

PATENT SPECIFICATION

375,723

Application Date: Jan. 20, 1932. No. 1754/32.

Complete Accepted: June 30, 1932.



COMPLETE SPECIFICATION.

Improvements in Lens Systems.

I, WILLY FRIEDRICH BIELICKE, of 30, Lahnstrasse, Berlin-Neukölln, Germany, a German citizen, 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 objective lens systems, such as are used for photographic microscopic, projection and similar purposes, the chief object of the invention being to provide a lens system corrected for spherical and chromatic aberration, astigmatism, distortion and coma and having a very large relative aperture.

An objective lens is known which is composed of three collective lenses enclosing a dispersive lens, one of the collective lenses being placed on that side of the dispersive lens which faces the incident light and the other two collective lenses being placed on the other side of the dispersive lens.

The object of my invention is to improve the covering power of this lens by which is understood a better correction of the residual aberrations for oblique beams of light. This is obtained by introducing a cemented collective lens surface in one or more of the collective lens elements. I make one or both of the collective lenses behind the dispersive lens of two lenses cemented together by Canada balsam, one being a dispersive lens of flint glass and the other being a collective lens of crown glass having a

higher refractive index and a lower dispersion than the flint glass.

It is known that the aberrations of a collective lens decrease as the refractive index increases. In high speed objective lenses generally crown glasses are used the refractive index of which is not higher than 1.625. Not long ago manufacturers of optical glass were able to produce a baryta Crown glass having a refractive index for the D-line of the spectrum as high as 1.658, the relative dispersion which is generally called by the letter *v*, being round 51. If one would replace the collective lenses of the lens system described above by lenses made of this glass of high refraction, flatness of field would be improved, but the high dispersion of the new crown glass would require that the single dispersive lens be made of a very heavy flint glass to obtain chromatic correction. These kind of glasses cannot be used in high speed objectives on account of their intensive yellow tint and their strong absorption of the blue light rays. The combined lens system can be corrected for chromatic aberration using a dense flint glass of not too high a refractive index if one or more of the collection members are made of two lenses as described above.

The data for making an objective lens according to my invention are shown in the accompanying drawing. The equivalent focal length is 100 mm. the relative aperture *f*: 2.5.

				<i>n</i> _D	<i>n</i> _G	<i>v</i>
75	$r_1 + 42.2$					
	$r_2 \infty$	d_1 7.2	I.	1.6580	1.6741	51.4
		l_1 11.4				
	$r_3 - 65.4$					
80	$r_4 + 42.9$	d_2 2.5	II.	1.6741	1.7015	32.0
		l_2 9.2				
	$r_5 - 213.1$					
		d_3 2.4	III.	1.5821	1.5998	42.0
85	$r_6 + 36.7$					
		d_4 9.6	IV.	1.6580	1.6741	51.4
		l_3 1.1				
	$r_7 - 52.1$					
	$r_8 + 252.5$					
90	$r_9 - 252.5$	d_5 4.8	V.	1.6513	1.6732	38.3

[Price 1/-]

The characters r_1 to r_2 inclusive indicate the radii of curvature of the lenses from left to right respectively. The light is presumed to be incident from left to right and all curvatures that are convex toward the incident light are positive and those that are concave are negative.

The characters d_1 to d_5 inclusive indicate the axial dimensions of the glass thicknesses and the characters l_1 to l_5 inclusive the air spaces.

The characters n_D and n_G denote the refractive indices for the D line and the G line of the spectrum, the character v the relative dispersion of the glasses of which lenses I to V are made.

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. In an objective lens system for photographic, microscopic, projection and similar purposes, the combination of four lenses, three of these being collective and enclosing a dispersive lens, one or both of the collecting lenses behind the dispersive lens being composed of a dispersive flint glass lens and a collective crown glass lens having a higher refractive index and lower dispersion than the flint glass lens.

2. In an objective lens system according to claim 1 collective lenses made of glass having a refractive index higher than 1.65 for the D-line of the spectrum.

Dated the 20th day of January, 1932.

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Registered Patent Agents.

[This Drawing is a full-size reproduction of the Original.]

