[Second Edition.]

PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION.

Means for the Division of a Beam of Light into Two Equal and Parallel Components.

We, LEONARD BELLINGHAM AND FRANK STANLEY, both of 71, Hornsey Rise, London, N. 19, British Subjects, do hereby declare the nature of this invention to be as follows: —

In optical prisms systems, designed to divide a beam of light into two components as for instance in range finders, two colour cameras and the like, it has been found impossible to secure simultaneous equality of intensity, accurate parallelism and freedom from parallax.

This invention relates to prisms of the Nicol type in which one half of the incident light is totally reflected at an internal transverse reflecting layer.

In such prisms the reflected component is usually absorbed by pigment on the unpolished wall or side of the prism, or is allowed to emerge at an angle to the direction of the incident light.

According to the present invention, this component is again totally reflected at a surface parallel to the internal transverse reflecting layer, thus emerging parallel to but laterally displaced from the transmitted ray.

The prism may consist of two members of doubly refracting material such as Iceland spar, united by a transverse totally reflecting layer as in the Nicol type of prism or its modifications, and combined with a third member geometrically similar to either of the other members, such third member being so disposed along the side of the entrance member of the prism but parallel to the exit member, that the light component reflected internally at the first reflecting surface is again internally reflected in a direction parallel to the component transmitted.

Optical continuity may be secured by uniting the polished contact faces by means of a suitable cementing medium, or the third member may be of one piece with the entrance member.

The exit member may be so prolonged that the path traversed by each light component is optically identical.

The third member may consist of a prism of glass of suitable refractive index and dispersion.

Alternatively the prism may consist of three prisms of glass, the first reflecting layer consisting of a plate of doubly refracting material as in the Feussner prism.

Dated the 17th day of February, 1933.

L. BELLINGHAM.
F. STANLEY.

COMPLETE SPECIFICATION

Means for the Division of a Beam of Light into Two Equal and Parallel Components.

We, LEONARD BELLINGHAM and FRANK STANLEY, both of 71, Hornsey Rise, London, N. 19, and both British Subjects, 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 optical systems, and refers more particularly to means for the division of a beam of light into two equal and parallel components. Such an optical system is suitable for use in many kinds of optical apparatus and may particularly be used with advantage in range finders, two colour cameras, and the like.

Various systems have been proposed from time to time for dividing a beam of light into two equal and parallel components, but it has been found impossible to secure simultaneous equality of intensity, accurate parallelism and freedom from parallax. The primary object of this invention is to provide an optical system of the kind in question which is

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free from the disadvantages just referred to.

The invention makes use of the well known Nicol type of prism whereby a beam of light entering the prism is divided into two parts, one of which passes through the prism and the other of which is totally reflected by an internal transverse reflecting layer. Usually this reflected beam is either absorbed by pigment applied to the unpolished side wall of the prism upon which it is reflected, or is allowed to emerge at an angle to the incident and transmitted beams, instead of being parallel thereto, as is required in the optical system with which the present invention is concerned.

According to the present invention, we combine with a prism of the Nicol type means whereby the reflected beam is again reflected at a surface parallel with the first reflecting surface, in such manner that it emerges in spaced relation to, but parallel to the incident beam and to the component of the incident beam which is transmitted. An ordinary Nicol prism made of Iceland Spar may be employed, or an equivalent thereof, such as two glass wedges united by a thin layer of Iceland Spar.

In carrying the invention into practice, the means employed for producing the second reflection of the reflected beam may consist of a third prism element geometrically similar as to its operative angle to either of the Nicol prism elements, which element is so applied to the side wall of the entrance member of the Nicol prism through which the reflected beam emerges, that the beam is internally reflected again by the opposite wall of said third element and emerges parallel to the incident and transmitted beams.

The spacing between the two emergent beams may be varied by optical members, such as prisms or rhombs, without affecting their parallelism. Also the lengths of the optical paths of the two beams may be made identical by prolonging or extending the exit members of the beam requiring to have its path prolonged.

In order that the invention may be clearly understood and readily carried into practice, we have appended hereto a sheet of drawings illustrating the same.

The drawing shows the preferred construction in which an equivalent of a Nicol prism is built up by two prisms *a* and *b* of glass, between the adjacent walls or sides of which is interposed a layer or plate *c* of doubly refracting material, such as Iceland spar, as in the Feussner prism. *a* is the incident element of the prism and *b* the emergent element for the transmitted beam. The interposed plate *c* of Iceland spar serves to divide the incident beam into two components of equal intensity, one of which is transmitted through the prism *b* and the other of which is reflected through the side wall or surface of prism *a*. However in accordance with this invention, against said side wall is placed a third prism *d* geometrically similar to the prism *a* as to its operative angle α so that its wall or side *e* is parallel to the doubly refracting layer *c*. Consequently a beam *x* incident upon the layer *c* will be reflected as to one half along *y* on to wall *e* and thence reflected along *z* in a direction parallel to the incident ray *x* and thus parallel to the beam *w* transmitted through prism *b*.—

In the construction shown, the third angle of prism *d* has been cut off to convert it into a rhomb providing an emergent face *f* for the reflected beam. Also an additional rhomb *g* has been applied to the emergent wall *h* of prism element *b* which displaces the transmitted beam *w* to position w^1 nearer to the reflected beam *z*, and may be arranged to equalise the optical paths of the two beams. D^1 indicates the spacing of the beams *w* and *z*, and D^2 the spacing between the beams w^1 and *z*.

Optical continuity between the contacting surfaces of the optical elements of the system is secured by uniting the surfaces together by a suitable cementing medium, or by simple juxta-position of the two members in optical contact. Alternatively, however, the third prism member *d* may be made in one piece with the entrance prism member *a*. The cement must have a suitable refractive index or optical density, matching the optical density of the glass used. Examples of suitable cements are piperine, compound of tolu balsam, and mono-bromnaphthalene.

As an alternative to the foregoing construction, instead of making the prisms *a* and *b* of glass with an interposed layer of doubly refracting material, we may make them of doubly refracting material, as Iceland Spar, united by a transverse reflecting surface of suitable optical density, as in the usual Nicol prism.

The improved optical system, according to the present invention, is applicable for use in various types of optical instruments, and its use is particularly contemplated in connection with two colour photographic or cinema cameras. More usually the prism system would be placed in front of the double lens system *l* of the camera provided with the two colour screens s^1 and s^2 in known manner. In

certain circumstances, however, a single lens may be placed in front of the prism system, say at position l^1, the colour screens being retained at positions s^1 and s^2.

Although the main purpose of the invention is to divide an incident beam into two equal parallel beams, this being, as hereinbefore described, effected by the optical elements *a*, *b* and *c*, it is to be understood that the two equal parallel beams may subsequently be modified in any desired manner. For example, instead of employing additional optical members such as *d* and *g* to alter the spacing of the beams whilst still keeping them parallel, the angles and reflecting surfaces of additional exit members, such as *d* and *g*, may be such that the emergent beams of the system as a whole, are reflected in any desired directions, which need not be parallel. For example, in some cases it may be required to reflect the two parallel beams at right angles to themselves, in opposite directions.

An important result of the application of this invention to colour photography is that the " fringing " effect which has hitherto marred coloured cinematography is entirely eliminated.

In conjunction with colour photography, the prism system may, if desired, be duplicated or otherwise modified to split the incident light up into more than two beams, for example, into four beams, which are dealt with by four corresponding colour screens.

It is to be clearly understood, of course, that our improved prism system need not necessarily be used in conjunction with lenses since its properties may render it useful alone, or in combination with other optical elements, such as mirrors, in suitable apparatus.

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. An optical system for dividing an incident beam of light into two parallel beams of equal intensity comprising the combination with a prism of the Nicol type of means whereby the reflected beam is again reflected at a surface parallel with the reflecting surface of the Nicol prism, in such manner that it emerges in spaced relation to, but parallel with, the incident beam and to the component of the incident beam which is transmitted.

2. An optical system for dividing an incident beam of light into two parallel beams of equal intensity, comprising a pair of prisms of doubly refracting material united by a transverse reflecting layer of suitable optical density, in combination with a third prism placed against one of the first prisms so as to receive the reflected beam emerging therefrom, said third prism having a reflecting surface parallel with the reflecting plane of the first pair of prisms, which reflects said reflected beam again in a direction parallel to the beam incident upon the entrance member of the first pair of prisms.

3. An optical system for dividing an incident beam of light into two parallel beams of equal intensity, comprising a pair of glass prisms placed reversely side by side with a layer of doubly refracting material between their surfaces and forming a transverse reflecting plane, in combination with a third glass prism placed against one of the first prism so as to receive the reflected beam emerging therefrom. said third prism having a reflecting surface parallel with the reflecting plane of the first pair of prisms, which reflects said reflected beam again in a direction parallel to the beam incident upon the entrance member of the first pair of prisms.

4. An optical system according to any of the preceding claims, in combination with optical means whereby the spacing of the parallel emergent beams is varied.

5. An optical system according to any of the preceding claims, in combination with optical means whereby the optical paths of the two parallel beams are equalised.

6. An optical system according to claim 5 or 6, wherein the optical means used in combination for varying the spacing of the emergent beams and/or equalising the optical paths of said two beams, consists of a prism or rhomb applied to a face of the main prism combination through which one of the beams emerges, said prism or rhomb reflecting said beam in a direction parallel to but in spaced relation to itself.

7. The use of an optical system according to any of the preceding claims, in colour photography, in combination with a lens system placed either in front of or behind the prism combination, and colour screens placed behind said combination.

8. Means for dividing an incident beam of light into two parallel beams of equal intensity substantially as herein described with reference to and as illustrated by the accompanying drawing.

Dated this 12th day of June, 1933.

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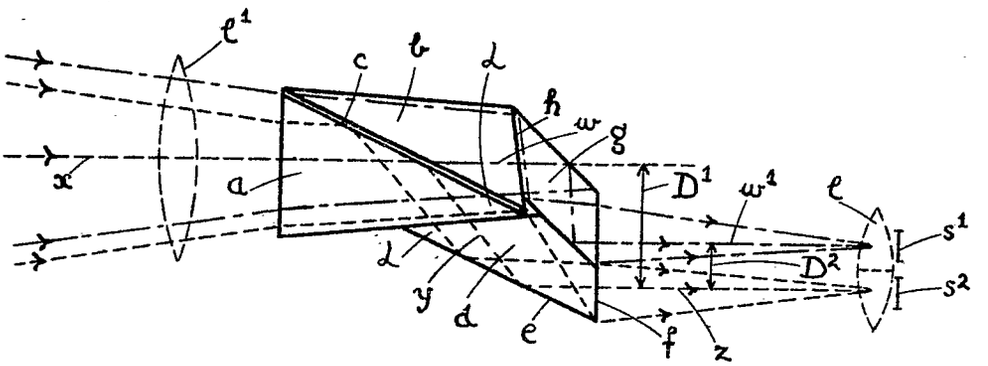
2nd Edition



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

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