N° 13,441

A.D. 1902

PROVISIONAL SPECIFICATION.

"Improvements in Lenses."

I, CARL AUGUST HANS HARTING of 20 Fasanenstrasse, Brunswick in the Empire of Germany, Doctor of Philosophy, do hereby declare the nature of this invention to be as follows:—

This invention has for its object a lens System embodying improvements
5 in Patent No. 22962/00 which has for its object a lens-system corrected chromatically, spherically and astigmatically, which, in addition to the usual conditions forming the characteristic features of the patent, is also corrected symmetrically. The calculations shown as an example in the specification of the said patent relate to a lens system which is symmetrical in every particular,
10 that is to say, as regards the arrangement, the scale, the magnitudes of the indices of refraction and dispersion, and the relative proportions of these indices to one another.

Now the present invention comprises a lens system which, whilst retaining the symmetry of the arrangement and the relative proportionate sizes of the
15 indices of refraction and dispersion, does not extend this symmetry to the scale or to the indices.

Although by this arrangement the image may not be rendered perfectly true, and the achromatism of the focal lengths may also be affected, yet it is possible to obtain a much more effective correction of astigmatism and of
20 the curvature of the field, and thus ensure a diminution of the so-called intermediate faults and spherical aberration outside the axis (coma) owing to the greater freedom in the choice of the proportions of scale.

By a suitable selection, such values for the scale figures may be found as afford the above mentioned advantages whilst they also remove the drawbacks
25 resulting from the indication of absolute symmetry.

This improved lens system does not therefore lose any of the advantages of an absolutely symmetrical system, but at the same time secures very considerable further advantages over the same.

As an example, a lens embodying the principle of the invention will now
30 be explained.

In this improved lens system the outer components may each consist of two lenses which will be called a^1 a^2 and b^1 b^2, of which the two lenses a^1 and a^2 are formed of flint glass and the two lenses b^1 b^2 of crown glass of higher refraction and less light dispersion. The central lens must then be made of flint glass
35 in accordance with my prior Patent No. 22962/00, the index of refraction of which lens is smaller or nearly as large as and its colour dispersion greater than that of the crown glass of the lenses b^1 b^2.

If the eight different radii of curvature of the lenses are assumed to be indicated by the letters r^1 r^2 r^3 r^4 r^5 r^6 r^7 r^8 and the thicknesses of

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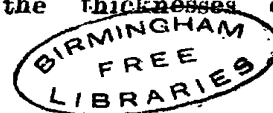
Harting's Improvements in Lenses.

the lenses measured on the optical axis by d^1 d^2 d^3 d^4 d^5 d^6 d^7, the following
equivalents result:—

$$r^1 = + \quad 40,38 \text{ mm}; \quad d^1 = + \quad 1,61 \text{ mm}$$
$$r^2 = + \quad 18,49 \text{ mm}; \quad d^2 = + \quad 4,82 \text{ mm}$$
$$r^3 = + \quad 123,4 \text{ mm}; \quad d^3 = + \quad 11,22 \text{ mm}$$
$$r^4 = - \quad 38,46 \text{ mm}; \quad d^4 = + \quad 0,64 \text{ mm}$$
$$r^5 = + \quad 31,01 \text{ mm}; \quad d^5 = + \quad 5,77 \text{ mm}$$
$$r^6 = + \quad 67,63 \text{ mm}; \quad d^6 = + \quad 4,82 \text{ mm}$$
$$r^7 = - \quad 19,23 \text{ mm}; \quad d^7 = + \quad 0,64 \text{ mm}$$
$$r^8 = - \quad 39,54 \text{ mm}$$

The equivalents of the kinds of glass are here assumed to be the following:

$$\text{For } a^1 : n_D = 1,54990, \quad n_G^1 = 1,56547$$
$$\text{„ } b^1 : n_D = 1,61294, \quad n_G^1 = 1,62686$$
$$\text{„ } c : n_D = 1,53644, \quad n_G^1 = 1,54988$$
$$\text{„ } b^2 : n_D = 1,61294, \quad n_G^1 = 1,62640$$
$$\text{„ } a^2 : n_D = 1,57073, \quad n_G^1 = 1,58866$$

The size of the opening which may be indicated for this lens system sup-
posing it to have a focal length of 100 millimetres, will in accordance with
the above elements amount to 23 millimetres, the diameter of the utilisable
field 92 millimetres corresponding to a pictorial angle from the side of the
object of roughly 50°.

The diaphragm or stop is in this case placed between the central and the
rear lens.

Dated this 12th day of June 1902.

<div style="text-align:right">

W. P. THOMPSON & Co.
Of 6 Lord Street, Liverpool,
Agents for the Applicant.

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COMPLETE SPECIFICATION.

"Improvements in Lenses."

I, CARL AUGUST HANS HARTING, of 20 Fasanenstrasse, Brunswick in the
Empire of Germany, Doctor of Philosophy, do hereby declare the nature of
this invention and in what manner the same is to be performed, to be par-
ticularly described and ascertained in and by the following statement:—

This invention has for its object a lens system embodying improvements
in Patent No. 22962/00 which has for its object a lens system corrected
chromatically, spherically and astigmatically, which, in addition to the usual
conditions forming the characteristic features of the patent, is also corrected
symmetrically. The calculations shown as an example in the specification of
the said patent relate to a lens system which is symmetrical in every particular,
that is to say, as regards the arrangement, the scale, the magnitudes of the
indices of refraction and dispersion, and the relative proportions of these indices
to one another.

Now the present invention comprises a lens system which, whilst retaining
the symmetry of the arrangement and the relative proportionate sizes of the
indices of refraction and dispersion, does not extend this symmetry to the scale
or to the indices.

Although by this arrangement the image may not be rendered perfectly true, and the achromatism of the focal lengths may also be affected, yet it is possible to obtain a much more effective correction of astigmatism and of the curvature of the field, and thus ensure a diminution of the so-called inter-
5 mediate faults and spherical aberration outside the axis (coma) owing to the greater freedom in the choice of the proportions of scale.

By a suitable seloction, such values for the scale figures may be found as afford the above mentioned advantages whilst they also remove the drawbacks resulting from the indication of absolute symmetry.
10 This improved lens system does not therefore lose any of the advantages of an absolutely symmetrical system, but at the same time secures very considerable further advantages over the same.

As an example, a lens embodying the principle of the invention will now be explained. The lens system is shown in the accompanying drawings.
15 In this improved lens system the outer components may each consist of two lenses a^1 a^2 and b^1 b^2, of which the two lenses a^1 and a^2 are formed of flint glass and the two lenses b^1 b^2 of crown glass of higher refraction and less light dispersion. The central lens must then be made of flint glass in accordance with my prior Patent No. 22962/00, the index of refraction of
20 which lens is smaller or nearly as large as and its colour dispersion greater than that of the crown glass of the lenses b^1 b^2.

If the eight different radii of curvature of the lenses are assumed to be indicated in the drawing by the letters r^1 r^2 r^3 r^4 r^5 r^6 r^7 r^8 and the thicknesses of the lenses measured on the optical axis by d^1 d^2 d^3 d^4 d^5 d^6 d^7, the following
25 equivalents result:—

$$r^1 = +\ 40,38 \text{ mm}: \quad d^1 = +\ 1,61 \text{ mm}$$
$$r^2 = +\ 18,49 \text{ mm}: \quad d^2 = +\ 4,82 \text{ mm}$$
$$r^3 = +\ 123,4 \text{ mm}: \quad d^3 = +\ 11,22 \text{ mm}$$
$$r^4 = -\ 38,46 \text{ mm}: \quad d^4 = +\ 0,64 \text{ mm}$$
30
$$r^5 = +\ 31,01 \text{ mm}: \quad d^5 = +\ 5,77 \text{ mm}$$
$$r^6 = +\ 67,63 \text{ mm}: \quad d^6 = +\ 4,82 \text{ mm}$$
$$r^7 = -\ 19,23 \text{ mm}: \quad d^7 = +\ 0,64 \text{ mm}$$
$$r^8 = -\ 39,54 \text{ mm}$$

The equivalents of the kinds of glass are here assumed to be the following:

35
$$\text{For } a^1: n_D = 1,54990,\ n_G^1 = 1,56547$$
$$b^1: n_D = 1,61294,\ n_G^1 = 1,62686$$
$$c\ : n_D = 1,53644,\ n_G^1 = 1,54988$$
$$b^2: n_D = 1,61294,\ n_G^1 = 1,62640$$
$$a^2: n_D = 1,57073,\ n_G^1 = 1,58866$$

40 The size of the opening which may be indicated for this lens system supposing it to have a focal length of 100 millimetres, will in accordance with the above elements amount to 23 millimetres, the diameter of the utilisable field 92 millimetres corresponding to a pictorial angle from the side of the object of roughly 50°.
45 The diaphragm or stop is in this case placed between the central and the rear lens.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

50 A lens systm corrected chromatically, spherically and astigmatically in accordance with the lens system described in Patent No. 22962⁰⁰ and consisting in the central lens being symmetrical in itself and to the outer lenses,
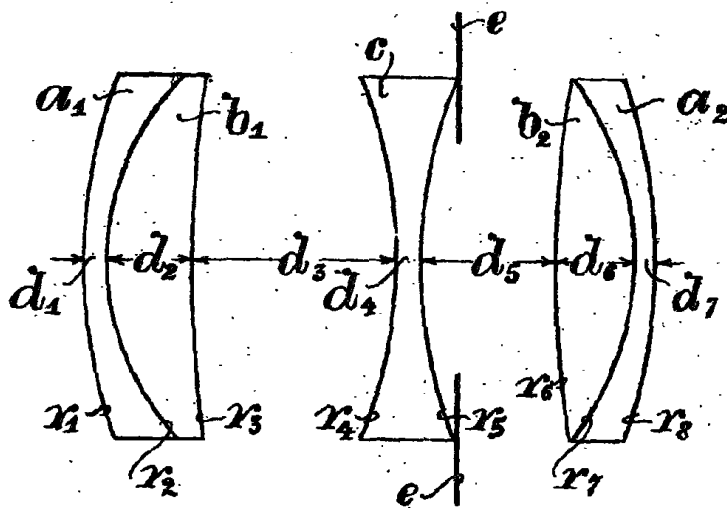
and the outer lenses being symmetrical to one another relative to the arrange-
ment and proportionate magnitudes of the indices of refraction and dispersion,
whilst as regards the scale and the absolute sizes of the indices of refraction
and dispersion they are unsymmetrical, substantially as hereinbefore described
and shown.   5

   Dated this 7th day of March, 1903.

                                        W. P. THOMPSON & Co.
                                            Of 6 Lord Street, Liverpool,
                                                Agents for the Applicant.