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PATENT SPECIFICATION



Application Date: Dec. 22, 1933. No. 36078/33.

422,246

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Complete Specification Accepted: Jan. 8, 1935.

PROVISIONAL SPECIFICATION

Improvements in Lenses

We, HORACE WILLIAM LEE, 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 large aperture anastigmatically corrected lenses, for photography, projection and the like, comprising three simple elements only, separated by air spaces; and its object is to provide an improved construction especially suitable for lenses of short focal length.

Hitherto, in lenses of this type having an aperture greater than $f/4$, the middle (dispersive) element has been placed more or less equidistant from the collective elements (e.g. in British Patent No. 22607/1893, Figure 7; British Patent No. 155,640) but such lenses are found to be difficult to mount accurately when made in focal lengths of one inch or less, and moreover the curves are too deep and the edge thickness of the collective elements and the central thickness of the dispersive element are too small for convenient manufacture.

We attain the object of our invention, without sacrificing good correction, by making:—

(a) the front air space less than half

the rear air space (where the front is that side presented to the longer conjugate for which the lens is corrected);

(b) the radii of curvature of the first and fourth surfaces (which are the deepest) counting from the front, not less than one third, nor greater than one half, the focal length of the system.

(c) the front collective element with an axial thickness greater than one twelfth the focal length of the system and the radii of curvature of its surfaces smaller than those of the corresponding surfaces of the rear element.

Preferably we make the front lens of glass of refractive index less than 1.60 as such glass is less liable to atmospheric corrosion than is denser glass.

Dated the twenty-first day of December, 1933.

HORACE WILLIAM LEE,
KAPELLA LIMITED.

The Common Seal of
Kapella Limited was
hereunto affixed in
the presence of:—

WM. TAYLOR,
Director.

G. STAFFORD,
Secretary.

COMPLETE SPECIFICATION

Improvements in Lenses

We, HORACE WILLIAM LEE, 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 large aperture anastigmatically corrected lenses for photography, projection and the like, of the kind comprising a single dispersive element placed between two single collective elements; and its object is to provide an improved construction especially suitable for lenses of short focal length and large aperture.

[Price 1/-]

Hitherto, in lenses of the kind referred to, having an aperture greater than $f/4$, the dispersive element has been placed more or less equidistant from the collective elements (e.g. in British Patent No. 22607/1893, Fig. 7, and in British Patent No. 155,640); but such lenses are difficult to manufacture and to mount accurately, when made of short focal lengths such as one inch or less, because the curves are deep, and the edge thicknesses of the collective elements and the central thickness of the dispersive element very small.

We surmount these difficulties according to the present invention, without sacrificing good corrections, by so design-

Price 4s 6d.

ing the lens that the front air space is less than half the rear air space (where the front is that side presented to the longer conjugate for which the lens is corrected) and by making the ratio of the power of the front element to that of the rear element between 1.1 and 3.0. These conditions being satisfied, the first and fourth surface of the system then have the shortest radii of curvature, and both these radii are between seven-twentieths and one half the focal length of the system. The radius of the third surface has a value at least one-eighth greater than, and less than twice as great as, that of the fourth surface, while the radius of the second surface is greater than two-and-a-half, and less than five times, that of the first. By these means we attain correction of aberrations with the use of shallow curves.

We prefer to make the dispersive element of glass of refractive index at least two per cent higher than that of one of the collective elements. Preferably the refractive index of one or both

collective elements amounts to at least 1.57, in order to obtain a sufficiently flat field. Preferably we make the exposed front element of glass of refractive index less than 1.60, as such glass is less liable to atmospheric corrosion than is denser glass.

We now give data for the construction of a lens according to our invention, illustrated in the accompanying drawing. The notation is that the successive radii of curvature, counting from the front, are called R_1, R_2 , etc., the sign + denoting that the curve is convex toward the incident light, and - that it is concave toward the same. The axial thicknesses of the elements are denoted by D_1, D_2 , etc., and the separations of the components by S_1, S_2 , etc.

The material is defined in terms of the mean refractive index nD , as conventionally employed, followed by the type number in Messrs. Chance Brothers' optical glass catalogue of 1934. The Abbe V number is also given:—

EXAMPLE.

	Equivalent focal length 1.0			Aperture f/2.5		
	Radii.	Thickness.	Separation.	nD .	V.	No.
55	$R_1 + 0.4$	D_1 .13		1.5843	56.1	582561
	$R_2 - 1.176$		S_1 .07			
	$R_3 - 0.516$	D_2 .04		1.6203	36.1	620361
60	$R_4 + 0.370$		S_2 .18			
	$R_5 + 2.04$	D_3 .10		1.6133	59.3	613593
65	$R_6 - 0.49$					

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. An anastigmatically corrected lens of the kind referred to, having an aperture greater than $f/4$, in which the front air space is less than half the rear air space, and in which the first and fourth radii lie between the values of seven-twentieths and one half the focal length of the system.

2. A lens as claimed in claim 1, in which the ratio of the power of the front element to that of the rear element lies between 1.1 and 3.0.

3. A lens as claimed in claim 1 or claim 2, in which the ratio of the radius of the third surface to that of the fourth

lies between nine-eighths and two, and the ratio of the radius of the second surface to that of the first lies between two-and-a-half and five.

4. A lens as claimed in claim 1 or claim 2, in which the refractive index of the dispersive element is at least two per cent higher than that of one of the collective elements.

5. A lens as claimed in any of the preceding claims, in which the refractive index of one or both of the collective elements is at least 1.57.

6. A lens as claimed in any of the preceding claims, in which the refractive index of the front element is not greater than 1.60.

7. A lens constructed substantially as herein described.

HORACE WILLIAM LEE.
KAPELLA LIMITED.

Dated the nineteenth day of September,
1934.

The Common Seal of
Kapella Limited was
hereunto affixed in
the presence of:—

J. RONALD TAYLOR,
Director.

G. STAFFORD,
Secretary.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1935.

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

