[Second Edition.]

PATENT SPECIFICATION

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356,701

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COMPLETE SPECIFICATION

Process of Photographic Printing.

We, I. G. FARBENINDUSTRIE AKTIENGESELLSCHAFT, a Joint Stock Company organised according to the Laws of Germany, of Frankfurt a/Main, Germany, 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:—

In Specification No. 353,121, a process has been described for printing a lenticular film without lateral inversion on to a sensitive photographic layer the support of which is not embossed with refractive microscopic elements, which chiefly consists in exposing the negative film to light with the lenticular support facing an objective equal in function to the lens system by means of which the negative film was originally exposed in such a manner that when viewed from the film side the negative film shows a picture in which the colours of the object are represented by their complementary colours. If the film to be printed, hereinafter always simply called "negative," is a positive film, it shows a picture of the object in which the colours are the actual colours. The said process is, of course, also well suited for the production both of a positive image from a negative and of a negative from a positive; furthermore, by application of a photographic reversal method a negative can be obtained from a negative and a positive from a positive.

Whereas, when operating with some printing material not provided on its support with refractive lenticular elements the negative film when illuminated as above described can be printed by contact, this is not possible when the sensitive printing layer is also supported by a sheet with a system of microscopic refracting lens elements on the back.

According to this invention a lenticular film can be printed on to another lenticular film in such a manner that in the images produced the tonal values are the actual tonal values and the right and left sides are not inverted, while illuminating the negative film, with or without a colour screen, through the embossing of microscopic lens elements by means of an objective equal in function to that by means of which the negative film was taken, by placing between the positive and negative films an optical system which has in front of the positive film a conjugate plane of the plane in which, when the negative film was exposed, the colour screen was placed, and placing in this conjugate plane an objective which projects on the positive film an image of the negative to be copied. The optical system is so chosen that an object in the plane in which the colour screen was placed when the negative film was exposed is projected in the conjugate plane in front of the positive film as an image whose size is either equal to that of the object or, if an enlargement on reduction is to be produced, bears to that of the object a ratio equal to the degree of enlargement or reduction required.

In order to render more clear the principle of the present invention, an arrangement of lenses will now be described, it being understood, however, that effects produced by the embossing of the negative film have for the sake of clearness in the first place not been taken into account. Fig. 1 of the accompanying diagrams shows a luminous plane E which is arranged in the focus of a condenser L_1 of the focal length f_1. The rays emanating from E, which for instance may be an illuminated disc of translucent glass, travel parallel to one another to the objective L_2 of the focal length f_2 being equal in function to the objective by means of which the negative film was originally exposed. (The term "equal in function" as applied to optical systems is to be understood herein in the same sense as in Specification No. 353,121). Each point of E will, therefore, appear in the focal plane of the objective L_2 in which the negative film N is placed. At a distance of twice the local length from the objective L_2 is arranged the lens L_3, the focal length of which is identical with that of the objective L_2. Hence, the negative film N is placed in the focal plane both of the objective L_2 and of the lens L_3. On the other side of the lens L_3, at a distance of double the focal length of the lens L_2, a

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further lens L_4 is placed which has the same focal length as the lens L_3 and the objective L_2. On the other side of the lens L_4, in its focal plane, with the lenticular support facing the lens, is arranged the positive film P upon which the print is to be produced. In consequence of this arrangement the rays emanating from a point of the negative film N are directed by the lens L_3 so as to run parallel and the plane F_1 in the objective L_2, equal in function to the objective adopted for originally exposing the negative film and corresponding with the screen plane of that objective, is reproduced in F_2 constituting the plane of the diaphragm of the projection lens.

As will be seen from the course of beams indicated all rays arrive at the positive film under exactly the same conditions under which the rays emanating from the object were received by the negative film in taking the picture. Particularly, the plane of the diaphragm F_2 of the projection lens L_4 appears when viewed from the positive film in the same manner as the screen plane F_1 when viewed from the negative film when the latter was exposed. Since for each point of the plane of the diaphragm F_2 of the projection lens L_4 the lens elements of the positive film will project the same image as that projected by the lens elements of the negative film N for the corresponding point of the plane F_1 of the projection lens L_2, there will be formed behind the single lens elements of the positive film P blackenings (dark parts) which exactly correspond with the blackenings to be found behind the respective lens elements of the negative film N. Since the formation of the blackenings depends on the geometrical-optical relations and not at all on the presence of a colour screen in front of the negative film, such a colour screen can be dispensed with in the arrangement of the projecting device according to this invention and the original can be printed on to a lenticular film provided with an ortho-chromatically sensitised emulsion layer by exposing it to white light.

In the preceding description the fact that the lens elements of the negative film change the course of the rays has been neglected. The net-work of the said film acts as an optical grid and gives rise to the formation of a number of lateral diffraction spectra of each point of the filter plane; this interferes with the formation of a colour-true print, which depends on the projection of each point without any overlapping. The number of these interference images will be the smaller the longer the focal length of the lens elements, the number of lens elements per unit of length remaining the same. In these cases the waterings (indistinctness) of the image caused by the interference images will be rather small so that the prints are still almost true in colours. When, however, the interference images extend further over the plane of the diaphragm of the projection lens vertically with respect to the longitudinal axes of the cylindrical microscopic lens elements, this disadvantage will be obviated by placing in the plane which the colour screen of the objective occupied in picture-taking, or in the corresponding or conjugate plane in front of the positive film, or in both planes simultaneously, a diaphragm which serves to retain only the central portion of the projecting beam eliminating thereby all the lateral diffraction spectra and consequently avoiding mixing of the colour areas with one another. For this purpose diaphragms can be used the openings of which correspond with the central parts of the colour areas of the three-colour screen used in picture-taking. A diaphragm of the kind described has been illustrated in Fig. 2. If desired, the diaphragm placed at F_2 may be replaced by a colour screen acting in the same manner as the colour screen placed at F_1; in this case, however, the process is limited to the application of panchromatically sensitised positive film, so that this arrangement which also reduces the light intensity in printing is not advisable. The best arrangement to avoid certainly any overlapping of the interference pictures of one zone with that of another zone of a colour stripe is the following; In the plane of the diaphragm F_1 of the projection lens L_2, a diaphragm is arranged which masks a part of each colour area corresponding with the stripes of the colour screen in such a manner that any line drawn on the diaphragm perpendicularly to the direction of the stripes, intersects only one unmasked colour area. In the plane of the real projected image of this diaphragm another diaphragm is placed the size of which substantially corresponds with the degree of enlargement to be produced. Thus, if the picture is to be enlarged or reduced n-times in copying, the second diaphragm and the projected image of the colour screen must be n-times greater or smaller than when the picture is to be copied without enlargement or reduction. Preferably a diaphragm in the form of stairs (stepped diaphragm) as shown in Fig. 3 is adopted for this purpose. Other still simpler forms of diaphragm producing the same effect are shown in Figs. 4 and 5. These diaphragms have slot-like openings at an acute angle to the longitudinal direction

of the cylindrical lenses of the negative film and the breadth of which is so determined that the interference images projected by them owing to the lenticular embossing will not cover each other and that the slot placed in the plane of the real image projected in front of the positive film allows to pass only the undeflected image emanating from the slot in front of the negative film. By this arrangement it becomes possible to suppress with certainty the streakiness frequently encountered with the printing methods hitherto used.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is :—

1. A process of printing a lenticular film by optical means on to another lenticular film without lateral inversion and with correct reproduction of the tonal values, wherein the negative film is illuminated, with or without a colour screen, from the side next the refracting surface through an objective equal in function to that by means of which the negative was taken, and there is placed between the negative film and the positive film an optical system which has in front of the positive film a conjugate plane of the plane in which the colour screen was placed during the taking of the negative film, in which conjugate plane is placed an objective which projects on the positive film an image of the negative to be copied.

2. A process as referred to in Claim 1, wherein there is placed in the plane which the colour screen of the objective occupied during the original exposure, or in the corresponding or conjugate plane projected by the optical system in front of the positive film, or at both places simultaneously, a diaphragm constructed and adapted to avoid any mixing of the interference images of one zone of the plane of the original exposure screen with those of another zone.

3. A process as referred to in Claim 1 or Claim 2, wherein in the illuminating objective a part of each area corresponding with the stripes of the colour screen is masked by means of a diaphragm in such a manner that any line drawn on the diaphragm perpendicularly to the direction of the stripes intersects only one unmasked colour area, and there is placed in the plane of the real image projected by this diaphragm a further diaphragm selected of an appropriate size corresponding with the degree of enlargement to be produced.

4. A process as referred to in Claim 3, wherein the diaphragm is provided with slot-like openings extending at an acute angle to the longitudinal direction of the cylindrical lens elements of the negative film and the breadth of which is selected so that the interference images projected by them, owing to the refracting lenticular surface, do not cover each other and that the slot placed in the plane of the real image projected in front of the positive film allows to pass only the undeflected image emanating from the slot in front of the negative film.

5. Arrangement of lenses for the process referred to in the preceding claims constructed and adapted so as to operate substantially as described with reference to Figs. 1, 2, 3, 4 or 5 of the accompanying drawings.

Dated this 8th day of May, 1930.

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W.C.2,
Agents for the Applicants.

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[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 1

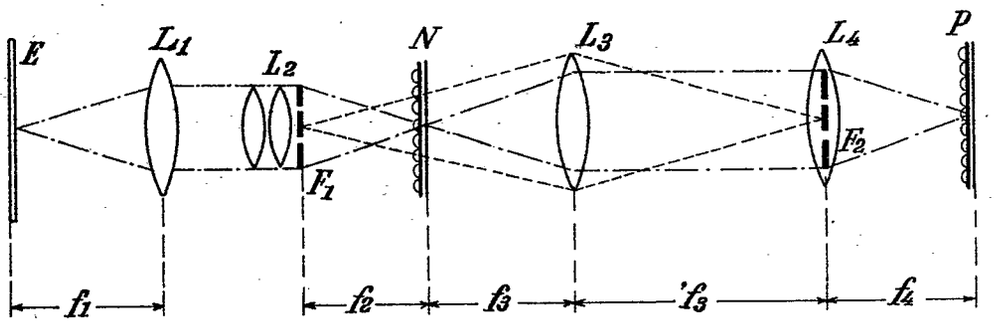


Fig. 2

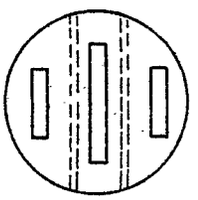


Fig. 4

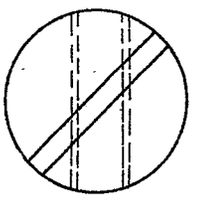


Fig. 3

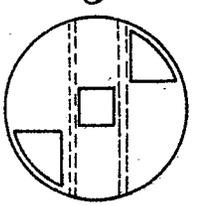
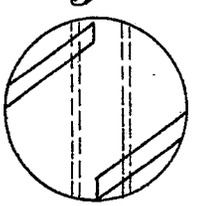


Fig. 5



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