PATENT SPECIFICATION

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One Complete Specification Left: Nov. 24, 1938.

Complete Specification Accepted: June 12, 1939.

PROVISIONAL SPECIFICATION

Improvements in or relating to Objectives for Photographic or like Purposes

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

This invention relates to wide aperture objectives for photographic or like purposes, of the kind comprising two compound dispersive meniscus components having their concave surfaces facing towards one another and disposed between two collective components. Objectives of this kind well-corrected for spherical and chromatic aberrations, coma, astigmatism and distortion are described in British Patent Specification No. 377,537, but for certain special purposes more especially in kinematography it is found desirable to provide an even higher degree of correction for distortion than is obtainable with such objectives. Thus with an F/2 objective of 2 inch focal length made in accordance with the data given in such prior specification and operating on the field of the 35 millimetre kinematograph film, a compression of the radial line from the centre to the extreme corner amounting only to .004 inch can be obtained.

The present invention has for its object to provide an objective of the kind described having a very high degree of correction for distortion, whereby the compression of the semi-diagonal in the example just mentioned will much more nearly approach the grain size of the negative emulsion, which may be say .0005 inch.

In the objective according to the present invention the radius of the rear surface of the front component (counting from the side of the longer conjugate) is greater than six times the focal length of the objective, and the radii of the concave and convex outer surfaces of the rear dispersive component are respectively less than .31 and .42 of such focal length, all the surfaces of the objective being spherical surfaces. In some instances, more especially in the case of the shorter focal lengths, it may be desirable also to increase the refractive index of the glass used for the rear collective component to a value greater than 1.63.

Numerical data for two convenient examples of objective according to the invention are set out in the tables below, in which the radii of curvature of the various surfaces are indicated by R_1 R_2 R_3 . . . , the thicknesses of the individual elements along the optical axis by D_1 D_2 D_3 . . . , and the air gaps along the axis by S_1 S_2 S_3, in each case counting from the side of the longer conjugate. Each example has an equivalent focal length 1.000 and a relative aperture F/2.

EXAMPLE 1.

Radius	Thickness or Separation.	Refractive Index n_D.	Abbé V Number.
R_1 + .9013	D_1 .0812	1.6130	59.3
R_2 +25.04	S_1 .0065		
R_3 + .4064	D_2 .1512	1.6130	59.3
R_4 + .6960	D_3 .0438	1.6137	37.2
R_5 + .2657	S_2 .1921		
R_6 − .3047	D_4 .0438	1.6468	33.8
R_7 + .4500	D_5 .1597	1.6437	48.3
R_8 − .4091	S_3 .0020		
R_9 + 1.746	D_6 .1015	1.6437	48.3
R_{10} − 1.001			

EXAMPLE 2.

Radius		Thickness or Separation.		Refractive Index n_D.	Abbé V. Number.
R_1 +	.8075	D_1	.08134	1.613	59.4
R_2 +	6.016	S_1	.03494		
R_3 +	.39561	D_2	.14737	1.613	59.4
R_4 +	.6016	D_3	.04178	1.6132	36.9
R_5 +	.25276	S_2	.21186		
R_6 −	.29974	D_4	.04206	1.6457	33.9
R_7 +	.52132	D_5	.14958	1.6458	48.1
R_8 −	.39667	S_3	.00491		
R_9 +	1.4516	D_6	.10213	1.613	59.4
R_{10} −	.95968				

For the longer ranges of focal length, Example 2, for which the second radius is 6.016, affords adequate distortion correction in most instances. Thus this example with a 3 inch focal length serves to reduce the compression of the semi-diagonal for a 35 millimetre kinematograph frame to .001 inch. Since, however, the linear distortion aberration increases as the cube of the angular field and as the first power only of the focal length, this example will not give sufficient improvement in the distortion correction for the shorter ranges of focal length for the special purposes for which the objective of the present invention is intended and in such cases it is preferable to resort to Example 1 which has a greatly increased second radius of 25.04 and further also an increased refractive index of 1.6437 for the glass of the rear component. With this example a greatly improved distortion correction is obtained and for a focal length of only 2 inches, the distortion compression of the semi-diagonal in the case mentioned is reduced to .001 inch.

Dated this 11th day of December, 1937.

A. F. PULLINGER,
Agent for the Applicants.

COMPLETE SPECIFICATION

Improvements in or relating to Objectives for Photographic or like Purposes

We, ARTHUR WARMISHAM, British Subject, CHARLES GORRIE WYNNE, British Subject, and TAYLOR, TAYLOR & HOBSON LIMITED, a Company registered under the Laws of Great Britain, all of Stoughton Street Works, 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 wide aperture objectives for photographic or like purposes, of the kind comprising two compound dispersive meniscus components having their concave surfaces facing towards one another and disposed between two collective components each consisting of a simple element. Objectives of this kind well-corrected for spherical and chromatic aberrations, coma, astigmatism and distortion are described in British Patent Specification No. 377,537, but for certain special purposes more especially in kinematography it is found desirable to provide an even higher degree of correction for distortion than is obtainable with such objectives. Thus with an F/2 objective of 2 inch focal length made in accordance with the data given in such prior specification and operating on the field of the 35 millimetre kinematograph film a compression of the radial line from the centre of the extreme corner amounting only to .004 inch can be obtained.

The present invention has for its object to provide an objective of the kind described having a very high degree of correction for distortion, whereby the compression of the semi-diagonal in the example just mentioned will much more nearly approach the grain size of the negative emulsion, which may be say .0005 inch.

In the objective according to the present invention the radius of the rear surface of the front simple collective component (counting from the side of the longer conjugate) is greater than six times the focal length of the objective, and the radii of the concave and convex outer surfaces of the rear dispersive component are

numerically less respectively than .31 and .42 of such focal length, all the surfaces of the objective being spherical surfaces. In some instances, more especially in the case of the shorter focal lengths, it may be desirable also to increase the refractive index of the glass used for the rear collective component to a value greater than 1.63.

Numerical data for two convenient examples of objective according to the invention are set out in the tables below, and the accompanying drawing illustrates the first of these examples, the second example differing from the first solely in respect of the numerical data. In the drawing and also in the tables the radii of curvature of the various surfaces are indicated by R_1 R_2 R_3 . . . . . (the positive sign indicating that the surface is convex towards the side of the longer conjugate and the negative sign that it is concave thereto), the thicknesses of the individual elements along the optical axis by D_1 D_2 D_3 . . . . . , and the air gaps along the axis by S_1 S_2 S_3, in each case counting from the side of the longer conjugate. Each example has an equivalent focal length 1.000 and a relative aperture F/2.

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For the longer ranges of focal length, Example 2, for which the second radius is 6.016 acords adequate distortion correction in most instances. Thus this example with a 3 inch focal length serves to reduce the compression of the semi-diagonal for a 35 millimetre kinematograph frame to .001 inch. Since, however, the linear distortion aberration increases as the cube of the angular field and as the first power only of the focal length, this example will not give sufficient improvement in the distortion correction for the shorter ranges of focal length for the special purposes for which the objective of the present invention is intended, and in such cases it is preferable to resort to Example 1 which has a greatly increased second radius of 25.04 and further also an increased refractive index of 1.6437 for the glass of the rear component. With this example a greatly improved distortion correction is obtained and for a focal length of only 2 inches, the distortion compression of the semi-diagonal in the case mentioned is reduced to .001 inch.

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 like objective of the kind described, in which the radius of the rear surface of the front simple collective component (counting from the side of the longer conjugate) is greater than six times the focal length of the objective, and the radii of the concave and convex outer surfaces of the rear dispersive component are numerically less respectively than .31 and .42 of such focal length, all the surfaces of the objective being spherical surfaces.

2. An objective as claimed in Claim 1, in which the refractive index of the glass used for the rear collective component is greater than 1.63.

3. An objective as claimed in Claim 1, having numerical data substantially in accordance with one or other of the tables herein set forth.

Dated this 24th day of November, 1938.

A. F. PULLINGER,
Agent for the Applicants.

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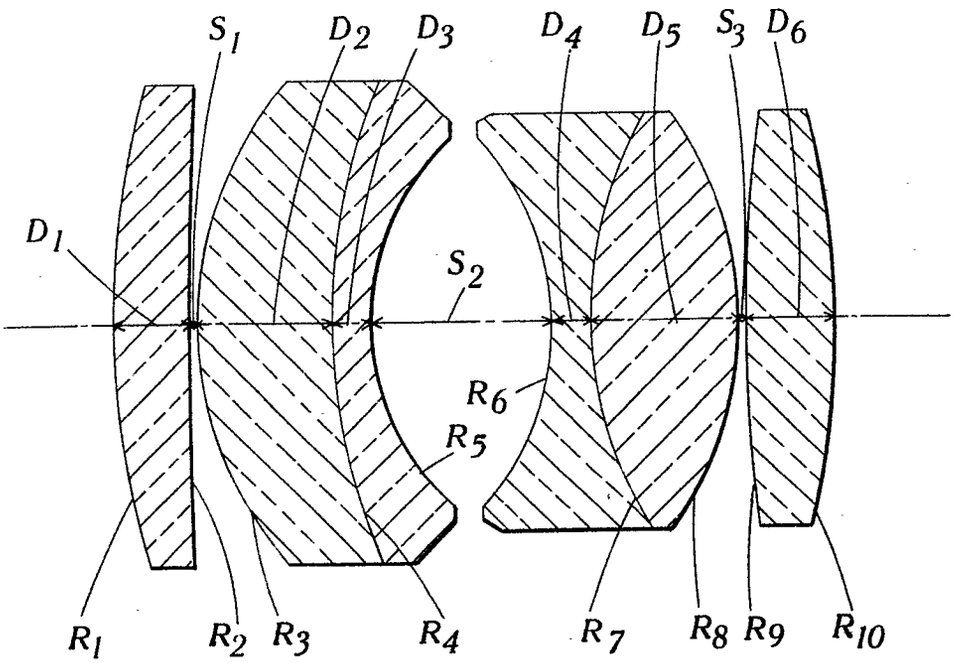

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