PATENT SPECIFICATION

Convention Date (United States): Oct. 31, 1935.

483,319

Application Date (in United Kingdom): Oct. 16, 1936. No. 28143/36.

Complete Specification Accepted: April 19, 1938.

COMPLETE SPECIFICATION

Improvements in or relating to Photographic Printing of Lenticular Film

We, KODAK LIMITED, a Company registered under the Laws of Great Britain, of Kodak House, Kingsway, London, W.C.2, (Assignees of ORAN ERNEST MILLER, a Citizen of the United States of America, of Kodak Park, Rochester, New York, United States of America), 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:—

The present invention relates to photographic copying or duplicating of lenticular film. In the printing of lenticular film carrying a plurality of colour separation images behind each lenticulation, a number of difficulties are encountered which are entirely absent from the printing of ordinary black and white pictures. These difficulties mainly reside in the elimination of certain defects, the most common of which are (1) colour wedging, (2) moire pattern, and (3) lack of colour separation. A number of arrangements have been proposed and devised for overcoming these faults, and although some of these arrangements are practicable, they are almost without exception elaborate and costly. Also, they slow down the printing speed, and for other reasons, including the structure requirements imposed upon the objective lens in projection printing, are not entirely satisfactory.

With a view to eliminating the above mentioned difficulties, a method of preparing a print on a sensitive transversely embossed film from an original transversely embossed film according to the present invention comprises the steps of continuously advancing the original and copy films at the same speed through a beam of light, forming an image of the original film in the plane of the copy film, and causing continuous relative movement in the direction of film movement between the image and the copy film.

In carrying the invention into effect according to one form, the two films are each moved past an exposure aperture of a height equal to the width of a single lenticulation and in such directions that the lenticulations of the original film are not resolved in the print, whereby no moire pattern appears in the print. In applying this form of the invention to projection printing of lenticular film, the two films are moved in the same direction, while in the application to contact printing the films are moved in opposite directions.

In applying the invention to projection printing of lenticular film, an alternative method may be adopted comprising projecting an image of the original film on the copy film at such a magnification that the movement of the image differs from the movement of the copy film by the height of one lenticular element during the passage of such element through an exposure position. With this form of the invention, however, the two films which are moved at the same speed must be advanced in opposite directions in order that the continuous relative movement in the direction of film movement between the image and the copy film may be effected to avoid the moire pattern.

When the invention is applied to projection printing it permits simplification of the objective lens and makes it possible to produce a copy which is geometrically similar to the original, so that the copy can be projected with identically the same system or its equivalent, that was used in taking the original film.

Several ways of carrying the invention into effect are illustrated by way of example in the accompanying drawing, in which:

Fig. 1 illustrates diagrammatically an optical printing system, in which an original film and a copy film move uniformly and in the same direction through the printing position;

Fig. 2 is a diagrammatic view of a mechanical and optical arrangement for practising the method illustrated in Fig. 1;

Fig. 3 illustrates diagrammatically the invention as applied to contact printing, and shows an illuminating system which may be substituted for that illustrated in Figs. 1 and 2; and

Fig. 4 is a diagrammatic arrangement for practising a modification of the invention.

Referring to Fig. 1 of the drawing,

[Price 1/-]

illustrating an arrangement for the optical printing of transversely lenticulated film in accordance with the invention, a source of light 1, preferably comprising a single filament lamp with the filament extending parallel to the film embossing, is imaged by a condenser lens 2 on the image layer 3 of an original film 4, provided with transverse lenticulations 5 through which the image layer 3 was originally exposed in a well-known manner. The condenser lens 2 is preferably but not necessarily of the same relative aperture as the objective lens 6 employed for imaging the original film 4 on to a copy film 7 provided with a sensitive layer 8, and on its opposite side with transverse lenticulations 13. The illumination of the image layer 3 of the original film 4 is restricted to an area equal to that lying behind a single lenticular element and this may be accomplished by means of a suitable mask 9 in which is provided a slit 10 having a width exactly equal to the width of a single lenticulation. It will be understood that this physical slit may be replaced by any suitable so-called slitless system, such as will be described in connection with Figure 3. This portion of the original film 4, which is illuminated, is imaged by the objective 6 on to the copy film 7 and a suitable mask 11 provided with a slit 12 may be provided to limit the light falling on the copy film 7 to a width equal to that of a single embossing 13. The two films 4 and 7 are moved continuously by any suitable well-known mechanism at a uniform speed and in the same direction as indicated by the arrows. This mechanism and optical system may, if desired, take the form shown in Figure 2, in which the films 4 and 7 are arranged in the same plane and are moved by sprockets 14 and 15 mounted on a common shaft 16. The light leaving the film 4 is directed through the objective 6 and to the copy film 7 by means of prisms 17 and 18.

With the above arrangement it will be evident that the copy film 7 and the image of the film 4 formed thereon, are coincident and travel in opposite directions so that the lenticulations of the original film are not resolved on the copy film, and hence, there is no resulting moire pattern. The picture is recorded point by point in the direction of motion and since the films are moved in the same direction, the recorded image is not inverted. Although the picture on the copy film 7 is reversed right and left, the embossings of the two films face in opposite directions, and this results in the print being recorded geometrically similar to the original.

With the arrangement just described there can be no colour wedging or "cat-eye" diaphragming of parts of the objective since the printing is done only along an axis parallel to the lenticulations, and this eliminates the need for compensating lenses to correct the convergence or divergence of the elementary beams from different elements of the picture. This is true because each element is recorded from the same position relative to the lens as any other element, and the axes of the elementary beams from different portions of the picture areas, have the same convergence or divergence as in the original film. This condition greatly simplifies the optical requirements of the objective lens, since the only unusual requirement is that it must have a relative aperture at least equal to that of the lens and filter combination used in taking the original film 4.

Since the illumination of the original film 4 is restricted so as to be equal to the width of a single embossed element, the illumination showing on the objective 6 and its distribution thereon, will be entirely independent of the movement of the film and dependent only on the colour values recorded in the image layer 3 of the original film 4.

The method described above in connection with optical printing may be applied to contact printing by moving the two films 4 and 7 in opposite directions, as indicated by the arrows in Figure 3, with their embossed surfaces substantially in contact. As is the case with Figures 1 and 2, the illumination of the original film 4, Figure 3, is restricted to an area having the width of a single lenticulation, and in this arrangement a slit defined by a mask 19 is imaged by a suitable objective 20 on to the image layer 3 of the original film 4. The conditions which this illuminating system must meet are, that regardless of the actual size of the illuminating slit, its image on the layer 3 will be of a width equal to one lenticular element of the film. In this arrangement the image of the original film 4 will move in a direction opposite to the film 7, with resulting elimination of any moire pattern for the same reason as was explained in connection with the system illustrated in Figure 1. In the latter arrangement the two films are moved in the same direction, but, of course, the image formed on the copy film 7 moves in a direction opposite to that of the film 4.

Figure 4 illustrates a modification in which the general optical system illustrated by Figures 1 and 2, may be employed, but in which the two films 4 and 7 are moved in opposite directions, as indicated by the arrows. This, of course, results in the image projected by the objective 6 moving in the same direction as the copy film 7. If the magnification were exactly

unity, then moire would appear in the printed film, but if the relationship between the magnification of the picture and the width of the slit 21, in front of the copy film and defined by a mask 22, is made such that the movement of the projected image is greater or less than the movement of the copy film 7 by the width of one embossed element during the time required for one element to pass the slit 21, then no moire pattern will appear in the copy film 7. Thus, if the width of the slit 21 is 1.0 mm. and there are thirty-two embossed elements per millimeter on the film 7 and if the magnification is made to equal 31/32 or 33/32, it will be evident that the moire pattern is eliminated without any greater loss of definition than is suffered by any of the other known methods for eliminating moire. The arrangement shown in Figure 4 will result in a print which is not similar to the original, but this may easily be corrected by inverting the banded filter in projection, and by providing the optical system in the printer with a single lateral reflection to compensate for the lateral inversion of the picture.

In this arrangement the printing slits are preferably kept narrow enough so that it can be assumed that all of the printing is being done on the axis of the projection lens 6, and in this case, the optical requirements for the printing objective are no more severe than was the case of printing with the films moving in the same direction. The fact that the arrangement last described permits the simultaneous illumination of a considerable number of lenticulations, gives it a distinct advantage over the other forms, because less printing light is required and it is possible to print at much higher speeds.

In the interests of clarity, the film feeding mechanism for advancing the films in the manner desired have not been illustrated in detail, but any person skilled in the art can readily provide any of several well-known means for advancing the two films continuously and at the same uniform speed.

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. In a photographic method of preparing a print on a sensitive transversely embossed film from an original transversely embossed film the steps of continuously advancing the original and copy films at the same speed through a beam of light, forming an image of the original film in the plane of the copy film, and causing continuous relative movement in the direction of film movement between the image and the copy film, for the purpose hereinbefore set forth.

2. A method according to claim 1, of preparing a print on a sensitive transversely embossed film from an original transversely embossed film, which comprises arranging the two films with their lenticular surfaces facing one another, and continuously advancing the films at the same speed past an exposure aperture of a height equal to the width of a single lenticulation.

3. A method according to claim 2, wherein an image of the original film is projected onto the copy film while both films are moved in the same direction as each other, for the purpose hereinbefore set forth.

4. A method according to claim 2, wherein contact printing of the lenticular film is effected while moving the two films in opposite directions to each other with their lenticulations substantially in contact.

5. A method according to claim 1 of preparing a print on a sensitive transversely embossed film from an original transversely embossed film, which comprises arranging the two films with their lenticular surfaces facing one another, continuously advancing the films at the same speed and in opposite directions past an exposure position, and projecting an image of the original film on to the sensitive film at such a magnification that the movement of the image differs from the movement of the sensitive film by the width of one lenticular element during the passage of such element through the exposure position.

6. A method of photographically copying an original transversely embossed film on to a transversely embossed copy film by the method diagrammatically illustrated and described with reference to Figs. 1 and 2, 3 or 4 of the accompanying drawings.

Dated the 16th of October, 1936.

RAYMOND E. CROWTHER,
Acting for Applicants.

Reference has been directed, in pursuance of Section 7, sub-section (4) of the Patents and Designs Acts, 1907 to 1932, to Specifications Numbered 377,177, 329,899 and 288,290.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1938.

Fig. 1.

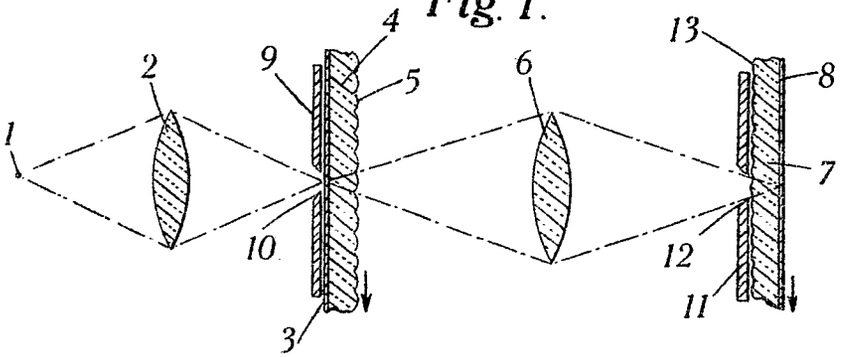


Fig. 2.

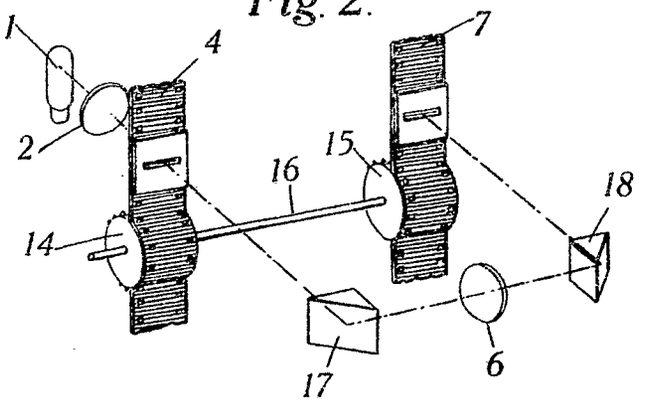


Fig. 4.

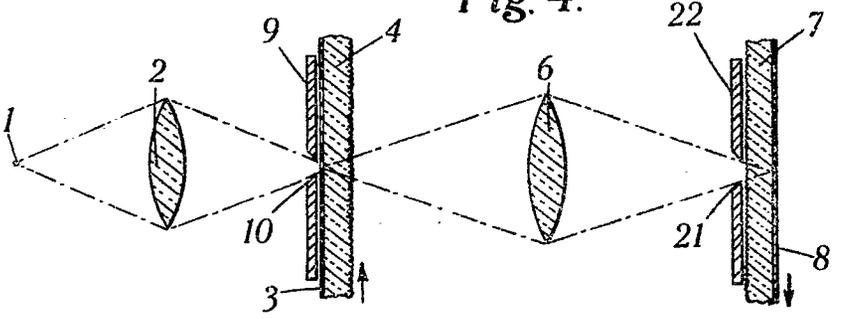
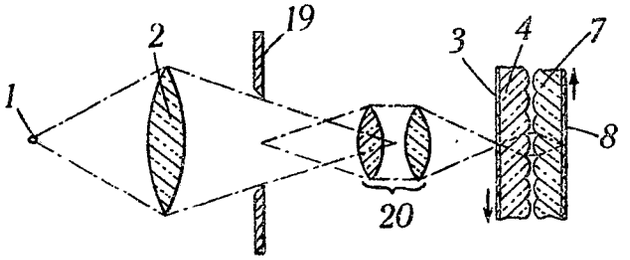


Fig. 3.



Malby & Sons, Photo-Lith.