PATENT SPECIFICATION

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Complete Accepted: Dec. 23, 1929.

COMPLETE SPECIFICATION.

Improvements in or relating to Colour Photography.

We, SOCIETE FRANCAISE DE CINEMATOGRAPHIE ET DE PHOTOGRAPHIE FILMS EN COULEURS KELLER-DORAIN, formerly known as Societe du Film en couleurs Keller-Dorain, a Societe Anonyme organised under the laws of France, of 42, Rue d'Enghien, Paris, France, 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 reproduction of films in colours by the process in which the support is goffered by a very large number of lenticular elements on a film of the same nature but for images in different size, presents considerable difficulties if the reproductions are to be faithful and the true colours are to be preserved.

The object of the present invention is to overcome the various complications and incompatible conditions which the problem presents. As Figure 1 of the accompanying drawing indicates, an objective, no matter of what quality may serve for the reproduction of the ordinary non-goffered films.

Let H—H^1 be the reproduction objective represented by its principal planes; F and F^1 the two foci, and O a, O^{1}a^1 the two films. There must always be a position of the film O a such that $\frac{O\,a}{O^1a^1} = \frac{OF}{FH} =$ G, the magnification which it is required to obtain.

This reproduction has no other condition than the properties of the objective and it depends neither on the angle ω nor on the angle ω^1 nor on their ratio, this latter being fixed by the magnification.

The reproduction of the goffered film employed for colour cinematography, the Keller-Dorain goffered film process, is quite different.

In the reproduction of these films, conditions occur the satisfying of which is complicated, particularly when it is required to reproduce a different size of image. These conditions and their resolution in the elementary dioptric are represented in Figure 2.

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Let H H^1 and H$_1$ H$^1_1$ be two objectives symmetrical with respect to the diaphragm D which is placed at the common or anterior focus of the two optical elements. F and F^1 are the corresponding posterior foci of each optical element which foci play the part of the two anti-principal planes of the optical combination H H^1, H$_1$ H$^1_1$. In the planes F and F^1 are placed the two films, the original film and the virgin film which for the sake of clearness in the drawing are considerably enlarged. The aperture of each separate optical element is equal to the aperture of the objective for taking the views. In summary, the conditions required for an objective in the reproduction of films on a goffered support for the Keller-Dorian process are as follows:—

F^1 is the image of F; O^1 is the image of D which in its turn is the image of O; the angle ω^1 is equal to the angle ω.

It is necessary to maintain the same conditions for the reproduction of the same films with a different sized image. But, in this case the following inconsistency arises. If the required degree of magnification is G, the ratio of the two focal distances must also be $G = \frac{F}{F^1}$. But, it is impossible to retain the same aperture for the two objectives thus coupled together since by definition the aperture of a photographic objective is the ratio of the diameter of the diaphragm of the objective to its focal length. The diaphragm of each objective in this case is the diaphragm common to the two optical elements.

In fact, as Figure 3 indicates, D is the diaphragm common to the two optical elements O and O^1, the focal distances of which have a ratio $F/F^1 = G$, the angle ω^1 is greater than the angle ω and the group of images a^1 corresponding to each part of the picture is greater than the group a. It is thus impossible to reproduce the groups faithfully.

In order to remedy this in accordance with the invention, the process of reproduction is performed through the intermediary of non-goffered films, thus

making two reproductions. The original film is reproduced on an ordinary film and thence on to the Keller-Dorian goffered film in the following manner:—

Referring to Figure 4, let the double reproduction objective consist of two optical elements O and O^1, the ratio of whose focal lengths $\frac{F}{F^1}=G$, G being the required magnification.

At the anterior focus of the objective O, is placed the original goffered film f; at the anterior focus of the objective O^1 is placed the ordinary virgin film, the sensitive layer of this latter facing the objective.

On the sensitive gelatine layer g is formed the image of the film f, suitably illuminated. On the other hand at the position of the diaphragm D is formed the image of the small groups of images a which are found facing each lenticular element. Each image of the film f will have to be reproduced on the film f^1 as many times as there are groups or bands of elementary colours in the selecting colour filter of the objective for taking the views. Each image obtained on the film f^1 is taken with a diaphragm D corresponding to a definite group a. If figure 4 shows the position of the diaphragm in order to take the band corresponding to blue, Figure 5 represents the same film in the second stage in taking the neighbouring band, for example, red.

The film thus obtained is precisely analogous to films obtained with several objectives provided with light filters, as in known polychrome processes. This film is again reproduced on a goffered Keller-Dorian film by an objective like that of Figures 4 and 5 with an exactly similar disposition of the diaphragm.

The succession of operations which must be performed in order to obtain the first non-goffered intermediary film are as follows:—

(1) The image f is impressed on the film f^1 with the diaphragm D (Fig. 4).

(2) Without moving the original film f we displace the film f^1 through a distance equal to one complete picture space of the film, we cause the diaphragm to shift, replacing it as shown in figure 5, and repeat the exposure.

We thus obtain another elementary image on f^1.

(3) Always without moving the original film f, we displace f^1 through a distance equal to one complete picture space of the film, we cause the diaphragm to shift to the position symmetrically opposite to that of figure 4, and repeat the exposure.

(4). We advance the films f and f^1 through a distance equal to one complete picture space of the film and shift the diaphragm to the position of figure 4 and recommence the cycle.

An analysis is thus made of the goffered film F, decomposing it into several elementary images.

It is necessary now to effect the synthesis, or return to a goffered film of different size to that of the initial film. Taking the intermediary film f^1:

(1) We form on the goffered film f^{11} (of different size to the first film) an elementary image of the film f^1 using the position of the diaphragm D shown in Fig. 4.

(2) The goffered film f^{11} remaining in position, we displace the film f^1 by a distance equal to the height of a complete image of that film, that is to say we form the image of the film f^1 on the film f^{11}, taking naturally as a diaphragm that which corresponds in position to figure 5 (as in the second of the first series of operations above described).

(3) The goffered film f^{11} remaining in position we again displace f^1 by a distance equal to the height of a complete image of this film, that is to say we impress the succeeding image of the film f^1 on the film f^{11} taking the diaphragm in a position symmetrical with respect to that of figure 4 (as in the third of the first series of operations).

Thus we superpose on the same height of the final goffered film f^{11} (a height corresponding to that of a complete elementary image of this film) the three elementary images of the ordinary film f^1, these three images corresponding to the three diaphragm positions previously referred to. To pass to the succeeding image we displace:

(a) f^{11} by the distance corresponding to one complete elementary image of this film.

(b) f^1 by the distance corresponding to one complete elementary image of this film, and we recommence the series of operations.

The new film can have the dimension required because it is possible as desired to choose the focus of the objective O^1 either in the first or second impression.

If the original film has been developed as a negative the intermediate film must be positive and the final film will be developed as a positive by inversion. If the orginal film is developed as a positive, the intermediate film is negative and the final film is positive direct. The intermediate film can in this case be developed as a positive by inversion and the final film can also be obtained as a positive by inversion.

Having now particularly described and ascertained the nature of our said inven-

tion and in what manner the same is to be performed, we declare that what we claim is:—

1. Process for the reproduction by optical projection, of colour record films having a goffered support on an identical blank film but with a different size of image which consists in using an intermediate ordinary non-goffered film on which is reproduced the original film, diaphragms being suitably employed, which intermediate reproduction is reproduced again on Keller-Dorian goffered films by placing the elementary images in juxtaposition, substantially as described.

2. Films having a goffered support obtained by the process claimed in claim 1.

Dated the 20th day of September, 1928.

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Fig. 1

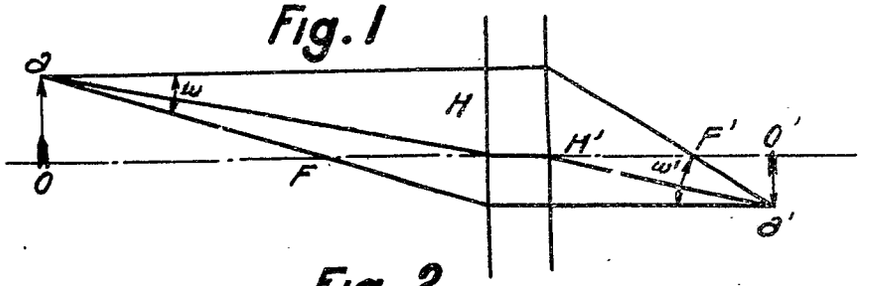


Fig. 2

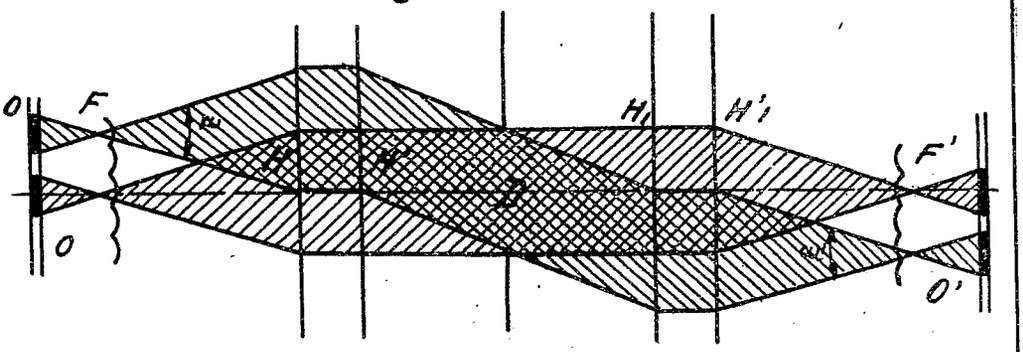


Fig. 3

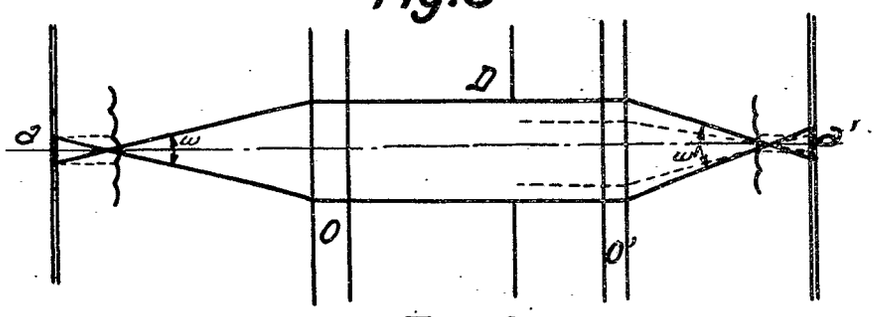


Fig. 4

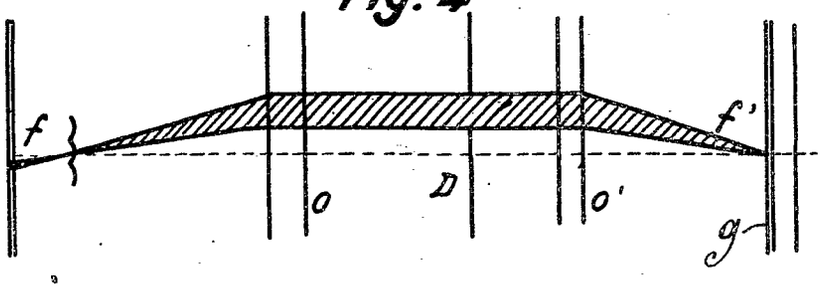
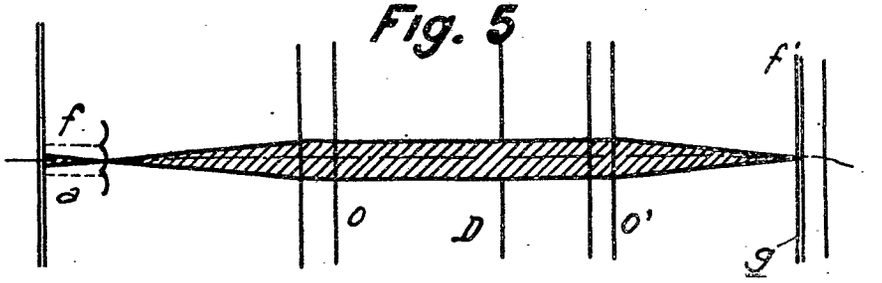


Fig. 5



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