

# RESERVE COPY PATENT SPECIFICATION

355,835



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COMPLETE SPECIFICATION.

## Improvements in Apparatus for Taking and Projecting Coloured Photographic and Cinematographic Pictures.

I, MAURICE AUDIBERT, of 17, rue Victor Hugo, Villeurbanne, Rhône, France, of French nationality, 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 an apparatus for taking and projecting coloured cinematographic and photographic pictures and more particularly to an apparatus of the type comprising a divergent optical system and an optical dividing system adapted to project the image of the divergent system several times on a sensitive surface.

An apparatus of this type is described in the British Patent Specification No. 24,809 A.D. 1911 and comprises a combination of a front objective giving a real or virtual image of the object, the image being taken up and projected by a dividing system formed of three or more identical objectives. Particularly in case of a divergent front objective the virtual image obtained thereby is projected by the dividing system upon the sensitive surface.

Such an arrangement is perfectly convenient when the size of the elementary images which are to be obtained is rather small, but it will not be useful any more when elementary images of larger size are to be obtained, or when it is desired to operate with objectives with larger apertures, because it will be necessary then to give practically too great dimensions to the system of the divergent front lens in combination with the dividing objectives. Particularly the total length of the apparatus from the front lens to the sensitive surface is prohibitive for practical application.

The object of the present invention is to overcome this inconvenience. According to the invention the optical divergent system is arranged so that its nodal points are brought in front of the lenses of the system, permitting to increase the aperture of the dividing objectives or to reduce the total length of the apparatus.

The invention will now be described with reference to the accompanying

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drawing in which

Figure 1 shows a single divergent lens.

Figure 2 shows a divergent optical system formed by a divergent front lens and a convergent back lens.

Figure 3 shows a similar disposition of a divergent and convergent lens as Figure 2, but combined with three objectives.

It is known that an optical system of the type called "tele-objectives" is usually formed of a combination of a convergent front element with a divergent rear element. The characteristic of such a system is that the nodal points lie considerably ahead of the system, so that the tele-objective operates like an objective lens of great focal distance, but would have its lenses much nearer the focal plane than would be the case with an ordinary objective of the same focal distance.

It will be evident that, when a divergent system is formed by the combination of a divergent front element with a convergent rear element and by a suitable choice of the constituting lenses, the system could be such that the nodal points lie ahead of the system. In other words, in such a system the focal virtual plane in the front of the system will be at greater distance from the constituting lenses than in the case where a single divergent lens of the same focal distance is used.

In the drawing, F indicates the focal virtual plane, N<sup>1</sup> and N<sup>2</sup> the nodal points, P<sup>1</sup> and P<sup>2</sup> the principal planes. (It is known that in a thick lens the nodal points are the conjugate foci of the optical centre of the lens with respect to the two faces of the lens and that the principal planes are the planes which are perpendicular to the optical axis and pass through the nodal points). The distance from CD to its focal plane is greater than the distance from the single lens *d* to its focal plane. It will be evident therefore that in combining the divergent optical system shown in Figure 2 with a dividing system formed of three or more objectives O<sup>1</sup>, O<sup>2</sup>, O<sup>3</sup> (Fig. 3) adapted to take up the obtained virtual image, the lenses C and D can be arranged much nearer to the dividing system than

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would be the case with a single divergent lens.

In Figure 3 the reference M indicates the real focal plane of the images formed by the three dividing objectives.

In other words, if, instead of using the lenses CD, the lens D alone were to be used, this lens would have to be placed approximately at  $N^1$ ,  $N^2$ , that means much further ahead than the combined lenses, C, D.

This arrangement of a divergent optical system comprising a divergent front lens and a convergent rear lens permits to reduce to one half the distance from the divergent lens to the dividing objectives, or when the same distance is to be maintained as when using a single lens D only, to employ secondary objectives with larger apertures since they can be spaced further apart. It has to be well understood that the improvements obtained with the present invention are independent of the composition of the dividing system, lenses, prisms, mirrors and like elements which can be disposed in the emergent pencil. There will be obtained several negative images of rigorously identical design on the same support.

In a practical embodiment of an optical system as described, the focal length of the positive element C is 250 millimetres and the focal length of the negative element D—90 millimetres, while that of the dividing objectives will be 50 millimetres. The distance between the dividing objectives and the positive lens D is 60 millimetres and the distance between the dividing objectives and the plane M upon which the image is formed 66 millimetres. The two lenses C, D are almost in contact.

It is evidently possible to use the described apparatus for producing colored photographic or cinematographic pictures according to the additive three-colour-method. For instance a coloured filter will be associated with each of the three dividing objectives and a negative will be produced of the object to be photographed, this negative being composed of three identical images which have the

same parallax. The positive is also taken by means of a photographic apparatus comprising an optical system as above described. Each dividing objective will again be combined with a colour filter and the negative is for instance photographed three times, once with each objective while the two remaining objectives are covered. After each impression of a partial positive on the sensitive support, this support, after developing, is dyed with a mordant in known manner.

Positives can also be produced by projecting the negatives by means of the described optical system, on a sensitized color screen support. Each negative picture would be associated with a colour filter similar to that which has served to produce the negative picture. Films provided with microscopic refractive elements can also be used with the described optical system to produce positives from the three identical negatives.

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

1. An apparatus for taking and projecting coloured photographic and cinematographic pictures, comprising an optical divergent system and an optical dividing system adapted to project the image of the divergent system several times on a sensitive surface, the optical divergent system having its nodal points in front of the lenses thereof, permitting the aperture of the dividing objectives to be increased or the total length of the apparatus to be reduced.

2. In natural colour photography, the use of an apparatus as claimed in Claim 1 for producing negative and positive pictures.

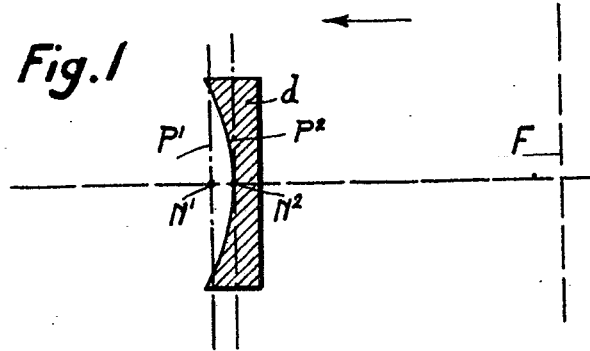
3. The improved apparatus for taking and projecting coloured photographic and cinematographic pictures, substantially as described and as illustrated in the accompanying drawing.

Dated this 2nd day of June, 1930.

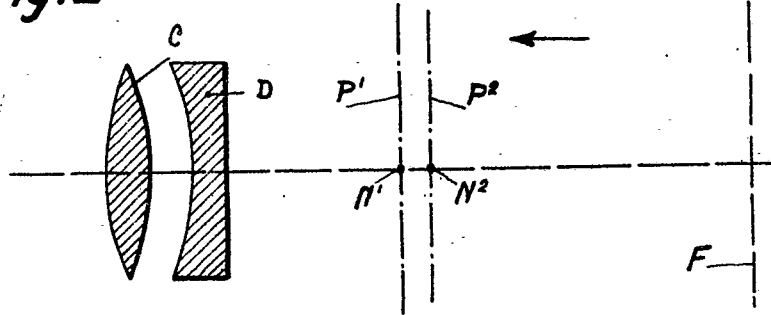
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*[This Drawing is a reproduction of the Original on a reduced scale.]*

**Fig.1**



**Fig.2**



**Fig.3**

