PATENT SPECIFICATION

Application Date: May 17, 1934. No. 14876/34. **438,605**

Complete Specification Left: May 17, 1935.

Complete Specification Accepted: Nov. 18, 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 anastigmatically corrected lenses for photography, projection and the like, comprising a simple dispersive element between two simple collective elements and separated therefrom by air spaces, and its objects are to provide an improved construction especially suitable for lenses of exceptionally short focal length, and to provide such lenses with large aperture.

It is sometimes desirable with lenses of this kind, especially when they are of exceptionally short focal length, to secure a relatively large clearance between the focal plane and the rear element of the lens system; and we attain this object according to the present invention by making:—

(a) the rear air space (that nearer to the shorter conjugate) less than 0.56 of the front air space, and

(b) the focal length of the front element exceeding 0.55 times that of the system.

In order to provide such lenses with large aperture (for example f/2.5) we make:—

(c) the dispersive element with radii of curvature differing by not less than ten per cent. and placing it with its shorter radius toward the back, and

(d) the refractive index of the dispersive element greater than that of either of the collective elements.

We prefer to make:—

(e) the axial thickness of the rear collective element greater than one-fifteenth the focal length of the system:

(f) the front element of glass whose index of refraction is less than 1.60, in order to minimise the risk of atmospheric corrosion:

(g) the rear element of glass whose index of refraction exceeds 1.60.

Dated the 16th day of May, 1934.

HORACE WILLIAM LEE,
KAPELLA LIMITED,
The Common Seal of Kapella Limited was hereunto affixed in the presence of:—

J. RONALD TAYLOR,
Director,
MARK H. TAYLOR,
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 lenses for photography, projection and the like, of the kind corrected anastigmatically and comprising a simple dispersive element between two simple collective elements and separated therefrom by air spaces.

The principal object of the invention is, while maintaining the correction of the aberrations, to attain at the same time a larger aperture and an abnormally large clearance between the focal plane and the rear element of the lens system.

Lenses of the kind referred to have been made with the dispersive element nearer to the rear collective element than to the front collective element, and by the rear we mean that side of the system which faces the shorter conjugate for which the lens is corrected, but such lenses have hitherto been made with collective elements substantially plano-convex and substantially equal in power. By these means alone, apertures larger than F/3.6 have been unattainable, nor has

[Price 1/-]

the clearance between the focal plane and the rear element been substantially increased.

According to the present invention we are able to increase the clearance between the focal plane and the rear element to more than 86 per cent of the equivalent focal length and to attain apertures as large as F/2.5, and this we do by:—

(a) making the rear air space less than 0.56 the front air space, the focal length of the front element exceeding 0.55 times that of the entire system, and the refractive index, for the D.line, of the glass composing the dispersive element greater than that of the glass composing the front element by more than two per cent.

(b) Preferably, to assist the corrections, we make the radius of curvature of the front surface of the dispersive element greater than that of the rear surface, in a ratio greater than 1.1.

(c) Preferably we make the front element of the system of glass whose index of refraction is less than 1.60, in order to minimise the risk of atmospheric corrosion.

(d) Preferably we make the rear element of glass whose index of refraction exceeds 1.60, in order that the Petzval sum can be sufficiently small to ensure that the field of the system is flat.

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. The Abbe V number also is given:—

EXAMPLE.

Aperture F/2.5. Radii.	Thickness.	Equivalent Focal Length 1.0. Separation.	^nD.	V.	No.
R_1 + .488					
	D_1 .078		1.5722	57.7	572577
R_2 − 6.94					
		S_1 .144			
R_3 − .447					
	D_2 .033		1.62046	36.1	626361
R_4 + .379					
		S_2 .072			
R_5 + .889					
	D_3 .133		1.61452	56.2	615562
R_6 − .376					

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. A lens for photography, projection, and the like, corrected anastigmatically, comprising a simple dispersive element between two simple collective elements and separated therefrom by air spaces, in which the rear air space is less than 0.56 the front air space, the focal length of the front element exceeds 0.55 times that of the entire system, and the refractive index, for the line D, of the glass composing the dispersive element exceeds that of the glass composing the front collective element by more than two per cent.

2. A lens as claimed in Claim 1, in which the two surfaces of the dispersive element have different radii of curvature, the surface facing the longer conjugate has the larger radius, and the ratio between the radii is not less than 1.1.

3. A lens as claimed in Claim 1 or Claim 2, in which the front element of the system is made of glass of refractive index less than 1.60.

4. A lens as claimed in any of the preceding Claims, in which the rear element is made of glass having a refractive index greater than 1.60.

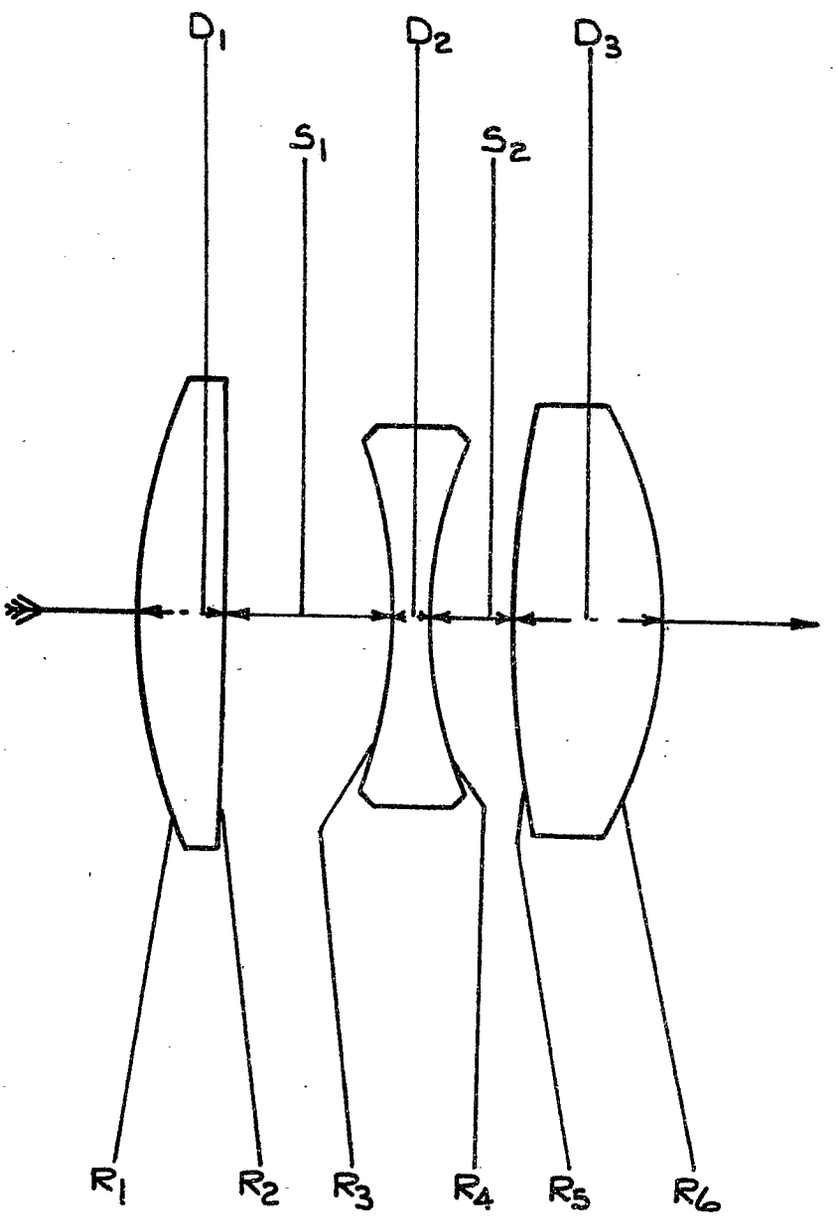
5. A lens constructed substantially as described with reference to the accompanying drawing.

Dated the 16th day of May, 1935.

HORACE WILLIAM LEE,
KAPELLA LIMITED,
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.



Malby & Sons, Photo-Lith.