N° 24,159 A.D. 1912

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Complete Specification Accepted, 22nd Oct., 1913

PROVISIONAL SPECIFICATION.

No. 24,159, A.D. 1912.

Improvements in Apparatus for Taking or Projecting Photographic Pictures.

We, CONRAD BECK, Optician, of 68, Cornhill, in the City of London, and COLIN NOEL BENNETT, Journalist, of 9, Morrab Road, Penzance, Cornwall, do hereby declare the nature of this invention to be as follows:—

This invention consists of apparatus for simultaneously taking two identical pictures of an object upon a photographic surface by means of a single lens or for projecting two identical pictures by means of a single lens, so that they coalesce into one image on a screen.

For certain purposes it is necessary to produce two photographs of the same object which are exactly identical as regards the size and relative positions of the constituent parts, but which may vary in the light and shade gradations to represent by this variation the values of different colours, this variation of the light and shade gradations being usually attained by the interposition of corresponding colour screens between the object and the photographic surface. Such a pair of identical photographs are required for preparing blocks for colour printing or for making films for colour cinematography and especially in the latter case it is preferable to produce the two photographs by one simultaneous exposure.

If two lenses be used side by side or one above another to produce two pictures side by side or one above another on a photographic plate or film, the pictures will not be identical, because the two lenses look at the object from a different point of view, and photographs resembling the two halves of a stereoscopic view will be obtained.

According to the present invention we employ a compound prism capable of dividing a bundle of light into two separate portions in such a manner that each of these portions comprise some light from all the different small areas of the bundle, in combination with means for directing one of the said portions approximately into parallelism with the other after emerging and for rendering equal the optical paths of the two portions of light from their entrance into the prism to a fixed plane at right angles to the direction of incidence.

Conversely, for projection, we arrange such a compound prism so as to receive and project in coincidence two bundles or portions of light entering the prism by different faces and coming from a plane behind the same.

With the present invention one lens can be employed.

In an arrangement according to the invention we place behind the lens a pair of equal-sized right-angled prisms with their hypotheneuses placed or cemented together so as to form a cube of about the size of the full aperture of the lens. The surface of junction of the two prisms is placed at an angle of 45° with the axis of the lens. The junction surface of one of the prisms is coated with a thin semi-transparent layer of silver or other reflecting material or with an

[*Price* 8*d.*]

opaque reflecting layer which is partially removed as for example lines ruled through the opaque surface or by dots or parts scraped away or by some similar device by which the surface is rendered equally semi-transparent over its whole area.

The light which passes from the lens through this prism is divided by means of this reflecting surface into two portions one of which passes directly through the cube and forms an image on the sensitised photographic plate, film, or the like placed in a suitable position behind. The other portion of the light is reflected at right angles to the axis of the lens, and it is then reflected by another right-angled prism or other suitable reflecting surface in a direction parallel to the axis of the lens, so that it forms a second image adjacent to that of the first on the same photographic plate, film, or the like, and situated at the side, above or below the first, according to the position in which the compound cube prism is placed. The path of the rays, from the lens to the plate or film, of that portion of the light which is reflected is longer than the path of that portion which is directly transmitted, and the two images are therefore not focussed in the same plane. To overcome this difficulty we may employ suitable means; for example we may interpose in the path of the reflected rays a thick parallel block of glass which may or may not be cemented to the totally reflecting right-angled prism. This block of glass is made of such a thickness and of a material of such a refractive index that it increases the distance of the focal plane from the lens to such an extent as to bring the image into focus on the same plane at right angles to the axis as that formed by the direct portion of the light.

The apparatus of the present invention may be used either for photographing two identical pictures of the same object, or by reversing the direction of the light for projecting two pictures upon a screen so that they may coalesce into one single image.

For projecting the simultaneous pictures, for example in colour cinematography, a beam or beams of light from the lantern is or may be sent through the pictures in the gate of the projector, the image of the one picture being transmitted through the compound semi-transparent prism direct and the other by reflection by means of the simple right angle prism or other reflecting surface and the reflecting portion of the compound cube prism, the combined image being then projected through the lens, the compound prism being combined as before mentioned with means for rendering equal the optical paths of the two sets of rays.

For taking or projecting the simultaneous pictures suitable colour screens may be interposed in any known or appropriate way.

Dated this 22nd. day of October, 1912.

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Chartered Patent Agents.

PROVISIONAL SPECIFICATION.

No. 3160, A.D. 1913.

Improvements in Apparatus for Taking or Projecting Photographic Pictures.

We, CONRAD BECK, Optician, of 68, Cornhill, in the City of London, and COLIN NOEL BENNETT, Journalist, of 9, Morrab Road, Penzance, Cornwall, do hereby declare the nature of this invention to be as follows:—

In a previous Provisional Specification No. 24,159 of 1912 we have described

apparatus for simultaneously taking two identical pictures of an object upon a photographic surface or for projecting two identical pictures so that they coalesce into one image on a screen.

The present invention likewise has for object to provide apparatus for simultaneously taking identical pictures upon a photographic surface or for projecting identical pictures so that they coalesce into one image on a screen, and it represents improvements on or modifications of the invention described in our said Provisional Specification.

According to one part of the present invention we employ in combination a plurality of optical arrangements such as described in our said Provisional Specification, so disposed as to take or to project simultaneously more than two identical images of an object.

By way of example for simultaneously taking three identical images we may dispose in front of the compound prism of a system for taking two images as described in the prior Provisional Specification, another similar compound prism having a partially reflecting and partially transmitting surface and arranged to reflect a portion of the bundle of light to a totally reflecting prism or surface which directs this reflected portion on to the screen. The portion of the rays which is transmitted directly through this compound prism then passes to the second compound prism disposed behind the first and passes partly through the second compound prism direct and partly by reflecting from the partially reflecting surface there of to a totally reflecting surface for direction on to the required surface. Thus three identical images may be taken simultaneously, suitable means being provided for rendering equal the optical paths of the different portions of light. Or by reversing the direction of the light the apparatus may be used for projecting three pictures so that they coalesce on a screen.

Similarly by employing additional compound prisms such as referred to and corresponding reflecting surfaces any desired number of identical pictures can be simultaneously taken or projected.

With arrangements as hereinbefore described a single lens may be employed for taking or projecting the pictures.

For some purposes it is inconvenient or difficult to place the compound prism or prisms such as above referred to behind the lens, and according to a further part of the present invention we dispose the same, in combination with a suitable reflecting surface or surfaces, outside two or more lenses (according to the number of identical pictures concerned). This is specially useful where it is required to form two or more identical images on one plane and displaced laterally to a considerable extent from each other, or to project two or more such images in superimposition on a screen. The reflecting surface or surfaces just referred to will be arranged to receive the rays reflected by the compound prism or prisms and to direct same into parallelism with the directly transmitted rays for taking, or to reflect the corresponding image or images on to the partially reflecting surface of the compound prism or prisms for projection in superimposition.

As the compound prism and reflecting arrangement is disposed outside the lenses which may be transversely in line, means for rendering equal the optical paths of the different portions of the rays may be dispensed with.

This form or modification of the invention will be better understood from the following description of an example of apparatus embodying the same and arranged for taking two identical pictures.

In this apparatus two identical lenses are disposed parallel to each other at a suitable distance apart. In front of one of these lenses is arranged a compound prism of the character above referred to, with its partially reflecting surface set at 45° to the axis of the lens so as to reflect a portion of the rays (received for example through an aperture in the casing) to a totally reflecting prism or mirror which is arranged to reflect this portion of the rays through the other

lens in a direction parallel to those which are transmitted directly through the compound prism.

In order to take three simultaneous pictures of the object, a second similar compound prism may be disposed in behind the first and be arranged to reflect a portion of the rays transmitted to it from the first on to a reflecting prism or mirror arranged to direct this reflected portion through a third lens in a direction parallel to the directly transmitted rays. This third lens may conveniently be arranged parallel to the other two and on the other side of that lens which is behind the compound prisms.

By adding to the number of compound prisms and providing corresponding reflecting surfaces to direct into parallelism with the directly transmitted light the rays reflected thereby any other desired number of identical pictures can be taken simultaneously.

By reversing the direction of the light, identical pictures can be projected in superimposition by apparatus according to the modification above described.

According to a further improvement when employing two or more compound prisms in alignment for the simultaneous taking or projection of pictures, the partially reflecting surfaces of the compound prisms are ruled or formed with lines such that those of one compound prism are at right angles to those of another. This is of advantage in that it avoids the difficulty sometimes encountered in adjusting compound prisms with parallel lines or dotted or stippled surfaces, in such relative positions to each other as to secure proper transmission and reflection of light.

Dated this 6th day of February, 1913.

MEWBURN, ELLIS & PRYOR,
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Chartered Patent Agents.

COMPLETE SPECIFICATION.

Improvements in Apparatus for Taking or Projecting Photographic Pictures.

We, Conrad Beck, Optician, of 68, Cornhill, in the City of London, and Colin Noel Bennett, Journalist, of 9, Morrab Road, Penzance, Cornwall, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for simultaneously taking two or more identical pictures of an object upon a photographic surface or surfaces, or for simultaneously projecting two or more identical pictures so that they coalesce into one image on a screen.

For certain purposes it is necessary to produce two or more photographs of the same object which are substantially identical as regards the size and relative positions of the constituent parts, but which may vary in the light and shade gradations to represent by this variation the values of different colours, this variation of the light, and shade gradations being usually attained by the interposition of corresponding colour filters between the object and the photographic surface or surfaces. Such identical photographs are required for example in preparing blocks for colour printing, or for making films for colour cinematography and especially in the latter case it is preferable to produce or project the two or more photographs by simultaneous exposure.

Now the present invention, in order to obtain or to project identical photographs such as referred to, is based upon the employment of a compound prism

capable of dividing a bundle of light into two or more separate portions in such a manner that each of these portions comprises some light from all the different small areas of the bundle, the prism elements of said compound prism being cemented together or separated by a substance of higher refractive index than air, and the compound prism being provided at one or more of the junction surfaces with a semi reflecting and semi transmitting layer, so that the portions into which a light bundle entering the prism is divided emerge therefrom displaced. Conversely, for projection, such a compound prism can receive and project in coincidence two or more bundles or portions of light entering the prism by different faces.

By employing a suitable number of compound prisms or a compound prism having a suitable number of part transmitting and part reflecting surfaces such as referred to, in conjunction with corresponding mirrors or totally reflecting surfaces, any desired number of identical pictures can be taken or projected simultaneously.

In carrying the invention into practice we construct a compound prism of right angled prisms having their hypothenuses placed or cemented together, and we coat the junction surface of one of the prisms with a thin semi-transparent layer of silver or other reflecting material, or we coat said surface with an opaque reflecting layer which is partially removed, as for example by ruling lines close together through the opaque reflecting surface or by dots or parts scraped away, or by some similar device by which the surface is rendered equally semi-transparent over its whole area. In some cases, as hereinafter mentioned the rectangular faces containing the right angle of a right angled prism may be placed or cemented against the hypothenuse faces of other right angled prisms, (as shown for example in Figs. 2 and 4) the two junction faces being provided with a uniformly semi-transparent coating or layer such as referred to. Such arrangement is equivalent in effect to two compound prisms each composed of two right angled prisms placed with their oblique faces together, which latter arrangement may also be employed according to the invention.

It will be understood that where prisms are simply placed together and not cemented, a medium of higher refractive index than air; such as water, oil or glycerine must be placed between the adjacent faces of the prisms.

When employing a compound prism or prisms comprising two or more partially reflecting and partially transmitting surfaces, these may be ruled or formed with lines so that the lines of one surface are at right angles to those of another. This is of advantage in that it avoids the difficulty sometimes encountered in adjusting compound prisms with parallel lines or dotted or stippled surfaces, in such relative positions to each other as to secure proper transmission and reflection of light.

A compound prism according to the invention may be disposed behind one lens or in front of a plurality of lenses, according to requirement, as will hereinafter more fully appear, but when the compound prism is placed behind a lens and the pictures are to be taken on or projected from a photographic surface representing a fixed plane at right angles to the direction of incidence on or emergence from the compound prism it will be necessary to employ suitable means for rendering equal the optical paths of the directly transmitted and the reflected portions of light from their entrance into the prism to said fixed plane or conversely in projection from such fixed plane to the point of emergence from the compound prism.

We will now proceed to describe more in detail suitable forms of apparatus constructed according to the invention, reference being had to the accompanying drawings.

Fig. 1 is a partially diagrammatic section of an arrangement in which a compound prism such as described is disposed behind a lens, in combination

with a mirror and means for rendering equal the optical paths of the portions of light on to a fixed plane at the back.

Fig. 2 is a diagram illustrating an arrangement of compound prism and two totally reflecting mirrors disposed behind a lens.

Fig. 3 is a diagram illustrating the application of a compound prism and totally reflecting mirror in front of a pair of lenses.

Fig. 4 is a diagram of a similar arrangement adapted for employment in conjunction with three lenses.

In the arrangement shown in Fig. 1 we place behind a single lens *a* a pair of equal-sized right-angled prisms *b c* with their hypothenuses placed or cemented together so as to form a cube of about the size of the full aperture of the lens. The surface of junction of the two prisms is placed at an angle of 45° with the axis of the lens. The junction surface of one of the prisms *b* or *c* is coated with a thin semi-transparent layer of silver or other reflecting material or with an opaque reflecting layer which is partially removed as before mentioned so that the surface is rendered equally semi-transparent over its whole area.

The light which passes from the lens through this compound prism is divided by means of the said reflecting surface into two portions one of which passes directly through the cube and forms an image d^1 on the sensitised photographic plate, film, or the like placed in a suitable position behind. The other portion of the light is reflected at right angles to the axis of the lens, and it is then reflected as at e^1 by another right-angled prism *e* or other suitable reflecting surface in a direction parallel to the axis of the lens, so that it forms a second image d^2 adjacent to that of the first on the same photographic plate, film, or the like, and situated at the side, above or below the first, according to the position in which the compound cube prism is placed. As the paths of the rays, from the lens to the plate or film, of that portion of the light which is reflected is longer than the path of that portion which is directly transmitted, and the two images are therefore not focussed in the same plane, we employ suitable means for rendering these optical paths equal, such for example as a thick parallel block of glass *f* which may or may not be cemented to the totally reflecting right-angled prism *e*. This block of glass *f* is made of such a thickness and of a material of such a refractive index that it increases the distance of the focal plane from the lens to such an extent as to bring the image into focus on the same plane at right angles to the axis as that formed by the direct portion of the light.

In the arrangement shown in Fig. 2 there is disposed behind the lens *a* a compound prism consisting of three right-angled prisms *b c* b^1 placed together and having their junction surfaces 1, 2 of the uniformly partially reflecting and partially transmitting character referred to. It will be seen that such a compound prism is in fact equivalent to two cubical prisms such as that in Fig. 1 placed one behind the other. The latter arrangement could, of course, be used. In either case it is preferred to form the partially reflecting surfaces by ruling lines so that the lines of the one surface are at right angles to those of the other as before mentioned.

g g^1 are totally reflecting mirrors (here right-angled prisms), and *h* h^1 are blocks of parallel glass for equalising the optical paths. It will be seen that a bundle of light entering the prism *b c* b^1 is divided into three portions, one of which passes straight through to form an image at I^1 on the required surface, another portion is reflected at right angles by the surface 1 and then again at right angles by the prism *g* so as to form an image I^2, whilst the third portion of light is similarly reflected twice at right angles by the surface 2 and the prism g^1 so as to form a third image I^3 on the required surface. The paths of these portions of light can readily be traced by the arrows on the figure.

It will be seen that with such an arrangement three identical images may be taken simultaneously.

According to a further part of the present invention as above mentioned, we

may dispose a compound prism or prisms such as before referred to, in combination with a suitable reflecting surface or surfaces, outside two or more lenses (according to the number of identical pictures concerned). This is specially useful where it is required to form two or more identical images on one plane and displaced laterally to a considerable extent from each other, or to project two or more such images in superimposition on a screen. The reflecting surface or surfaces just referred to will be arranged to receive the rays reflected by the compound prism or prisms and to direct same into parallelism with the directly transmitted rays for taking, or to reflect the corresponding image or images on to the partially reflecting surface of the compound prism or prisms for projection in superimposition.

As the compound prism and reflecting arrangement is disposed outside the lenses which may be transversely in line, means for rendering equal the optical paths of the different portions of the rays may be dispensed with in most cases, *i.e.*, unless the object or projected image is extremely close to the plane of the lenses.

This form of modification of the invention will be better understood from the following description of two examples of apparatus embodying the same and arranged for taking two identical pictures and three identical pictures respectively (see Figs. 3 and 4).

In the apparatus of Fig. 3 two identical lenses A^1 A^2 are disposed parallel to each other at a convenient distance apart. In front of one of these lenses A^1 is arranged a compound prism *b c* similar to that of Fig. 1, with its partially reflecting surface set at 45° to the axis of the lens so as to reflect a portion of the rays (received for example through an aperture in the casing of the instrument) to a totally reflecting prism or mirror *e* which is arranged to reflect this portion of the rays through the other lens A^2 in a direction parallel to those which are transmitted directly through the compound prism. Thus two identical images I^1 I^2 can be formed on the required surface.

In the arrangement shown in Fig. 4 a compound prism *b c* b^1 like that of Fig. 2 (or it may be two cubical compound prisms like that of Fig. 1 disposed behind each other with their respective partial reflecting surfaces at right angles to each other) is disposed in front of one of three lenses A^1, A^2, A^3 and right angle prisms or mirrors *g* g^1 are arranged opposite the other two lenses respectively so as to receive the portions of light reflected to them by the partial reflecting surfaces of the compound prism or prisms and to reflect the same in parallel paths, so as to form three images I^1 I^2 I^3 on the required surface.

It will be understood that by reversing the direction of the light with apparatus according to the invention, identical pictures can be projected in superimposition so as to coalesce into one picture on a screen as hereinbefore mentioned.

For example in colour kinematography a beam or beams of light from the lantern may be sent through the pictures in the gate of the projector, the image of one of the identical pictures being transmitted through the compound semi-transparent prism or prisms direct, and the image or images of the other identical picture or pictures being directed by the totally reflecting mirror or mirrors to the corresponding face or faces of the compound prism or prisms so as to be directed thereby into coincidence with the directly transmitted image.

For taking or projecting the simultaneous pictures, suitable colour screens may be interposed in any known or appropriate way.

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. In apparatus for taking simultaneous photographic pictures, a compound prism capable of dividing a bundle of light into two or more separate portions in such manner that each of these portions comprises some light from all the

different small areas of the bundle, the prism elements of said compound prism being cemented together or separated by a substance of higher refractive index than air, and the compound prism being provided at one or more of the junction surfaces with a semi-reflecting and semi-transmitting layer, so that the portions into which a light bundle entering the prism is divided emerge therefrom displaced.

2. In apparatus according to Claim 1, for taking simultaneous photographic pictures a reflecting surface for the compound prism for dividing a bundle of light, and consisting of a glass surface coated with an opaque layer of silver or other highly reflecting material which is partly cut away or removed, for instance by ruled lines or dots or squares over the whole surface, substantially as described.

3. In apparatus according to Claim 1 or 2, the employment of right-angled prisms or other totally reflecting mirrors for the purpose specified.

4. In combination with apparatus according to Claim 1, 2 or 3, means for rendering equal the optical paths of the portions of light from their entrance into the prism to a fixed plane at right angles to the direction of incidence.

5. Apparatus according to Claims 1 to 4 respectively, in combination with a photographic lens so arranged that two, three or more pictures may be formed simultaneously on a film or surface by means of the one lens, substantially as described.

6. Apparatus according to Claims 1 to 3, respectively in combination with a plurality of photographic lenses disposed behind the compound prism and reflecting system, for the purpose of taking a corresponding number of simultaneous pictures substantially as described.

7. Apparatus for projecting simultaneous photographic pictures substantially as set forth in Claims 1 to 6 respectively but with reversal of the direction of light for projection.

8. In apparatus according to the preceding claims and wherein a plurality of compound prisms or part reflecting and part transmitting surfaces are employed, the ruling of said surfaces so that the lines of one are at right angles to those of another, for the purpose described.

9. Apparatus for taking or projecting photographic pictures constructed and arranged substantially and described with reference to Figs. 1 to 4 respectively.

Dated this 22nd day of April, 1913.

MEWBURN, ELLIS & PRYOR,
70 & 72, Chancery Lane, London, W.C.,
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Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1913.

ERRATA.

SPECIFICATION No. 24,159, A.D. 1912.

Page 5, line ~~40~~ 39, *for* "prisms" *read* "prism"
,, 8, ,, 34, *for* "and" *read* "as"

PATENT OFFICE,
31*st August*, 1914.

Fig. 1.

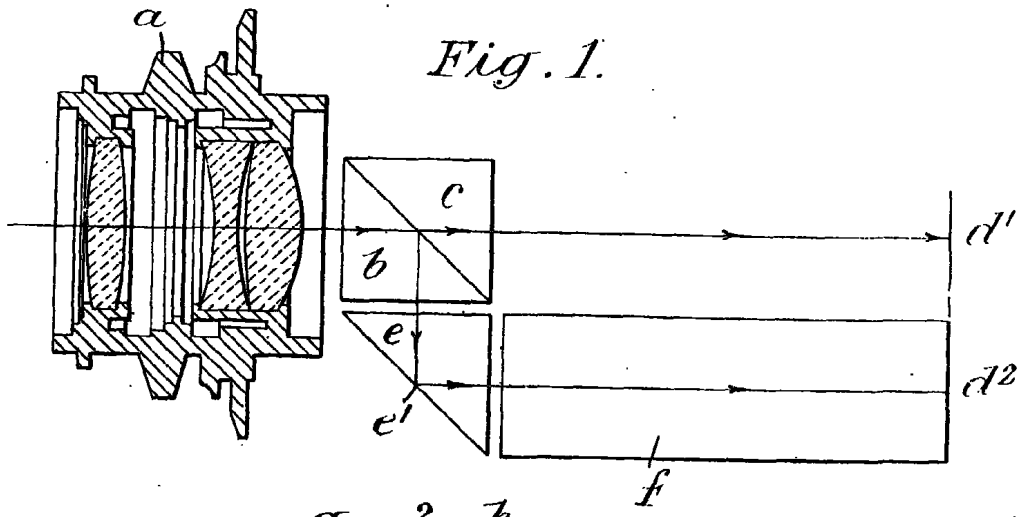


Fig. 2.

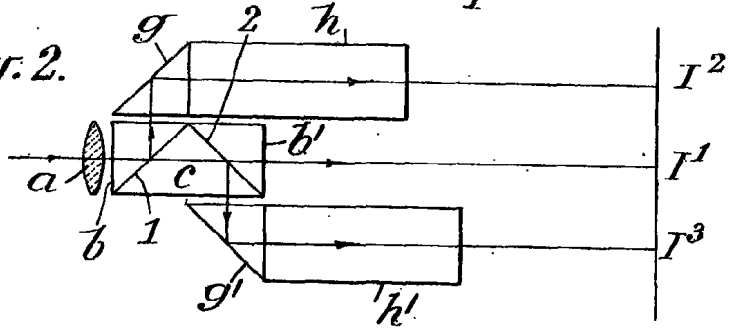


Fig. 3.

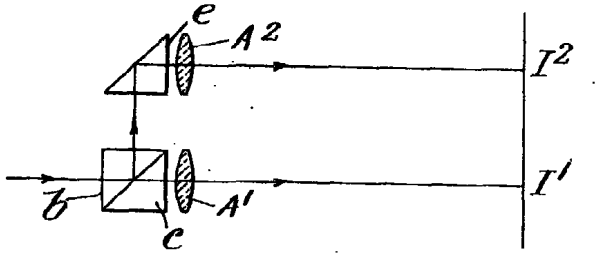
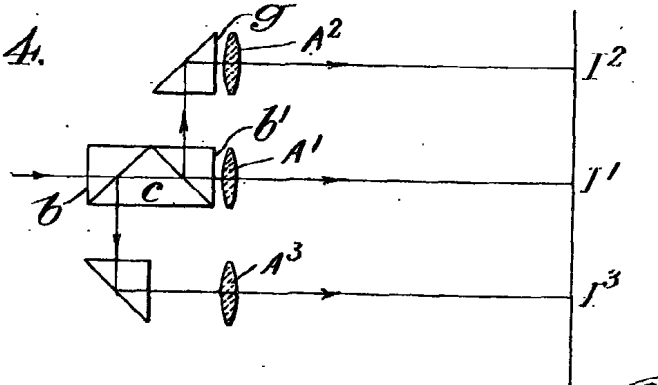


Fig. 4.



Malby & Sons, Photo-Litho.