yellow, magenta and blue-green color. Three consecutive pictures of the series are shown in the drawing. Y′ represents the yellow-colored part-image of one of the multi-color pictures of the series, M′ represents the magenta-colored part-image of the same multi-color picture, and C′ represents the blue-green-colored part-image of the same multi-color picture, designated as Picure I in the following description. Similarly, Y″, M″ and C″ together constitute a second three-color picture of the series, designated hereinafter as Picture II. Y‴, M‴ and C‴ represent the three part-images of a third multi-color picture of the series, designated in the following as Picture III.

In the position shown in the drawing, multi-color Picture I is positioned between a light source **6** and the printing material, with the interposition of a blue light filter **7** between the light source **6** and Picture I. On the opposite side of Picture I there follows first a fluorescent screen **8** and then a green filter **9**. Similarly, Picture II is in such a position that the light from light source **10** passes through a green filter **11**, through multi-color Picture II onto a fluorescent screen **12**; between the fluorescent screen **12** and the printing material there is a red filter **13**. In the case of Picture III, **14** is a light source, **15** is a red filter, **16** is a fluorescent screen and **17** is a filter transmitting light of the long-wave red and the infra-red spectral regions.

In the printing material, layer **2** is sensitive to green light and dyed yellow, layer **3** is sensitive to red and dyed magenta, and layer **4** is sensitive to dark-red and infra-red and is colored blue-green.

Of the fluorescent screens, **8** emits green light under the influence of blue light, **12** emits red light under the influence of green light, and **16** emits dark-red or infra-red light under the influence of yellow or red light.

In the position shown in the drawing, the blue light transmitted by filter **7** is absorbed by part-image Y′, and at the places corresponding to the transparent areas of part-image Y′ there will be a green fluorescence in screen **8**. The green fluorescence light acts through green filter **9** onto the green-sensitive layer **2** of the printing material and produces therein a latent print of Y′. Similarly, the green light of light source **10** transmitted by the transparent areas of part-image M″ causes red fluorescence in screen **12**, which acts through filter **13** onto the red-sensi-

tive layer 3 of the printing material, and produces therein a latent print of M''. In the same manner the red light from 14 causes dark-red or infra-red fluorescence at the places of the screen 16 corresponding to the transparent areas of part-image C''', and a latent print of C''' is thus recorded in layer 4 of the printing material.

The system of light sources, filters and screens remaining in place, if now the original film and the printing film are both moved in the direction of the arrow into the next printing position, in which Picture I and also that area of the printing material already containing the latent print of Y' are opposite light source 10, then green light from light source 10 and filter 11 will print M' into layer 3 in register with the latent print of Y'. At the same time, red light from light source 14 and red filter 15 will print C'' into layer 4 in register with the latent print of M''.

By moving the films again in the direction of the arrow into the next printing position, in which Picture I and also that area of the printing material which already contains the latent prints of Y' and M' are opposite light source 14, then red light from light source 14 and filter 15 will print C' into layer 4 in register with the existing latent prints of Y' and M'.

The printing material is now developed and fixed, and then subjected to local dye destruction at the places where silver is present. The three superposed images Y', M' and C' together then form a positive three-color picture. The same applies to the other multi-color prints that are completed by further printing steps performed in the same manner.

The printing can be carried out by the optical process, if necessary, with enlargement or reduction. The lenses necessary for this process have been omitted in the schematic drawing. The printing can also be carried out by the contact process. If phosphorescent screens are used, the printing step can be carried out after the phosphorescent screen has been illuminated through the original.

What is claimed is:

1. A photographic printing process for printing the single color separation records of a multicolor picture formed by a plurality of differently colored separation records, wherein in printing the single color separations a fluorescent screen is illuminated through said multicolor picture with colored light which is highly transmitted by the most transparent parts of the colored record to be printed and highly absorbed by the least transparent parts of the colored record to be printed, said fluorescent screen being responsive to said colored light and emitting a fluorescent light of different spectral composition, the fluorescent light being recorded in one of the light sensitive silver halide emulsion layers of a multilayer material comprising a plurality of differently sensitized silver halide emulsion layers each sensitized to light emitted by the fluorescent screen used in printing the record into said layer.

2. A photographic printing process for printing the single color separation records of a subtractive multicolor picture formed by a plurality of differently colored separation records, wherein in printing the single color separations a fluorescent screen is illuminated through said multicolor subtractive picture with colored light which is highly transmitted by the most transparent parts of the colored record to be printed and highly absorbed by the least transparent parts of the colored record to be printed and which is transmitted by the other differently colored records of said subtractive multicolor picture, said fluorescent screen being responsive to said colored light and emitting a fluorescent light of different spectral composition, the fluorescent light being recorded in one of the light-sensitive silver halide emulsion layers of a multilayer material comprising a plurality of differently sensitized silver halide emulsion layers each sensitized to light emitted by the fluorescent screen used in printing the record into said layer.

3. A photographic printing process for printing selectively a part image of a subtractive multicolor picture in which colored light, chiefly transmitted by the most transparent parts of the colored part image to be printed and by the other part images but highly absorbed by the least transparent portions of the part image to be printed, is used to illuminate a fluorescent screen through said multicolor picture, said fluorescent screen being responsive to said colored light and emitting light of a different spectral composition, the colored light emitted by the fluorescent screen being recorded on a light-sensitive photographic silver halide emulsion layer which is sensitive to the fluorescent light.

4. A photographic printing process for printing selectively a part image of a subtractive multicolor picture in which colored light, chiefly transmitted by the most transparent parts of the colored part image to be printed and by the other part images but highly absorbed by the least transparent portions of the part image to be printed, is used to illuminate a light responsive light source through said multicolor picture, said light responsive light source being responsive to said colored light and emitting light of a different spectral composition, the light emitted by the light responsive light source being recorded on a light-sensitive silver halide emulsion layer substantially insensitive to light used to illuminate said light responsive light source.

5. The process of selectively printing a colored part image of a subtractive multicolor picture comprising differently colored part images, on a light sensitive silver halide emulsion printing layer which is not sensitive to colored light rays absorbed to a substantial extent by the coloring substance forming said part image but which is sensitive to light not absorbed to any substantial extent by said coloring substance, which comprises projecting said part image with light passing through said multicolor picture and substantially absorbed by the coloring substance forming said part image but substantially unabsorbed by said other part images or at those portions of said part image where none of said coloring substance is present, upon a luminescent screen responsive to said light and emitting light of a different spectral composition to which said printing layer is sensitive, and exposing said printing layer to the luminescent image on said screen.

6. The process of selectively printing a colored part image of a subtractive multicolor picture comprising differently colored part images, on a light sensitive silver halide emulsion printing layer which is not sensitive to colored light rays absorbed to a substantial extent by the coloring substance forming said part image but which is sensitive to light not absorbed to any substantial extent by said coloring substance, which com-

prises projecting said part image with light passing through said multicolor picture and substantially absorbed by the coloring substance forming said part image but substantially unabsorbed at those portions of said multicolor picture where none of said coloring substance is present, upon a fluorescent screen responsive to said light and emitting light of a different spectral composition to which said printing layer is sensitive, and exposing said printing layer to the fluorescent image on said screen.

7. The process of selectively printing a colored part image of a subtractive multicolor picture comprising differently colored part images, on one of the light sensitive silver halide layers of a multilayer material comprising a plurality of differently sensitized silver halide emulsion layers, said one of said layers being insensitive to colored light rays absorbed to a substantial extent by the coloring substance forming said part image but sensitive to light not absorbed to any substantial extent by said coloring substance and another of said layers being sensitive to colored light rays absorbed to a substantial extent by the coloring substance forming said part image, which comprises projecting said part image with light substantially absorbed by the coloring substance forming said part image and substantially unabsorbed at those portions of said part image where none of said coloring substance is present, upon a fluorescent screen responsive to said light and emitting light of a different spectral composition to which said first mentioned silver halide layer of said multilayer material is sensitive, and exposing said first mentioned layer to the fluorescent image on said screen while screening said second mentioned layer from the light used in projecting said colored part image on said fluorescent screen.

8. In a system for producing a print of a single colored color separation record of a multi-color picture formed by a plurality of differently colored color separation records, a light sensitive silver halide printing layer diffusely dyed with a dyestuff having a color substantially the same as the coloring substance forming said colored record, said printing layer being sensitive to a range of light rays transmitted by said dyestuff and substantially insensitive to light rays absorbed by said dyestuff, means for illuminating said colored record with light substantially absorbed by the coloring substance forming said colored record and substantially unabsorbed at those portions of said colored record where no coloring substance is present, and means including a screen responsive to the unabsorbed light for reproducing an image of said colored record in differently colored light transmitted by said dyestuff and to which said printing layer is sensitive, said printing layer being so positioned and arranged as to be exposed to said last mentioned image.

9. A process for producing a photographic print from a single colored color separation record of a multi-color picture formed by a plurality of differently colored color separation records onto a light-sensitive silver halide emulsion printing layer which is sensitized to light other than the light with which said single record must be illuminated in the printing operation, which comprises illuminating a fluorescent screen through said multi-color picture with light substantially transmitted by the most transparent portions and substantially absorbed by the least transparent portions of said single record, said fluorescent screen being responsive to said light and emitting light of a different spectral composition including light to which the printing layer is sensitive, and exposing the printing layer to only that part of the light emitted by said fluorescent screen to which said printing layer is sensitive.

10. A process for producing a photographic print from a single colored color separation record of a multi-color picture formed by a plurality of differently colored color separation records onto a light-sensitive silver halide emulsion printing layer which is substantially insensitive to light for which the color of said single record is absorptive and which is sensitive to light freely transmitted by the color of said single record, which comprises illuminating a light responsive light source through said multicolor picture with light substantially transmitted by the most transparent portions and substantially absorbed by the least transparent portions of said single record, said light responsive light source being responsive to said light and emitting light of a different spectral composition including light to which the printing layer is sensitive, and exposing the printing layer to only that part of the light emitted by said light responsive light source to which said printing layer is sensitive.

11. A photographic printing process for printing the singe color separation records of a multicolor picture formed by a plurality of differently colored separation records, wherein in printing the single color separations a luminescent screen is illuminated through said multicolor picture with colored light which is highly transmitted by the most transparent parts of the colored record to be printed and highly absorbed by the least transparent parts of the colored record to be printed, said luminescent screen being responsive to said colored light and emitting a luminescent light of different spectral composition, the luminescent light being recorded in one of the light sensitive silver halide emulsion layers of a multilayer material comprising a plurality of differently sensitized silver halide emulsion layers each sensitized to light emitted by the luminescent screen used in printing the record into said layer.

12. A photographic printing process for printing the single color separation records of a subtractive multicolor picture formed by a plurality of differently colored separation records, wherein in printing the single color separations a luminescent screen is illuminated through said multicolor subtractive picture with colored light which is highly transmitted by the most transparent parts of the colored record to be printed and highly absorbed by the least transparent parts of the colored record to be printed and which is transmitted by the other differently colored records of said subtractive multicolor picture, said luminescent screen being responsive to said colored light and emitting a luminescent light of a different spectral composition, the luminescent light being recorded in one of the light-sensitive silver halide emulsion layers of a multilayer material comprising a plurality of differently sensitized silver halide emulsion layers each sensitized to light emitted by the luminescent screen used in printing the record into said layer.

13. A photographic printing process for printing selectively a part image of a subtractive multicolor picture in which colored light, chiefly transmitted by the most transparent parts of the colored part image to be printed and by the other part images but highly absorbed by the least

transparent portions of the part image to be printed, is used to illuminate a luminescent screen through said multicolor picture, said luminescent screen being responsive to said colored light and emitting light of a different spectral composition, the colored light emitted by the luminescent screen being recorded on a light-sensitive photographic silver halide emulsion layer which is sensitive to the luminescent light.

14. A process for producing a photographic print from a single colored color separation record of a multicolor picture formed by a plurality of differently colored color separation records onto a light-sensitive silver halide emulsion printing layer which is sensitized to light other than the light with which said single record must be illuminated in the printing operation, which comprises illuminating a luminescent screen through said multicolor picture with light substantially transmitted by the most transparent portions and substantially absorbed by the least transparent portions of said single record, said luminescent screen being responsive to said light and emitting light of a different spectral composition including light to which the printing layer is sensitive, and exposing the printing layer to only that part of the light emitted by said luminescent screen to which said printing layer is sensitive.

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