

PATENT SPECIFICATION



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312,536

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PROVISIONAL SPECIFICATION.

Improvements in Objectives.

We, ARTHUR WARMISHAM, a British Subject, and KAPELLA LIMITED, a British Company, both of 104, Stoughton Street, Leicester, do hereby declare the nature of this invention to be as follows:—

This invention relates to objectives for photographic and the like purposes, and especially to those of the type described in Patent Specification 113,590, and its object is to produce alternative and improved constructions by the use of glasses which are more stable than those used in the constructions described in said specification.

Objectives of the type referred to comprise four simple glasses separated by air spaces, and the two outer components are made of highly refractive baryta crown glass, because the optical constants of such glasses are, mathematically speaking, the most favourable of any existing type of glass. They have, however, one drawback, namely such glasses are not very stable, and when exposed to ordinary atmospheric conditions, they develop a characteristic stain or discoloration.

There exists a category of glasses known as medium baryta crowns, which, exposed to similar conditions, are much more stable than the heavy baryta crowns; but this improved physical condition is only obtained at the expense of substantial reduction in the refractive index, and such glasses are therefore much less favourable, from the mathematical standpoint, for the construction of wide

aperture objectives with a wide extent of anastigmatically flattened field.

According to the present invention, objectives of the type referred to are constructed with the front, that is the more exposed glass, made of medium baryta crown, and only the back glass, which comes inside the camera, made of heavy baryta crown, and the mathematical disadvantage in the use of a diminished refractive index in the front component is overcome by suitable selection of refractive indices, curvatures and spacings of the four components. By proper choice of the degree of departure from symmetry, combined with suitable first and third air spaces, objectives can be constructed not inferior in the degree of correction of the several aberrations to those made according to the specification referred to, and having the additional advantage of improved stability of the front glass.

Dated the 13th day of July, 1928.

ARTHUR WARMISHAM,
KAPELLA LIMITED,
The Common Seal of Kapella Limited was hereunto affixed in the presence of:—

WM. TAYLOR,
G. STAFFORD,
Directors.
T. E. HUDSON,
Secretary,

COMPLETE SPECIFICATION.

Improvements in Objectives.

We, ARTHUR WARMISHAM, a British Subject, and KAPELLA LIMITED, a British Company, both of 104, Stoughton Street, Leicester, 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 objectives for photographic and the like purposes, and

especially to those of the type described in Patent Specification 113,590, and its object is to produce alternative and improved constructions by the use of glasses which are more stable than those used in the constructions described in said specification.

Objectives of the type referred to comprise four simple glasses separated by air spaces, and the two outer components are

made of highly refractive baryta crown glass, because the optical constants of such glasses are, mathematically speaking, the most favourable of any existing type of glass. They have, however, one drawback, namely such glasses are not very stable, and when exposed to ordinary atmospheric conditions, they develop a characteristic stain or discoloration.

There exists a category of glasses known as medium baryta crowns, which, exposed to similar conditions, are much more stable than the heavy baryta crowns; but this improved physical condition is only obtained at the expense of substantial reduction in the refractive index, and such glasses are therefore much less favourable, from the mathematical standpoint, for the construction of wide aperture objectives with a wide extent of anastigmatically flattened field.

According to the present invention, objectives of the type referred to are constructed with the front, that is the more exposed glass, made of medium baryta crown, and only the back glass, which comes inside the camera, made of heavy baryta crown, and the mathematical disadvantage in the use of a diminished refractive index in the front component is overcome by suitable selection of refractive indices, curvatures and spacings of the four components. It is readily possible, by sufficiently increasing the powers of the several components, and in addition, or alternatively, increasing the first and third air spaces, to reduce to a normal value the Petzval curvature of the combination.

Such methods, however, would introduce increased oblique aberrations and would result in the restriction of good definition to a smaller angle than desired. We prefer not to increase the first and third air spaces compared with those normal in ob-

jectives made according to the specification cited.

According to the present invention, the mean refractive index of either of the divergent members is made at least .02 less than that of the front component. The first and third air spaces lie between 14% and 18% of the equivalent focal length of the objective, the seventh radius is between 50% and 70% stronger than the second, and the difference between the sixth and seventh substantially equal to the difference between the third and second, or, in other words, the two air lenses formed by the first and third separations are of substantially equal net curvature, but the back one is considerably more bent over than the front one. These several limitations provide good definition over a wide field, in spite of the disadvantage inherent in the use of the medium refractive index in the front crown.

A numerical example of this improved construction will now be described and illustrated with reference to the drawing:—

The notation of the example is that the successive radii of curvature, counting from the front, are called R_1, R_2, \dots , the sign + denoting that the curve is convex toward the front, and - that it is concave toward the front.

The thicknesses of the lenses are denoted by T_1, T_2, \dots , and the axial distances between the surfaces R_2 and R_3, R_4 and R_5, R_6 and R_7 , are denoted by D_1, D_2, \dots respectively.

The material is defined in terms of the mean refractive index nD and the mean dispersive power V , as conventionally employed, and further by the type-number in Messrs. Chance Brothers' optical glass catalogue.

	E.F.L.	10"	Relative aperture	F/4.5	Messrs. Chance	
			nD	V	Brother's	
					Catalogue Number.	
	$R_1 + 2.9328$					
		T_1	.4047	1.57380	57.4	9002
95	$R_2 - 9.7348$	D_1	.1736			
	$R_3 - 4.9270$	T_2	.1473	1.54997	45.8	1018
	$R_4 + 4.4527$	D_2	.4097			
100	$R_5 - 5.3427$	T_2	.1473	1.54997	45.8	1018
	$R_6 + 3.8188$	D_2	.1736			
105	$R_7 + 5.9775$	T_4	.4541	1.62340	56.3	6665
	$R_8 - 3.2063$					

Objectives made according to the above numerical specification give well-corrected definition over a field of semi-angle 26° , the definition being not inferior to that
 5 given by objectives of the same relative aperture, made according to the Patent Specification No. 113,590 referred to.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to
 10 be performed, we declare that what we claim is:—

1. Objectives for photographic and the like purposes, of the type comprising four
 15 separated simple components, the two inner ones being divergent, and the two outer ones convergent, characterized by the front component being made of Medium Barium Crown, either divergent
 20 component being made of a Light Flint having n_D .02 less than that of the front component, and the back component made of Heavy Barium Crown, the first and the
 25 and not greater than 1.8% of the equiva-

lent focal length of the objective, the seventh radius being between 50% to 70% stronger than the second radius, and the difference between the second and third curvatures being substantially equal
 30 to the difference between the sixth and seventh curvatures, as and for the purpose described.

2. Objectives according to Claim 1, and substantially according to the numerical
 35 example described and illustrated in the drawing.

Dated the 11th day of April, 1929.

ARTHUR WARMISHAM,
 KAPELLA LIMITED,
 The Common Seal of Kapella
 Limited was hereunto
 affixed in the presence
 of:—

WM. TAYLOR,
 G. STAFFORD,
 Directors.
 T. E. HUDSON,
 Secretary,

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

