

# PATENT SPECIFICATION

342,889

Application Date: Jan. 28, 1930. No. 2871/30.

Complete Left: Nov. 28, 1930.

Complete Accepted: Feb. 12, 1931.



## PROVISIONAL SPECIFICATION.

### Improvements in Photographic 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:—

5 This invention relates to photographic and projection objectives, and especially to those of modified Petzval type described in British Patent Specification No. 258,092; and its aim is to improve the field flatness of said type of objective while still retaining undiminished the high relative aperture.

10 According to the invention, this aim is achieved by constructing the back divergent member, hitherto simple, as a cemented doublet comprising a highly refractive convergent member cemented to a divergent member of lower refractive index. Such improved compound divergent back member can be advantageously employed in any of the several constructions described in the specification referred to, that is in combination

with a front comprising two convergent members, either or both of which are compound, and a single simple back convergent member, or, alternatively, in combination with a one- or two-member front and two convergent back members. In any such combination, the novel back divergent member produces a substantial reduction in the Petzval curvature without detriment to the zonal spherical aberration and without increasing the number of air-glass surfaces.

Dated the 27th day of January, 1930.

ARTHUR WARMISHAM.  
KAPELLA LIMITED.

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

WM. TAYLOR,  
G. STAFFORD,

Directors.

G STAFFORD,  
Secretary.

## COMPLETE SPECIFICATION.

### Improvements in Photographic 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:—

45 This invention relates to photographic and projection objectives, and especially to those of modified Petzval type described in British Patent Specification No. 258,092; and its aim is to improve the field flatness of said type of objective while still retaining undiminished the high relative aperture.

50 According to the invention, this aim is achieved by constructing the back divergent member, hitherto simple, as a cemented doublet comprising a highly refractive convergent component cemented to a divergent component of lower refractive index.

[Price 1/-]

This novel back divergent member produces a substantial reduction in the Petzval curvature without detriment to the zonal spherical aberration and without increasing the number of air-glass surfaces. Such improved divergent back member can be advantageously employed in any of the several constructions described and illustrated in the specification referred to, that is in combination with a front comprising two convergent members, either or both of which are compound, and a single simple back convergent member, or, alternatively, in combination with a one- or two-member front and two convergent back members.

75 In order to illustrate the invention, we show in the accompanying drawings in Fig. 1, a lens according to the present invention, and a modification of the type of lens illustrated in Fig. 2 of said Specification; and in Fig. 2 herewith a lens which is a modification according to

the present invention of the type illustrated in Fig. 5 of said Specification.

We now give numerical data and drawing of an objective of relative aperture  $F/1.5$ , constructed according to our invention.

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  $R_5$ , and  $R_6$ , and  $R_7$  and  $R_8$ , are denoted by  $D_1, D_2$  and  $D_3$  respectively.

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

25	Equivalent Focal Length 1.059"				Chance Brothers' Catalogue Number
			$^mD$	$V$	
	$R_1 + .8831$	$T_1 .096$	1.5735	57.5	9002
30	$R_2 + 1.454$	$D_1 .002$	AIR		
	$R_3 + .7005$	$T_2 .230$	1.5181	60.3	9322
	$R_4 - .7930$	$T_3 .032$	1.6521	33.5	5093
35	$R_5 + 1.775$	$D_2 .130$	AIR		
	$R_6 + .7247$	$T_4 .180$	1.6437	48.3	
40	$R_7 \infty$	$T_5 .020$	1.5635	42.9	8653
	$R_8 + .3922$	$D_3 .090$	AIR.		
	$R_9 + .7500$	$T_6 .200$	1.6437	48.3	
45	$R_{10} - 2.559$				

The residual Petzval curvature of the objective in this example is .696, whereas that of an objective constructed according to the Specification of Letters Patent No. 258,092 is .809, which shows an improvement of some twelve per cent in the residual curvature by constructing objectives according to the present invention.

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 photographic or projection objective of the kind comprising a convergent front system separated by an air space from a convergent back system, the front system containing one or more convergent members, whereof one at least is compounded; and the back system containing one or more convergent members, and a divergent member, in which the divergent member is compounded of a convergent component of high refractive index, with a divergent component of lower refractive index.

2. An objective as claimed in claim 1, in which the front system comprises one

compound convergent member only, and the back system comprises two simple convergent members, and a divergent member, said divergent member being compounded of a convergent component of high refractive index, with a divergent component of lower refractive index.

3. An objective as claimed in claim 1, in which the front system comprises a compound convergent member and a simple convergent member; and the back system comprises a simple convergent member and a divergent member, said divergent member being compounded of a convergent component of high refractive index, with a divergent component of lower refractive index.

Dated the 27th day of November, 1930.

KAPPELLA LIMITED.

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

WM. TAYLOR,  
G. STAFFORD,  
Directors.

G. STAFFORD,  
Secretary.

For selves and co-applicant.

[This Drawing is a reproduction of the Original on a reduced scale.]

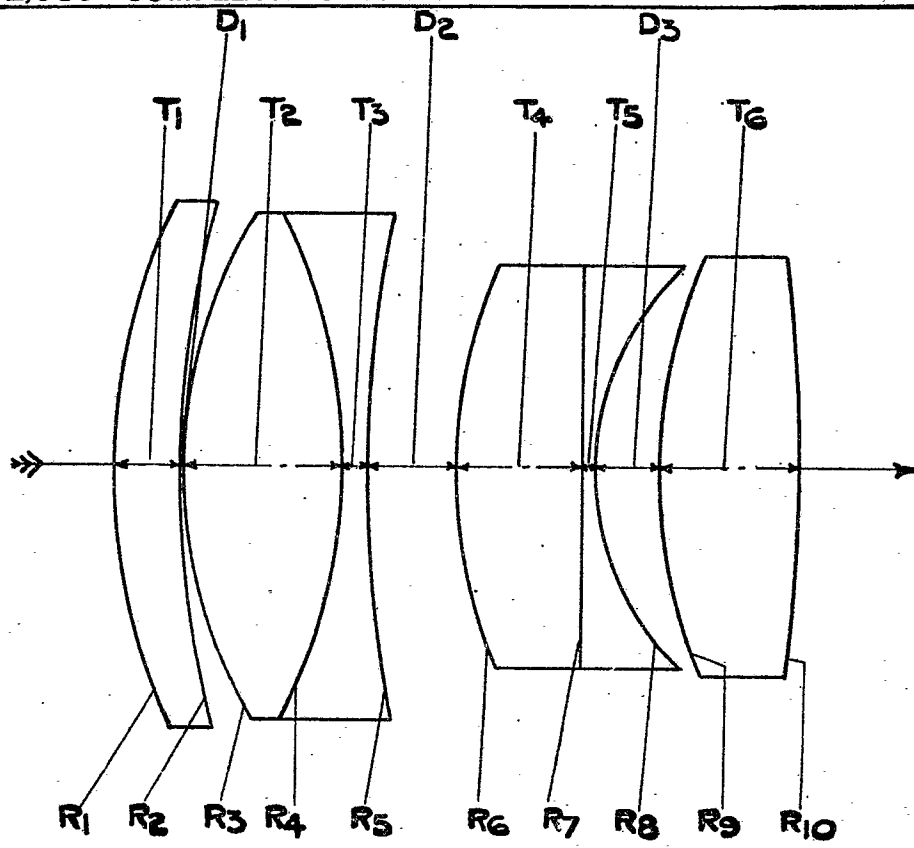


FIG. 1.

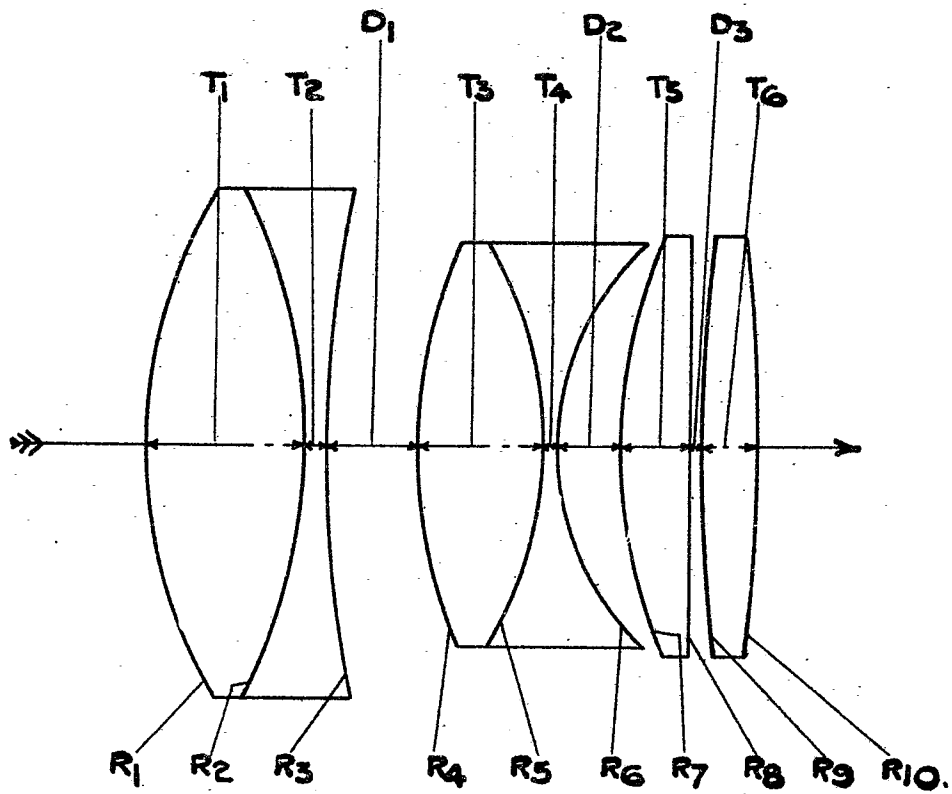


FIG. 2.