

N° 15,732



A.D. 1905

(Under International Convention.)

Date claimed for Patent under Patents Act, 1901,
being date of first Foreign Application (in } 13th Apr., 1905
Germany),

Date of Application (in the United Kingdom), 1st Aug., 1905

Accepted, 19th Oct., 1905

COMPLETE SPECIFICATION.

Improvements in Lenses:

We, RATHENOWER OPTISCHE INDUSTRIE-ANSTALT vormalis Emil Busch, Actien-Gesellschaft, of Rathenow, in the Province of Prussia, German Empire, 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:—

This invention relates to lens systems of the so-called telephoto type the focal distance of which is considerably greater than the image distance. Such combinations have the advantage of obtaining comparatively great focal distance by means of relatively short extensions of the camera.

10 Telephoto combinations hitherto used have all the great defect of producing an image much less clear than that produced by means of a rectilinear lens. Such telephoto combinations usually consist of an ordinary converging lens (positive element) and a diverging lens having a shorter focal distance (negative lens) the lenses being corrected separately but not as a combination.

15 By this means a well corrected telephoto lens having a large aperture is not obtained.

Further attempts have also been made to correct the combination of a positive and negative element, the combination being considered as a single objective lens. This method also has not produced a practically useful telephoto lens.

20 This last method is only theoretically correct. Our telephoto combination consists of a positive lens at the front and a negative lens at the back each of which consists of at least two glasses and has its concave surface towards the stop. This form is particularly favourable for avoiding the astigmatic sinus and distortion defects.

25 To correct chromatic aberration in direct and oblique pencils the front lens as well as the back is made of at least two different glasses, and the most favourable arrangement is that in which the positive element as well as the negative is separately free from chromatic aberration.

In order to make our invention more clear, we refer to the accompanying drawing in which:

Figures 1 and 2 are cross sections of two modifications of the new lens,

Figure 3^a illustrates a lens of the usual kind in connection with a telescope.

Figure 3^b shows our improved lens system for the same purpose.

35 In Figures 1 and 2 R^1 R^2 R^3 R^4 R^5 R^6 indicate the radii of the lens surfaces, δ^1 , δ^2 , δ^3 , δ^4 are the thicknesses of the lenses and ζ signifies the distance between the two lenses. n n etc are refractive indices. The numerical values for the illustrated lenses are as follows

[Price 8d.]



Improvements in Lenses.

FIGURE 1

Focal distance 240 mm Aperture = F : 11

$R^1 = + 29,74$	$\delta_1 = 3,84$	$\frac{n^1}{d}$	1,61358	$\frac{n^1}{g^1}$	1,62783
$R^2 = - 157,38$	$\delta_2 = 1,49$	$\frac{n^2}{d}$	1,61358	$\frac{n^2}{g^1}$	1,63562
$R^3 = + 350,25$	ζ 36,67 air				
$R^4 = - 19,32$	$\delta_3 = 1,92$	$\frac{n^3}{d}$	1,53000	$\frac{n^3}{g^1}$	1,54100
$R^5 = + 480,00$	$\delta_4 = 4,80$	$\frac{n^4}{d}$	1,51000	$\frac{n^4}{g^1}$	1,52180
$R^6 = - 28,42$					

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FIGURE 2

Focal distance 240 mm Aperture = F : 8

$R^1 = + 21,99$	$\delta_1 = 6,00$	$\frac{n^1}{d}$	1,61400	$\frac{n^1}{g^1}$	1,62825
$R^2 = - 43,64$	$\delta_2 = 0,72$	$\frac{n^2}{d}$	1,61400	$\frac{n^2}{g^1}$	1,63604
$R^3 = + 38,66$	ζ 25,20 air				
$R^4 = - 15,06$	$\delta_3 = 1,34$	$\frac{n^3}{d}$	1,59000	$\frac{n^3}{g^1}$	1,60229
$R^5 = + 43,64$	$\delta_4 = 3,36$	$\frac{n^4}{d}$	1,55100	$\frac{n^4}{g^1}$	1,56685
$R^6 = - 26,23$					

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The lenses made according to these calculations give a clear image up to the edge of the 9 × 12 photographic plate.

In order to avoid distortion in the combination it is advisable to place the stop as close as possible to the back lens, or the latter must be of smaller diameter, of course without restricting the aperture. 20

These lenses are suitable for hand cameras having a short extension.

After removing the negative back lens the front lens can be used in combination with small stops as a wide-angle lens. Also the distance between both lenses can be varied within certain limits to alter the focal distance and the back focus. 25

This new system having a short back focus and showing the tapering of the ray cone produced by the back lens can be usefully employed as a telescope lens, especially for prism-telescopes, as in such cases the instruments can be provided with much smaller prisms than are in the usual instruments or the length of the instruments can be shortened if the prism remains the same. 30

In Figures 3^a and 3^b such a device is shown. Fig. 3^a is a Porro-prism system in which $p^1 p^2$ indicate the prisms in connection with an ordinary lens O.

Fig. 3^b illustrates an object lens O according to our invention in connection with the same prism system $p^1 p^2$ and it is clearly to be seen that in consequence of the construction of the ray cone the dimensions of the prisms $p^1 p^2$ are considerably lessened. 35

Improvements in Lenses.

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:—

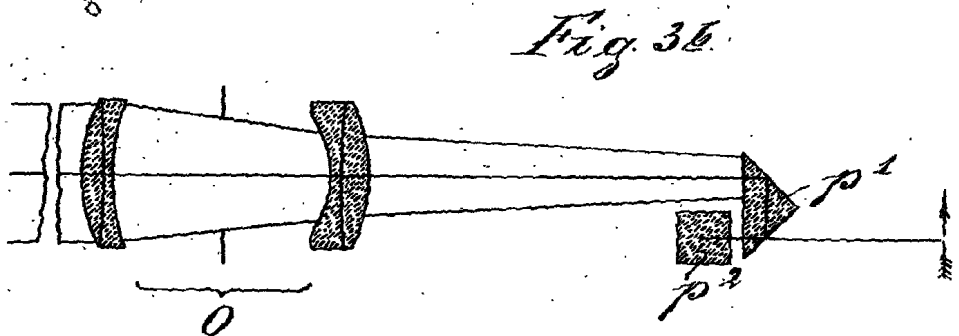
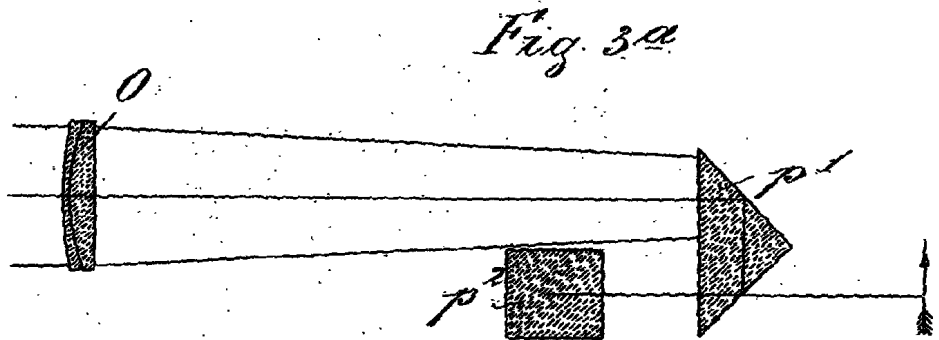
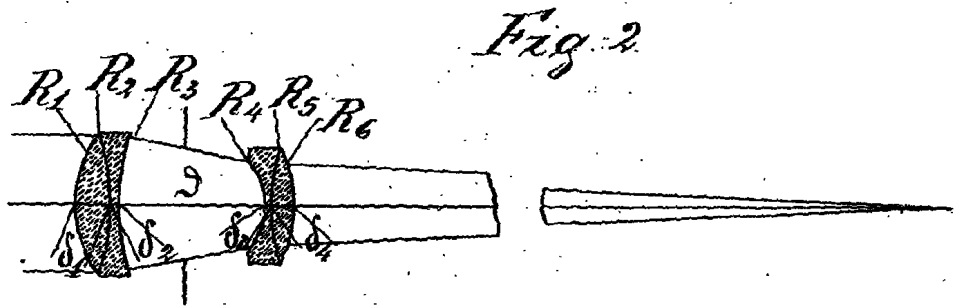
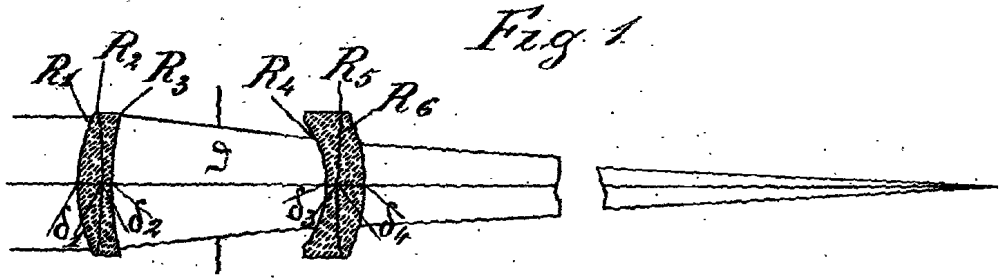
- 5 (1). A lens system having a relatively short back focus, consisting of a positive and a negative lens having their concave surfaces opposite each other, each lens for the purpose of correcting optical defects being made from at least two glasses of the required refractive power, and the negative lens having a focal distance about equal to or smaller than the focal distance of the positive lens, substantially as described.
- 10 (2). In a lens system according to Claim 1, the employment of a positive front lens as single object lens, substantially as described.
- (3). The application of a lens system according to Claim 1 to telescopes, especially prism telescopes, in order to obtain short telescopic length and small prisms, substantially as described.

15 Dated this 1st day of August 1905.

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A.D. 1905. Aug. 1. N° 15,732.

THE COMPLETE SPECIFICATION OF KATHENOWER OPTISCHE INDUSTRIE-ANSTALT
EMIL BUSCH. ACT.-GES. (3 SHEET



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

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