

PATENT SPECIFICATION

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**POOR
QUALITY**

PROVISIONAL SPECIFICATION

Improvements in or relating to Optical Objectives

We, TAYLOR, TAYLOR & HOBSON LIMITED, a Company registered under the Laws of Great Britain, and ARTHUR WARMISHAM, British Subject, both of 104, Stoughton Street, Leicester, do hereby declare the nature of this invention to be as follows:—

This invention relates to optical objectives for photographic or other purposes, corrected for spherical aberration, coma, astigmatism, field curvature and distortion, and comprising two compound meniscus divergent components disposed behind two simple convergent components and in front of a further simple convergent component. It is to be understood that the front of the objective is to be taken as the side nearer the longer conjugate and the rear the side further therefrom.

The invention has for its object to provide an improved objective of this kind corrected for a wide angular field of, say, 24 degrees semi-angle.

To this end according to the invention the radius of curvature of the front surface of the rear convergent component is greater than that of the rear surface thereof and the cemented surface of the front compound divergent component is slightly

collective. Preferably the difference between the mean refractive indices of the two elements of the front divergent component is greater than .015 and less than .035; the front element having the higher index.

The front and rear surfaces of the front convergent component are preferably more strongly curved respectively than those of the second convergent component. Preferably the sum of the numerical values of the radii of curvature of the concave air-exposed surfaces of the two divergent components is greater than 0.5 and less than 0.65 of the equivalent focal length of the objective.

Numerical data for a convenient practical example according to the invention are given in the following table, in which R_1, R_2, \dots indicate the radii of curvature of the individual surfaces counting from the front, the positive sign indicating that the surface is convex to the front, and the negative sign that it is concave thereto, whilst D_1, D_2, \dots indicate the axial thicknesses of the various lens elements and S_1, S_2, \dots the axial lengths of the air spaces between the components.

[Price 1/-]

Price 3s. 6d.

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Equivalent focal length 1.000		Relative aperture F/1.4		
Radius	Thickness or Separation	Refractive Index n_D	Abbé V Number	
5	$R_1 + .8106$	$D_1 .0671$	1.613	
	$R_2 + 1.653$			
	$R_3 + .8549$	$S_1 0$	59.3	
10	$R_4 + 1.765$	$D_2 .0610$		1.613
	$R_5 + .4430$	$S_2 .0020$		
	$R_6 \infty$	$D_3 .1474$	1.644	48.3
15	$R_7 + .2675$	$D_4 .0305$	1.621	
	$R_8 - .3434$	$S_3 .2033$		
	20	$R_9 + .7644$	$D_5 .0305$	1.651
$R_{10} - .4793$		$D_6 .1474$	1.644	
25		$R_{11} + 2.210$	$S_4 .0020$	1.644
	$R_{12} - .7526$	$D_7 .0814$	1.644	

It will be noticed that in this example R_{11} is greater than R_{12} , R_3 is greater than R_1 and R_4 is greater than R_2 , whilst the numerical sum of R_1 and R_2 is .6109 times the equivalent focal length.

The difference between the mean refractive indices of the two elements of the third component is .023, the front element having the higher index, and the cemented surface between them is flat.

This provides the surface with a small amount of convergence, and the surface contributes a small amount of under-corrected astigmatism. This example is well-corrected over a semi-angular field of 24 degrees.

Dated this 21st day of October, 1940.
PULLINGER & MALET-VEALE,
Agents for the Applicants.

COMPLETE SPECIFICATION

Improvements in or relating to Optical Objectives

We, TAYLOR, TAYLOR & HOBSON LIMITED, a Company registered under the Laws of Great Britain, and ARTHUR WARMISHAM, British Subject, 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 optical objectives for photographic or other purposes, corrected for spherical aberration, coma, astigmatism, field curvature and distortion, and comprising two compound meniscus divergent components disposed behind two simple convergent components and in front of a further simple conver-

gent component. It is to be understood that the front of the objective is to be taken as the side nearer the longer conjugate and the rear the side further therefrom.

The invention has for its object to provide an improved objective of this kind corrected for a wide angular field of, say, 24 degrees semi-angle.

To this end according to the invention the radius of curvature of the front surface of the rear convergent component is numerically greater than that of the rear surface thereof and the cemented surface of the front compound divergent component is slightly collective. Preferably the difference between the mean refractive indices of the two elements of the

front divergent component is greater than .015 and less than .035, the front element having the higher index.

The front and rear surfaces of the front convergent component are preferably more strongly curved respectively than those of the second convergent component. Preferably the sum of the numerical values of the radii of curvature of the concave air-exposed surfaces of the two divergent components is greater than 0.5 and less than 0.65 of the equivalent focal length of the objective.

A convenient practical example of ob-

jective according to the invention is illustrated in the accompanying drawing and numerical data for this example are given in the following table, in which R_1, R_2, \dots indicate the radii of curvature of the individual surfaces counting from the front, the positive sign indicating that the surface is convex to the front, and the negative sign that it is concave thereto, whilst D_1, D_2, \dots indicate the axial thicknesses of the various lens elements, and S_1, S_2, \dots the axial lengths of the air spaces between the components.

Equivalent focal length 1.000		Relative aperture F/1.4	
Radius	Thickness or Separation	Refractive Index n_D	Abbé V Number
$R_1 + .8016$	$D_1 .0671$	1.613	59.3
$R_2 + 1.653$	$S_1 0$		
$R_3 + .8549$	$D_2 .0610$	1.613	59.3
$R_4 + 1.765$	$S_2 .0020$		
$R_5 + .4430$	$D_3 .1474$	1.644	48.3
$R_6 \infty$	$D_4 .0305$	1.621	36.1
$R_7 + .2675$	$S_3 .2033$		
$R_8 - .3434$	$D_5 .0305$	1.651	33.5
$R_9 + .7644$	$D_6 .1474$	1.644	48.3
$R_{10} - .4793$	$S_4 .0020$		
$R_{11} + 2.210$	$D_7 .0814$	1.644	48.3
$R_{12} - .7526$			

It will be noticed that in this example R_{11} is greater than R_{12} , R_3 is greater than R_1 and R_4 is greater than R_2 , whilst the numerical sum of R_7 and R_8 is .6109 times the equivalent focal length.

The difference between the mean refractive indices of the two elements of the third component is .023, the front element having the higher index, and the cemented surface between them is flat. This provides the surface with a small amount of convergence, and the surface contributes a small amount of under-corrected astigmatism. This example is well-corrected over a semi-angular field of 24 degrees.

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 optical objective of the kind described, in which the radius of curvature of the front surface of the rear convergent component is greater than that of the rear surface thereof, and the cemented surface in the front compound divergent component is slightly collective.

2. An optical objective as claimed in Claim 1, in which the difference between the mean refractive indices of the two elements of the front divergent component is greater than .015 and less than .035, the front element having the higher index.

3. An optical objective as claimed in Claim 1 or Claim 2, in which the front and rear surfaces of the front convergent component are more strongly curved re-

spectively than those of the second convergent component.

4. An optical objective as claimed in Claim 1 or Claim 2 or Claim 3, in which
- 5 the sum of the numerical values of the radii of curvature of the concave air-exposed surfaces of the two divergent components is greater than 0.5 and less than

0.65 of the equivalent focal length of the objective.

5. An optical objective having numerical data substantially in accordance with the table herein set forth.

Dated this 21st day of October, 1941.

PULLINGER & MALET,
Agents for the Applicants.

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

