[Second Edition.]

PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION.

Improvements relating to Colour Photography and Colour Cinematography.

We, EDOUARD LUCIEN GROC, French citizen, of 29, Sisters Avenue, London, S.W. 11, and Dr. PHIL. ANTHONY BERNARDI, an Austrian Citizen, of 9, Hart Street, London, W.C. 1, do hereby declare the nature of this invention to be as follows:—

This invention relates to apparatus used for taking and projecting two or more pictures taken with suitably coloured light filters by means of one lens with special prismatic arrangement or two or more lenses. It refers more especially to apparatus used for cinematographic pictures. In order to ensure that the pictures taken with any camera fitted with our prismatic attachment shall be projected in correct superposition on the screen when used with any of the standard projecting apparatuses, it is essential that any selected identical points in the images of the group of two or more pictures shall be a chosen distance apart, and the line joining these points shall always make the same angle with the edge of the base material used.

In order that the pictures shall have as large an area as possible when using a given sized " gate ", it is essential that the two or more pictures shall be practically touching.

Further to do away entirely with parallax errors we prefer to use one single lens with suitable prisms silvered in such a way that the light from the lens is divided up to take two or more pictures. We furthermore use a special glass plate to compensate for the different lengths of optical paths in the prisms to ensure that all the pictures lie in the same plane.

This allows of all the pictures being taken simultaneously on the senzitised surface, being in perfect register in relation to each other. According to this invention a transparent plate is provided with two or more marks on it having the desired separations. This graticule is provided with an examining microscope which either rotates to view each of the marks consecutively or the microscope has a sufficiently large field to examine all of them at the same time. This examining microscope can be replaced by an illuminating apparatus viz: an illuminant and suitable condenser.

The taking and/or projecting lens or lenses with their coloured light filters are mounted on the opposite side of the graticule to the microscope and form two or more images of a suitable target which is mounted on and in the same plane as a projection screen, such target and screen being placed at any given distance; the graticule being provided with lateral movements at right angles allows the observer to set one image of the target on one of the standard marks.

Then by means of adjusting screws or prisms or combination of both, the other image or images are brought into coincidence on their corresponding marks.

The microscope is now removed and the illuminating apparatus substituted when the two or more setting marks should appear in perfect register on the screen.

Dated the ninth day of February, 1928.

EDOUARD LUCIEN GROC.
A. BERNARDI.

COMPLETE SPECIFICATION.

Improvements relating to Colour Photography and Colour Cinematography.

We, EDOUARD LUCIEN GROC, a French Citizen, of 29, Sisters Avenue, London, S.W. 11, and Dr. PHIL ANTHONY BERNARDI, an Austrian Citizen, of 9, Hart Street, London, W.C. 1, 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:—

It has heretofore been proposed to take two or more pictures in the same plane

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and to arrange the same within a single monochromatic space by means of a single lens or lens unit in order to overcome parallax errors and to split up the incident beam by means of a prism combination having at least one face disposed transversely to the beam adapted to partially reflect and partially transmit the beam in order to space apart the separate colour images, means being provided to compensate for the unequal paths of the light rays of the two pictures in order that the same may be in the same plane.

The present invention has for its chief object to provide an improved arrangement of the pictures in the single film space so that effective and clear kinematography may be obtained without resort to the phenomenon known as "persistence of vision" to give the colour effect and also without the use of any special projector mechanism, the film being run at the ordinary speed through the projector mechanism so that no extra strain is placed on the projector mechanism.

According to this invention two pictures of the same object or group of objects are arranged diagonally within the space which is normally occupied by a single picture in the monochromatic cinematography. The two pictures are taken through suitable colour filters so that when the pictures are combined by means of a suitable optical device a projected picture is obtained in substantially natural colours.

We will hereinafter refer to the space normally occupied by a single picture in the present monochromatic cinematography as a "single monochromatic space".

In order to secure the desired result, using one lens or lens unit only, it is essential that the optical lengths of the light paths from the plane of each of the pictures to the lens should be absolutely the same. This may be accomplished by either of the following methods.

Firstly, when the distance from the centre of each of the pictures to the optical axis of the lens is the same, we use a rhomboidal prism, with its acute angles approximately 45 degrees between the lens and the sensitised surface. The first reflecting face of this prism (hereinafter called unit 1) is either "half silvered", silvered in strips, or in any desired pattern. On to this reflecting surface a second unit (a prism with an angle between its two polished faces, the third being grey, equal to the acute angle of the rhomboidal prism) is cemented to allow the light, from the lens, to pass through the unsilvered portion of the first reflecting surface. The uncemented face of the second unit must be in the same plane as the adjacent face of the obtuse angle of the first unit.

A third unit, a rhomboidal prism identical to the first unit is cemented or placed on to the emergent side of the second unit. The third unit (rhomboidal prism) lies at right angles to the first rhomboidal prism, so that the light which passes through the partially silvered surface of the first unit is deflected at right angles to the reflected light. This allows of a maximum size being obtained for the pictures.

A fourth unit, a parallel sided plate of glass, is cemented or placed on to the emergent face of the first rhomboidal prism, of the same thickness as the total glass path traversed by the light which goes direct through the partially silvered surface less the glass path through the third unit (rhomboidal prism).

Since the reflection is equal for both pictures it follows that if the material of the three prisms and the glass plate have all the same refractive index, then the optical paths will all be equal, and the pictures will lie in the same plane.

However, since the standard size film in common use at the present time is rectangular, it becomes necessary to make the smaller pictures, which have to lie inside the area of the standard gate, also rectangular in order that the pictures projected from them may conveniently fit the screen. This fact entails making the distances from the centres of the pictures to the optical axis of the lens unequal.

We therefore make one of the rhomboidal prisms, corresponding to the shortest separation between the centre of the picture and the lens axis, of a glass whose refractive index is lower than that of which the remaining three units, constituting the prism block, are made.

Then the two images can be made to lie in the same plane:—

1. By adjusting the air space between the emergent faces of units Nos. 3 and 4, and the thickness of unit 4.

2. By varying the refractive index and the thickness of unit 4 when the emergent faces of units 3 and 4 are in one plane.

3. By varying the refractive index and the thickness of unit 4 in conjunction with the air space between units 3 and 4 emergent faces. For example, if the rhomboidal prism gives the greater deflection, then it and its parallel plate (called the 4th unit above) are made of the same baryta flint to avoid refraction at the partially silvered surface. The third unit (rhomboidal prism giving the lesser reflection) can be made of a crown glass of

such refractive index that by varying the thickness of the 4th unit (parallel plate) the two images lie in the same plane. The coloured light filters can be placed between the prisms and the sensitised film, and we can then take advantage of these filters to finally correct, if necessary, any difference in the plane of the pictures due to errors of calculation or manufacture of the prism or glass plate. This we effect by varying the thickness of the filters or their cover glasses by such an amount as to cause the pictures to lie in the same plane.

In the rhomboidal prisms we make the deflection produced by them greater than the width of the used entrance and emergence faces measured in the direction of the deflection; since if the entrance and exit faces, measured in the direction of the deflection, equal the deflection, then parallel beams of light entering the prism perpendicular to the entrance face are twice reflected, but some of the rays of light entering the prism which make a smaller angle with the first reflecting surface than the before mentioned perpendicular to the entrance surface rays, pass through the parallel faces of the prism, and after refraction at the entrance and exit faces emerge parallel to their direction of incidence. These rays, having travelled a less distance than the twice reflected rays, will come to a focus beyond the true focus, and will cause halation on the sensitised surface. When the deflection exceeds the used entrance and exit faces, and the surplus area adjacent to the obtuse angle of the prism on both exit and emergent faces are rendered opaque then the oblique rays previously mentioned are cut off to an extent dependent on the width of the opaque surface.

In the drawings Figure 1 is a diagrammatic view of the lens and prism arrangement according to this invention and

Figure 2 is a similar view to Figure 1 looking in a direction at right angles to that of Figure 1.

Figure 3 shows the disposition of the pictures on the film, and

Figures 4 and 5 are views illustrating a detail of construction of the prisms.

Referring to the drawings, the single lens unit L has lenses which may be considerably larger than the length of the pictures to be taken. The entrance surface of the prism U^1 is rectangular, having a width approximately the same as the picture and a length equal to the aperture of the back lens of the Lens unit L. Figure 1 is a side elevation of the prism block. The light from the object emerges from the back lens of the Lens unit L and passes into the rhomboidal prism U^1. Approximately one half is transmitted and one half is reflected by the partially silvered surface PS of the prism U^1. The reflected light undergoes a second reflection in prism U^1 as shown and then passes through the filter F^1, and parallel plate U^4 to form an image at C^1 on the sensitised surface of the film P^1, P^2.

The transmitted light passes through prisms U^1 and U^2 and the filter F^2 without reflection and enters the rhomboidal prism U^3. After being twice reflected in prism U^3, see Figure 2, it forms an image C^2 on the same sensitised surface P^1 and P^2, as the previously mentioned image C^1, provided that the optical length of the light paths through units U^1 and U^4 are exactly equal to the optical length of the light paths through units U^1, U^2 and U^3, plus the air space AS between the emergent faces of U^3 and U^4.

In the example indicated in the diagram units U^1 and U^2 having the same refractive index. This refractive index is higher than the refractive index of the glass of which unit U^3 is made.

The parallel plate U^4 can be made of any suitable refractive index to render the optical light paths equal, taking the air space AS into consideration. Figure 3, shows the area of the rectangular gate of the ordinary cinema camera or projector corresponding to the views shown in Figures 1 and 2. The lens unit L has its axis LA displaced with relation to the centre of the gate aperture. C^1 is the centre of the picture given by the reflected light through units U^1 and U^4 (Figure 1) and C^2 is the centre of the picture transmitted through units U^1, U^2 and U^3; the deflection of the picture C^1 is indicated in Figures 1, 2 and 3, by S^1, and that of the other picture by S^2.

Figure 4 shows a rhomboidal prism whose deflection D^1 equals the width EN, EX of the used entrance and exit faces measured in the direction of the deflection. The ray of light A falling perpendicular to the surface EN is twice reflected, and emerges from surface EX. The oblique ray B after refraction at surface EN passes through the prism without reflection and is again refracted at surface EX to emerge parallel to its direction of incidence and would produce halation of the sensitised surface.

In Figure 5 the rhomboidal prism is made longer so that D^2, the deflection, becomes greater than the width of the picture by the width of the opaque surface O, the clear width of EN and EX, the entrance and exit faces respectively,

and the distance between them remaining the same as in Figure 4, then while the perpendicular ray A suffers two reflections as before, the oblique ray B after refraction at surface EN is stopped by the opaque portion of surface EX thus preventing halation.

It will therefore readily be seen that when pictures are taken through the composite prism unit as above described two pictures will be formed on the negative as shown in Figure 3 and furthermore these two pictures are arranged within a single monochromatic space. By disposing the two pictures diagonally within the single monochromatic space according to this invention we are enabled to obtain the least possible interference between the pictures since they have no line common to both pictures, as is the case in which the pictures are arranged side by side, but only the opposite corners of the two pictures are in proximity. Further, the manufacture of the composite prism is greatly facilitated. In this manner a clear and effective projection can be obtained without one of the colour components interfering with the other colour component. The negative will, if ordinary commercial film be used, be a monochromatic one. When the positive, taken from the negative is to be projected the same is run through the projector at the ordinary speed and, as will be readily appreciated, the two pictures will appear before the gate at the same time. A prism unit, either the same as or similar to the prism unit above described, is placed in front of the film whereupon the light passing through the picture P^1 will pass through the units U^4 and U^1 and the light from the picture P^2 will pass through the units U^3, U^2 and U^1 and the pictures emerging from the emergent face of the rhomboidal prism U^1 will be combined and can be projected on to a screen of any size with the usual sharpness of definition and an entire absence of parallax errors due to the fact that the pictures are taken through a single lens unit. Further as the film is run through the projector at the standard speed no extra strain is put on the projector mechanism.

A further very great advantage of this invention is that ordinary standard monochromatic film can be used in the ordinary way whereby the production of the coloured pictures, according to this invention, is no more expensive than the production of ordinary monochromatic pictures.

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. The simultaneous production in the same plane and in a single monochromatic space of two similar pictures by means of a single lens or lens unit through suitable colour filters whereby the pictures are free from parallax errors, the said pictures being arranged diagonally within the said monochromatic space substantially as described.

2. A composite prism unit for use with a photographic lens to produce two pictures comprising a rhomboidal prism having its first reflecting surface suitably treated to partially reflect and to partially transmit the incident light; the transmitted light being reflected twice by a further rhomboidal prism thereby enabling two pictures to be taken simultaneously with a single lens and to be arranged diagonally within a single monochromatic space, means being provided to compensate for the unequal paths of the light rays of the two pictures.

3. A composite prism unit according to Claim 2 in which the deflection of the rhomboidal prisms, measured in the direction of the deflection, is greater than the width of the prism face used to produce the picture, the surplus area of the entrance and emergent faces being rendered opaque in order to prevent oblique rays of light reaching the sensitised surface without first having undergone two reflections.

4. A method of colour cinematography using ordinary monochromatic films of standard width and a single lens thereby avoiding parallax errors consisting in passing the light through a suitable composite prism to divide the light into two beams each beam being reflected at least twice before falling on the sensitised surface and each beam being passed through a colour filter, the two images being arranged diagonally within a single monochromatic space and means being provided to cause the images to lie in the same plane.

5. The composite prism unit for producing two diagonally arranged similar pictures within a single monochromatic space having its parts constructed, arranged and adapted to operate substantially as described with reference to the accompanying drawings.

Dated the 31st day of August, 1928.

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Agents for the Applicants.

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2nd Edition

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

Fig. 2.

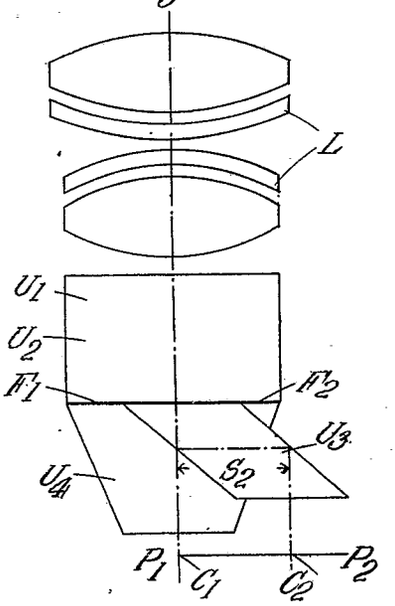


Fig. 1.

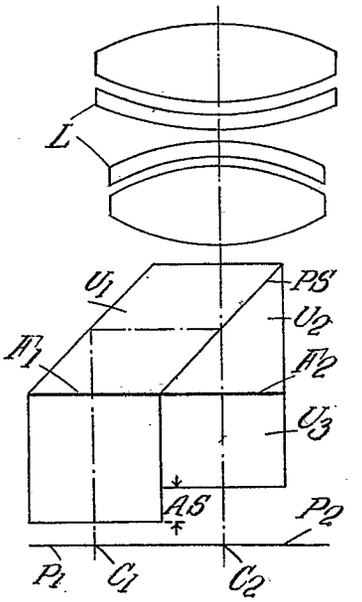
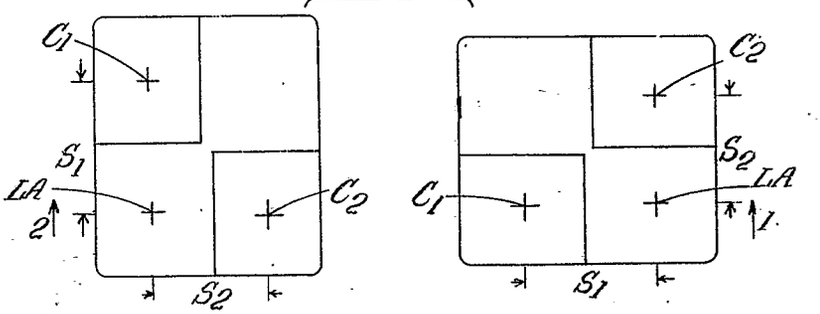


Fig. 3.



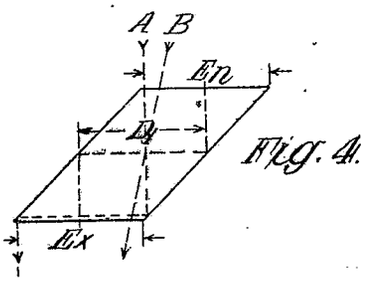


Fig. 4.

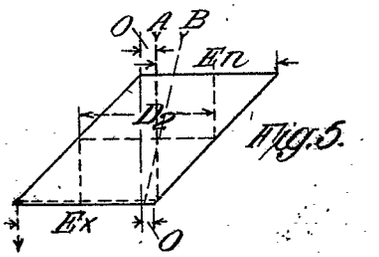


Fig. 5.

Charles & Read Ltd. Photo Litho.