

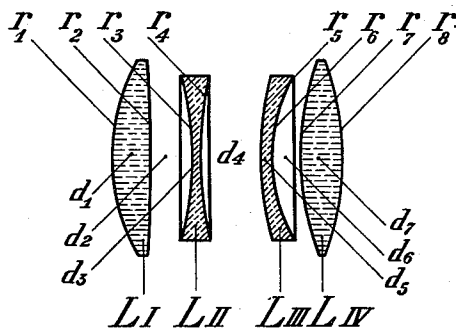
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F. URBAN

FOUR-LENS OBJECTIVE

Filed March 9, 1922



Inventor:

Frank Urban
by
Geo. J. Matherly atty.

UNITED STATES PATENT OFFICE.

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FOUR-LENS OBJECTIVE.

Application filed March 9, 1922. Serial No. 542,227.

To all whom it may concern:

Be it known that I, FRANZ URBAN, a citizen of the German Republic, residing at Steglitz, near Berlin, Germany, have invented certain new and useful Improvements in Four-Lens Objectives (for which I have filed patent application in Germany March 8th, 1921), of which the following is a specification.

My present invention for which till now I have filed patent applications only in Germany on March 8th, 1921, relates to improvements in spherically, chromatically, astigmatically and comatically corrected objectives built up of four lenses of which the two outer ones are bi-convex and formed of highly refractive baryta-crown glass and the two inner ones negative lenses of higher dispersive property than the biconvex lenses. The purpose of the invention is to provide an objective built up of four lenses as above indicated which is distinguished by great luminosity and by a very satisfactory correction of the astigmatic aberration of the image produced thereby. To this end in the new objective according to the invention one of the two negative lenses of the system is made biconvex and the other convex concave and positioned so as to turn its convex surface towards the biconcave lens, so that an air space of meniscus shape is formed between said two lenses, such air meniscus preferably having the form of a negative lens.

In this new objective construction the high dispersive property of the biconvex lenses is of decisive character for the effect aimed at. In view of the fact that a somewhat lower dispersive property of the one concave inner lens can be compensated by a somewhat higher dispersive property of the other concave inner lens the effect depends thereon that the sum of the dispersive powers of the glasses for the two lenses is not less than a certain value. Although this value is not positively fixed and may be varied it can be said that it should not be less than 0.04, it being understood that the value here mentioned is equal to the sum of the differences of the refractive indices for the lines G' and D of the spectrum in both said concave inner lenses. If for instance in the example which will be given later on the indices of refraction n_G , and n_D are respectively 1.6761 and 1.6504 and if these indices

are the same for both said lenses then the sum here in question is 0.0514.

An embodiment of the new objective is illustrated on the accompanying drawing in axial section. The lenses are designated $L_I, L_{II}, L_{III}, L_{IV}$, the lens L_I being that which is situated on the light entrance side. The radii of curvature of the surfaces of the lenses are designated r_1 to r_8 and the thicknesses of the lenses and those of the air spaces between the lenses are designated d_1 to d_7 . The values of the radii of curvature r_1 to r_8 and those of d_1 to d_7 and furthermore the values of the indices of refraction n_D and n_G for the D line and G line of the spectrum for each of the lenses L_I to L_{IV} are given in the following table for an objective in accordance with the invention having a focal length equal to 150 mm. and a ratio of aperture equal to 1:2.

$r_1 = + 74,2$	$d_1 = 14,7$	L_I	$n_D = 1,6216$	$n_G = 1,6352$	
$r_2 = -533,4$	$d_2 = 16,5$				
$r_3 = -118,2$	$d_3 = 4,5$	L_{II}	$n_D = 1,6504$	$n_G = 1,6761$	
$r_4 = +200,0$	$d_4 = 23,1$				
$r_5 = +140,8$	$d_5 = 5,1$	L_{III}	$n_D = 1,6504$	$n_G = 1,6761$	
$r_6 = + 63,2$	$d_6 = 10,5$				
$r_7 = +103,9$	$d_7 = 16,8$	L_{IV}	$n_D = 1,6230$	$n_G = 1,6366$	
$r_8 = -114,6$					

What I claim is:—

1. A spherically, chromatically, astigmatically and comatically corrected objective built up of two outer biconvex lenses made of highly refractive baryta-crown glass and two concave inner lenses, one of said concave inner lenses being biconcave and the other convex concave, the latter turning its convex surface towards the biconcave lens, both said concave inner lenses having substantially higher dispersive property than the two outer biconvex lenses, the dispersive properties of the inner lenses being such that the total of the differences of the indices of refraction n_G , and n_D for the lines G' and D of the spectrum for both said lenses is not less than 0.04.

2. A spherically, chromatically, astigmatically and comatically corrected objective built up of two outer biconvex lenses made of highly refractive baryta-crown glass and two concave inner lenses, one of said concave inner lenses being biconcave and the other convex concave, the latter turning its convex surface towards the biconcave

lens, and having such curvature that an air spectrum for both said lenses is not less 10
meniscus in the form of a negative lens is than 0.01.
formed between said two concave inner lenses In testimony whereof I have signed this
both of them having substantially higher specification in the presence of two sub-
5 dispersive property than the two outer bi- scribing witnesses.
convex lenses, the dispersive properties of
the inner lenses being such that the total of
the differences of the indices of refraction
 n_G , and n_D for the lines G' and D of the

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Witnesses:

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