PATENT SPECIFICATION

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,
5 Stoughton Street, Leicester, do hereby declare the nature of this invention to be as follows:—

This invention relates to an optical objective for photographic or other pur-
10 poses of the kind corrected for spherical and chromatic aberrations, coma, astigmatism, field curvature and distortion, and comprising two compound divergent meniscus components located between two
15 simple convergent components and each having a divergent element cemented to a convergent element.

The invention has for its object to provide an improved objective of this kind
20 well corrected over a wide angle of view for all the aberrations.

In the objective according to the present invention the average value of the Abbé V numbers of the glasses used for the four
25 convergent elements lies between 46 and 50 and the average value of the Abbé V numbers of the glasses used for the two divergent elements lies between 33 and 37.

Preferably, each convergent element is
30 made of dense barium flint glass having mean refractive index between 1.64 and 1.66, whilst each divergent element is made of flint glass having mean refractive index between 1.62 and 1.66.

Numerical data for a preferred example 35 of objective according to the invention are given in the following table. in which R_1 R_2 . . . represent the radii of curvature of the individual lens surfaces counting from the front (that is the side of the longer 40 conjugate), the positive sign indicating that the surface is convex to the front and the negative that it is concave thereto, D_1 D_2 . . . represent the axial thicknesses of the various elements, and S_1 S_2 S_3 repre- 45 sent the axial air separations between the components. The table also gives the mean refractive indices and the Abbé V numbers of the materials used for the individual elements of the objective. 50

In this example it will be noticed that all four convergent elements are made of the same dense barium flint glass having Abbé V number 48.3 and mean refractive index 1.644, whilst the two divergent 55 elements are made of different flint glasses having average Abbé V number 34.8, the mean refractive indices of both lying between 1.62 and 1.66. This example is well corrected for all the aberrations over 60 a semi-angular field of 24 degrees.

	Equivalent focal length 1.000		Relative aperture F/2.0	
Radius		Thickness or Air Separation	Refractive Index n_D	Abbé V Number
65 R_1 + .5810				
	D_1	.0689	1.644	48.3
R_2 +1.841				
	S_1	.0030		
R_3 + .3802				
70	D_2	.1023	1.644	48.3
R_4 −1.607				
	D_3	.0304	1.621	36.1
R_5 + .2597				
	S_2	.1570		
75 R_6 − .2947				
	D_4	.0304	1.651	33.5
R_7 +2.666				
	D_5	.0901	1.644	48.3
R_8 − .3684				
80	S_3	.0030		
R_9 +6.330				
	D_6	.0608	1.644	48.3
R_{10} − .8568				

It will be appreciated that the foregoing example has been given by way of example only and that the invention can be carried into practice in other ways.

Dated this 14th day of July, 1941.

PULLINGER & MALET,
Agents for the Applicants.

COMPLETE SPECIFICATION

Improvements in or relating to Optical Objectives

5 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 10 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:—

15 This invention relates to an optical objective for photographic or other purposes of the kind corrected for spherical and chromatic aberrations, coma, astigmatism, field curvature and distortion, and 20 comprising two compound divergent meniscus components located between two simple convergent components and each having a divergent element cemented to a convergent element.

25 The invention has for its object to provide an improved objective of this kind well corrected over a wide angle of view for all the aberrations.

In the objective according to the present 30 invention the average value of the Abbé V numbers of the glasses used for the four convergent elements lies between 46 and 50 and the average value of the Abbé V numbers of the glasses used for the two 35 divergent elements lies between 33 and 37, the convergent elements of the two compound meniscus components each being made of dense barium flint glass having mean refractive index between 1.64 and 40 1.66.

Preferably, each of the two simple convergent components is also made of dense barium flint glass having mean refractive index between 1.64 and 1.66, whilst each divergent element is made of a flint glass 45 having mean refractive index between 1.62 and 1.66.

A preferred example of objective according to the invention is illustrated in the accompanying drawing and numerical 50 data for such example are given in the following table, in which R_1 R_2 . . . represent the radii of curvature of the individual lens surfaces counting from the front (that is the side of the longer con- 55 jugate), the positive sign indicating that the surface is convex to the front and the negative that it is concave thereto, D_1 D_2 . . . represent the axial thicknesses of the various elements, and S_1 S_2 S_3 repre- 60 sent the axial air separations between the components. The table also gives the mean refractive indices and the Abbé V numbers of the materials used for the individual elements of the objective. 65

In this example it will be noticed that all four convergent elements are made of the same dense barium flint glass having Abbé V number 48.3 and mean refractive index 1.644, whilst the two divergent 70 elements are made of different flint glasses having average Abbé V number 34.8, the mean refractive indices of both lying between 1.62 and 1.66. This example is well corrected for all the aberrations over 75 a semi-angular field of 24 degrees.

	Equivalent focal length 1.000		Relative aperture F/2.0	
Radius		Thickness or Air Separation	Refractive Index n_D	Abbé V Number
R₁ + .5810				
		D₁ .0689	1.644	48.3
R₂ + 1.841				
		S₁ .0030		
R₃ + .3802				
		D₂ .1023	1.644	48.3
R₄ − 1.607				
		D₃ .0304	1.621	36.1
R₅ + .2597				
		S₂ .1570		
R₆ − .2947				
		D₄ .0304	1.651	33.5
R₇ + 2.666				
		D₅ .0901	1.644	48.3
R₈ − .3684				
		S₃ .0030		
R₉ + 6.330				
		D₆ .0608	1.644	48.3
R₁₀ − .8568				

It will be appreciated that the foregoing example has been given by way of example only and that the invention can be carried into practice in other ways.

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 corrected for spherical and chromatic aberrations, coma, astigmatism, field curvature and distortion, and comprising two compound divergent meniscus components located between two simple convergent components and each having a divergent element cemented to a convergent element, wherein the average value of the Abbé V numbers of the glasses used for the four convergent elements lies between 46 and 50 and the average value of the Abbé V numbers of the glasses used for the two divergent elements lies between 33 and 37, the convergent elements of the two compound meniscus components each being made of dense barium flint glass having mean refractive index between 1.64 and 1.66.
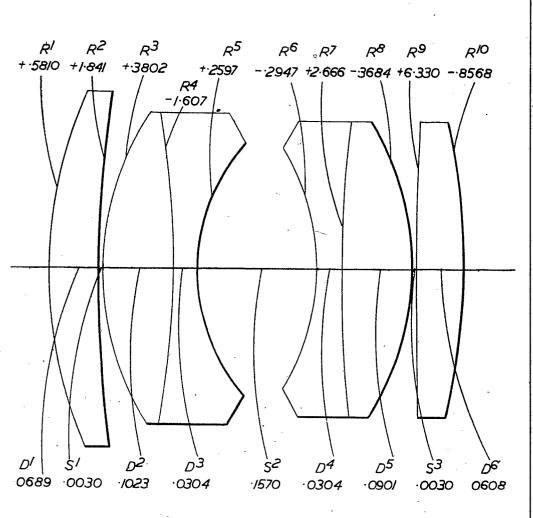
2. An optical objective as claimed in Claim 1, in which each of the two simple convergent components is made of dense barium flint glass having mean refractive index between 1.64 and 1.66, whilst each divergent element is made of flint glass having mean refractive index between 1.62 and 1.66.

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

Dated this 24th day of June, 1942.
PULLINGER & MALET,
Agents for the Applicants.

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

R¹ +·5810 R² +1·841 R³ +·3802 R⁴ −1·607 R⁵ +·2597 R⁶ −·2947 R⁷ +2·666 R⁸ −·3684 R⁹ +6·330 R¹⁰ −·8568

D¹ ·0689 S¹ ·0030 D² ·1023 D³ ·0304 S² ·1570 D⁴ ·0304 D⁵ ·0901 S³ ·0030 D⁶ ·0608

Malby & Sons, Photo-Litho.