

PATENT SPECIFICATION

RESERVE COPY
Application Date: Oct. 21, 1931. No. 29,181/31.

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PROVISIONAL SPECIFICATION.

No. 29,181, A.D. 1931.

Improvements in Photographic 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 photographic lenses of the kind consisting of a single meniscus element and a diaphragm placed behind said element: and its object is to provide a lens of this kind, which at the same time gives improved definition and is capable of being constructed more cheaply than lenses of the kind hitherto made.

These objects we attain by utilising shallower curves and a greater diaphragm

distance than have hitherto been used.

A lens constructed according to the present invention, and having a focal length of unity, may be made to the following specification, in which the notation is that the radii of curvature, counting from the front, are called R_1 and R_2 , the sign + denoting that the curve is convex toward the incident light. The axial thickness of the element is denoted by D , and the separation of the diaphragm by S . The material is defined in terms of the mean refractive index n_D , as conventionally employed, followed by the Abbe V number, and by the type number in Messrs. Chance Brothers' optical glass catalogue.

EXAMPLE.

35	Equivalent focal length 1".				
	$R_1 = +.209$	n_D	V	Aperture F/14 No.	
		$D = .023$	1.5215	59.4	3071
40	$R_2 = +.333$	$S = .14$			

Dated the Twentieth day of October, 1931.

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.

PROVISIONAL SPECIFICATION.

No. 30,563, A.D. 1931.

Improvements in Photographic Lenses.

We, HORACE WILLIAM LEE, a British Subject, and KAPELLA LIMITED, a British Company, both of 104, Stoughton Street, [Price 1/-]

Leicester, do hereby declare the nature of this invention to be as follows:—
This invention relates to photographic

lenses of the kind consisting of a single meniscus element and a diaphragm placed behind said element: and its object is to provide a lens of this kind, which at the same time gives improved definition and is capable of being constructed more cheaply than lenses of the kind hitherto made.

These objects we attain by utilising shallower curves than have hitherto been used.

A lens constructed according to the present invention, and having a focal

length of unity, may be made to the following specification, in which the notation is that the radii of curvature, counting from the front, are called R_1 and R_2 , the sign + denoting that the curve is convex toward the incident light. The axial thickness of the element is denoted by D , and the separation of the diaphragm by S . The material is defined in terms of the mean refractive index n_D , as conventionally employed, followed by the Abbe V number, and by the type number in Messrs Chance Brothers' optical glass catalogue.

		EXAMPLE.		
30	Equivalent focal length 1".	n_D	Aperture F/14 V	No.
	$R_1 = +.188$	$D = .032$	1.5215	59.4 3071
	$R_2 = +.277$	$S = .08$		

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

Dated the Fourth day of November,
1931.

WM. TAYLOR,
Director,
G. STAFFORD,
Secretary.

PROVISIONAL SPECIFICATION.

No. 1105, A.D. 1932.

Improvements in Photographic 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 photographic lenses of the known type in which a single meniscus lens is used with a diaphragm between it and the picture plane: and its object is to provide an improved lens of this kind, which at the same time gives better definition and is capable of being constructed more cheaply than lenses of this kind hitherto made. The spherical aberration and coma inherent in lenses of this kind can be diminished by increasing the ratio between the curvatures of the surfaces while reducing their absolute values, and at the same time the astigmatism can be corrected by correctly placing the stop relatively to the lens. The approximate equations for the correction of astigmatism yield two solutions for the position of the stop. By investiga-

tion, we have found that these solutions are real only so long as the ratio of the power of the first surface to the power of the lens is greater than the square of the refractive index of the glass for the shortest wave length for which the lens is used.

The improvement made according to the present invention consists in making said ratio at least equal to the square of the refractive index but

not exceeding $\frac{3}{1}$. By this means we improve both the spherical aberration and coma and we maintain the correction for astigmatism by suitably placing the diaphragm.

In the case of a photographic lens the shortest wave length used is about 3,500 Angstrom units. For Hard Crown glass, which is that most suitable for the present purpose the refractive index would be about 1.54.

A lens constructed according to the present invention and having a focal length of unity and aperture $f/14$ may be made to the following specification, in which the notation is that the radii of curvature, counting from the front, are called R_1 and R_2 , the sign + denoting that the curve is convex toward the incident light. The axial thickness of the element is denoted by D , and the S is distance of the vertex of the surface having the radius R_2 from the stop, placed so as to correct the astigmatism. The material is defined in terms of the means refractive index n_D , as conventionally employed.

20 $R_1 = +.176$ n_D
 $R_2 = +.252$ $D = .024$ 1.524
 $S = .072$

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.

Dated the Thirteenth day of January,
 1932.

COMPLETE SPECIFICATION.

Improvements in Photographic 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:—

30 This invention relates to photographic lenses, for cheap cameras, of the known types comprising a single lens with a diaphragm between it and the picture plane: and its object is to provide an improved lens of this kind, which at the same time gives better definition and is capable of being constructed more cheaply than lenses of this kind hitherto made.

40 The spherical aberration and coma inherent in lenses of this kind can be diminished continuously until the lens becomes plano-convex, for any lens of given focal length, by increasing the ratio between the radii of curvatures of the surfaces while increasing the radii. At the same time the astigmatism can be corrected by correctly placing the stop relatively to the lens. The approximate equations for the correction of astigmatism yield two solutions for the position of the stop. By investigation, we have found that these solutions are real only so long as the ratio of the power of the first surface to the power of the lens is greater than the square of the refractive index of the

glass for the shortest wave length for which the lens is used. By first surface we mean that on which the light is first incident.

The improvement made according to the present invention consists in making said ratio at least equal to the square of the refractive index but

not exceeding $\frac{3}{1}$. By this means we im-

prove both the spherical aberration and coma, and we maintain the correction for astigmatism by suitably placing the diaphragm.

In the case of a photographic lens the shortest wave length used is about 3,500 Angstrom Units and the longest about 7,000. For Hard Crown glass, which is what we prefer for the present purpose, the refractive index would be about 1.54 for said short wave and about 1.517 for the long wave.

The improvement of definition made according to the present invention is accompanied by increased radii of curvatures, and this cheapens construction by enabling more such lenses to be ground and polished together as one unit.

We shall describe our invention with reference to the accompanying drawing which shows in section a meniscus glass A, and diaphragm B, comprising the principal elements of a lens of the kind

referred to. The reference letters correspond with those used in the following specifications.

A lens constructed according to the present invention and having a focal length of unity and aperture F/14 may be made to any of the following three specifications, in which the notation is that the radii of curvature, counting from the front, are called R_1 and R_2 , the sign + denoting that the curve is convex

toward the incident light. The axial thickness of the element is denoted by D, and S is distance of the vertex of the surface having the radius R_2 from the stop, placed so as to correct the astigmatism. The material is defined in terms of the mean refractive index n_D , as conventionally employed, and the refractive index n_X for a wave length of 3,500 Angstrom units.

EXAMPLE I.

		n_D	n_X	RATIO. power of first surface power of lens	
25	$R_1 = +.209$				
	$R_2 = +.333$	D = .023	1.5215	1.544	2.5
		S = .14			

EXAMPLE II.

30	$R_1 = +.188$				
	$R_2 = +.277$	D = .032	1.5215	1.544	2.78
		S = .08			

EXAMPLE III.

35	$R_1 = +.176$				
	$R_2 = +.252$	D = .024	1.524	1.546	2.98
		S = .072			

40 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:—

45 1. A single meniscus photographic lens of the kind referred to in which the ratio of the power of the first surface to the power of the lens is greater than the square of the refractive index of the glass for a wave length of 3,500 Angstrom units, but is not greater than 3.

50 2. A lens as claimed in Claim 1 in which the refractive index of the glass for the sodium line is not less than 1.5.

3. A lens as claimed in Claim 1 or Claim 2 constructed substantially as described.

Dated the twenty-sixth day of January, 1932.

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

WM. TAYLOR,
Director,
G. STAFFORD,
Secretary.

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

