Aug. 30, 1932. A. OSWALD 1,874,601

PROCESS FOR REPRODUCING FILMS

Filed Sept. 21, 1928 2 Sheets-Sheet 1

Fig. 1

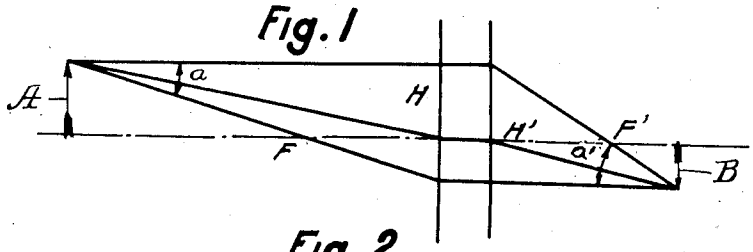

Fig. 2

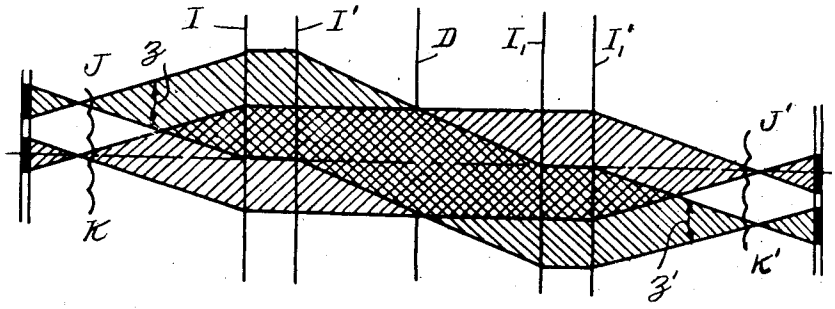

Fig. 3

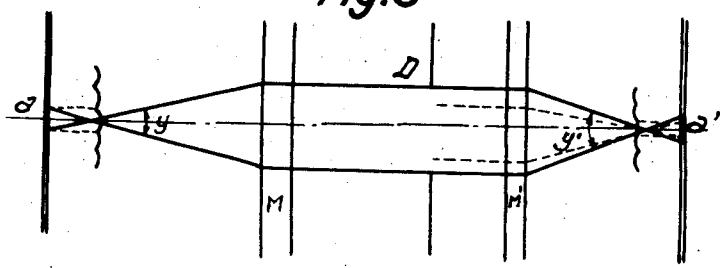

Fig. 4

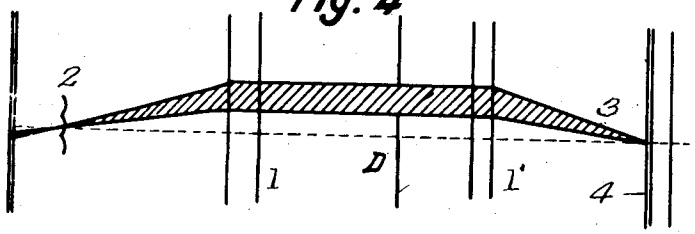

Fig. 5

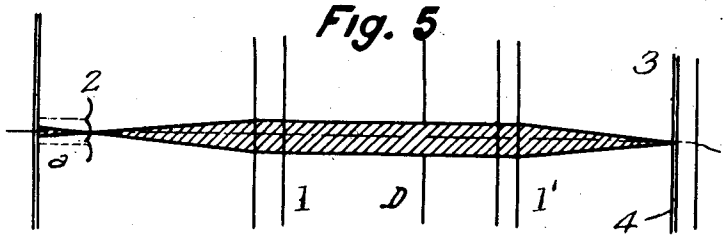

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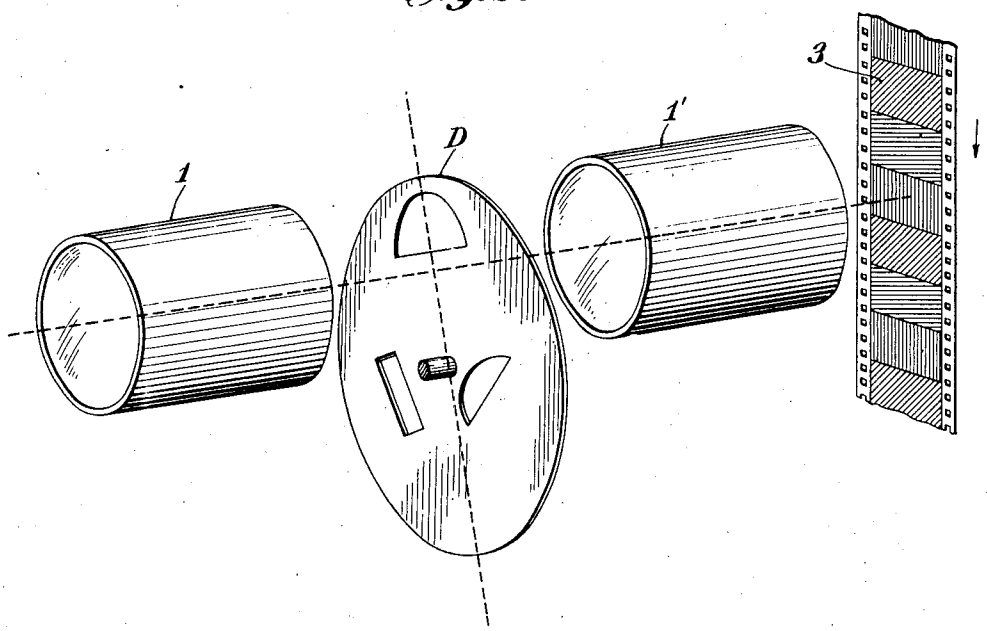
Fig. 6.



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Patented Aug. 30, 1932

1,874,601

UNITED STATES PATENT OFFICE

ANDRÉ OSWALD, OF PARIS, FRANCE, ASSIGNOR, BY MESNE ASSIGNMENTS, TO KELLER-DORIAN COLORFILM CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

PROCESS FOR REPRODUCING FILMS

Application filed September 21, 1928, Serial No. 307,364, and in France September 27, 1927.

The reproduction of films in colors, by means of the process involving the goffering of the support with a very large number of lenticular particles, on a film of the same nature but having different size images, presents considerable difficulty when it is desired to obtain conditions of faithful reproduction and to conserve the true colors in the projection of the counter-symbols.

It is an object of my present invention to overcome these difficulties and objectionable features as above indicated.

In the drawings—

Fig. 1 is a diagram illustrating the method of reproducing ordinary films such as in black and white;

Fig. 2 is a diagram illustrating the usual method of reproducing Keller-Dorian films in colors;

Fig. 3 is another diagram illustrating the difficulties encountered when enlarging a Keller-Dorian film;

Fig. 4 is a diagram illustrating my improved method;

Fig. 5 is another diagram illustrating another stage of my method; and

Fig. 6 is a somewhat diagrammatic perspective view illustrating the disposition of the various elements as used in my method.

As illustrated in Fig. 1, a good objective can serve to reproduce ordinary non-goffered films. Elements H and H′ represent the principal planes of the reproducing objective. F and F′ are the two focus points and arrows A and B the images of the two films. The image A always has a position such that the ratio of the size of image A to the size of image B equals the ratio of the distance of image A from point F to the distance of image B from point F′, which we shall call G, the magnitude of the enlargement sought to be obtained.

The said reproduction depends solely on the quality of the objective and does not depend either on the angle a nor on the angle a' nor on their ratio which is fixed by the enlargement.

The reproduction of Keller-Dorian goffered films used for moving pictures presents a different problem. In reproducing such films a number of conditions to be satisfied are met with, which become particularly intricate when different images must be reproduced within a given space.

These conditions and the solution of the problem in the elementary dioptric will now be set forth in connection with Fig. 2.

I, I′ and 1_1, I_1' are the two principal planes of two objectives disposed symmetrically with respect to the diaphragm D which is disposed at the common rear focus point of the two optical parts. Films J and J′ are disposed at the corresponding front focusing points of each optical part which act as two antiprincipal planes of the optical assembly I, I′, I_1, I_1' and D. Of the films, J represents an original film and J′ a virgin film, which have been represented on an enlarged scale for purposes of clearness. The opening of each separate optical part is equal to the opening of the exposing objective.

In short, the necessary conditions for an objective required in the reproduction of films with a goffered support for the Keller-Dorian process are:

J′ must be the image of J; K′ must be the image of D which in turn is the image of K; and the angle z' must be equal to the angle z.

It is absolutely necessary to maintain these same conditions for the reproduction of one film on another of different size images. This is where a handicap is met, as the enlargement required must equal the ratio of the two focal distances of the points I and I_1'. Now it is impossible to preserve the same opening in the two objectives thus coupled together because, by definition, the opening of a photographic objective is the ratio of the diameter of the light admitting opening of said objective to the focal length thereof. The light admitting opening of each objective in the case in question is the diaphragm common to two optical parts.

As shown in Fig. 3, D is the diaphragm as before common to the two optical parts M and M′ the ratio of the focal lengths thereof being equal to the enlargement desired, with the angle y less than the angle y' and the sec-

tor a' greater than a. It is thus impossible to faithfully reproduce the two sectors.

Thus far my invention has only been by way of explanation in order to indicate clearly the difficulties encountered. My invention contemplates overcoming these difficulties by passing the image of an intermediate film on to a non-goffered film and then reproducing anew on the film which is to receive such image. I reproduce the original film on an ordinary film and then reproduce the ordinary film on the goffered Keller-Dorian film in a way which will now be disclosed in connection with Figs. 4 to 6.

In Fig. 4 the reproducing objective is of the double compound type consisting of two optical parts 1 and 1′ the ratio of the focal lengths thereof being equal to the desired enlargement.

At the front focusing point of objective 1 I place the original goffered film 2 and at the front focusing point of the objective 1′ I place the ordinary virgin film 3, with the sensitive surface 4 thereof toward the objective.

On the layer of sensitized gelatine 4 I form the image of the film 2, suitably lighted. On the other hand, on the diaphragm D I form the image of the small sectors a which are disposed opposite each lenticular particle. The image of film 2 must be reproduced on film 3 as many times as there are sectors or bands of colors in the selecting color filter of the exposing objective. Each image obtained by the film 3 is cast by the diaphragm D corresponding to a predetermined sector a. In Fig. 4 it is assumed that the position of the diaphragm is that for casting the sector corresponding to blue and Fig. 5 represents the same film in the second stage, casting the adjacent sector in red, for example.

The film thus obtained is entirely analogous to films obtained with several objectives provided with light filters in accordance with known polychrome processes. I reproduce this film anew on a Keller-Dorian goffered film by an objective analogous to that of Figs. 4 and 5 with a diaphragm device exactly the same. This time I superpose the elementary images of the intermediate film 3 on another film which is to receive the same, likewise with diaphragms, each corresponding to the image of film 3. My new film can have any desired dimensions because the focus point of the objective 1 may be chosen at will either in the first printing operation or the second.

Fig. 6 shows the disposition and details of the elements involved on an enlarged scale. The reference characters being the same as those used in diagrams 4 and 5, no further explanation is necessary. Suffice it to say, however, that whether the process is used for enlarging or reducing the image of the original film the same disposition of parts is utilized, the only difference being in the focal lengths of objectives 1 and 1′. Likewise in reproducing on the film which is to finally receive the image of the original film either in reduced or enlarged form, with the exception that the ordinary film which originally received the image is placed at the position of 2 and the film which is to finally receive such image is placed in the position of 3.

If the original film has been developed in the negative, the intermediate film will be in the positive and the final film is developed in the positive by inversion. If the original film is developed in the positive, the intermediate film will be in the negative and the final film is directly positive. The intermediate film can, in this case be developed in the positive by inversion and the final film can also be printed in the positive.

Having described my invention what I claim as new and desire to secure by Letters Patent is:

1. The process which comprises reproducing from the images on a goffered film corresponding images of a different size on another goffered film with substantially the same relative color reproducing values as in said first-mentioned images, by reproducing, with the aid of an objective, said images on an intermediate non-goffered film in a series of monochrome images from the first-mentioned images by projection printing with a diaphragm having different apertures corresponding to the color filter apertures of the taking objective and then reproducing said monochrome images from the intermediate film onto said other goffered film so as to form a series of multicolor images of different size from those of the first-mentioned goffered film by means of diaphragm apertures of a similar character as above, the reproduction being carried out with a lens system having different focal lengths to obtain the different size.

2. The process which comprises reproducing from the images on a goffered film corresponding images of a larger size on another goffered film with substantially the same relative color reproducing values as in said first-mentioned images, by reproducing, with the aid of an objective, said images on an intermediate non-goffered film in a series of monochrome images from the first-mentioned images by projection printing with a diaphragm having different apertures corresponding to the color filter apertures of the taking objective, and then reproducing said monochrome images from the intermediate film onto said other goffered film so as to form a series of multicolor images of a larger size than those of the first-mentioned goffered film by means of diaphragm apertures of a similar character as above, the reproduction being carried out with a lens system

having different focal lengths to obtain the larger size.

3. The process which comprises reproducing from the images on a goffered film corresponding images of a different size on another goffered film with substantially the same relative color reproducing values as in said first-mentioned images, by reproducing, with the aid of an objective, said images on an intermediate non-goffered film in a series of monochrome images from the first-mentioned images by projection printing with a diaphragm having different apertures corresponding to the color filter apertures of the taking objective and then reproducing said monochrome images from the intermediate film onto said other goffered film so as to form a series of multicolor images of different size from those of the first-mentioned goffered film by means of diaphragm apertures of a similar character as above and an objective having the same opening as the objective associated with the first-mentioned goffered film, the reproduction being carried out with a lens system having different focal lengths to obtain the different size.

4. The process which comprises reproducing from the images on a goffered film corresponding images of a larger size on another goffered film with substantially the same relative color reproducing values as in said first-mentioned images, by reproducing, with the aid of an objective, said images on an intermediate non-goffered film in a series of monochrome images from the first-mentioned images by projection printing with a diaphragm having different apertures corresponding to the color filter apertures of the taking objective, and then reproducing said monochrome images from the intermediate film onto said other goffered film so as to form a series of multicolor images of a larger size than those of the first-mentioned goffered film by means of diaphragm apertures of a similar character as above and an objective having the same opening as the objective associated with the first-mentioned goffered film, the reproduction being carried out with a lens system having different focal lengths to obtain the larger size.

In testimony whereof I hereunto affix my signature.

ANDRÉ OSWALD.