

# PATENT SPECIFICATION



Application Date: Dec. 20, 1923. No. 31,931/23.

225,398

Complete Left: Sept. 15, 1924.

Complete Accepted: Dec. 4, 1924.

## PROVISIONAL SPECIFICATION.

### Improvements in Photographic Lenses.

We, ROBIN HILL, of 21, Barton Road, Cambridge, Gentleman, of British nationality, and R. & J. BECK, LIMITED, of 68, Cornhill, in the City of London, E.C., Manufacturing Opticians, a British company, do hereby declare the nature of this invention to be as follows:—

Our invention consists of a new form of optical system for taking photographs on a flat plate of views which subtend very large angles, as for instance of a sky subtending 180 degrees.

In order to accomplish this our apparatus reduces the angle of the rays which are the axes of the pencils of light from each point in the object, so that they emerge from our optical system at a smaller angle to that at which they enter. Thus the light from the sky which enters our apparatus at 180 degrees may emerge from the optical system in a cone of light which does not exceed ninety or one hundred degrees.

In this way a distorted image is produced and it is convenient to make the distortion of such a nature as to render the image on the flat plate in approximately either stereographic or equidistant projection.

One form of our invention consists of a divergent meniscus lens system with a convex surface nearest the view combined with a more powerful positive single or compound lens system. The two systems may be separated by an air-space in which stops, filters or shutters can be inserted.

Dated the 20th day of December, 1923.

ROBIN HILL.

R. & J. BECK, LIMITED.

Sealed in the presence of

CONRAD BECK,

Chairman.

SYDNEY BURHUNT,

Secretary.

## COMPLETE SPECIFICATION.

### Improvements in Photographic Lenses.

We, ROBIN HILL, of 21, Barton Road, Cambridge, Gentleman, of British nationality, and R. & J. BECK, LIMITED, of 68, Cornhill, London, E.C. 3, Opticians, a British company, 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:—

Our invention consists of a new form of optical system for taking photographs on a flat plate of views which subtend very large angles, as for instance of a sky subtending 180 degrees.

In order to accomplish this our apparatus reduces the angle of the rays which are the axes of the pencils of light from each point in the object, so that they emerge from our optical system at a smaller angle to that at which they enter. Thus the light from the sky

which enters our apparatus at 180 degrees may emerge from the optical system in a cone of light which does not exceed ninety or one hundred degrees.

In this way a distorted image is produced and it is convenient to make the distortion of such a nature as to render the image on the flat plate in approximately either stereographic or equidistant projection.

One form of our invention consists of a divergent meniscus lens system with a convex surface nearest the view combined with a more powerful positive single or compound lens system. The two systems may be separated by an air-space in which stops, filters or shutters can be inserted.

In the accompanying drawing the figure shows a sectional view of our apparatus. The lens system consists in the form shown of three lenses *a*, *c* and *d*,

with a diaphragm *b*, with a small aperture and a photographic plate *e*.

The lens *a*, has a front surface facing the view which is convex to the view and a back surface which is deeply concave. The pencils of light from each point of the object are so refracted by the lens *a*, that the axes of such pencils which are incident upon the lens at a very great angle emerge from the lens *a*, at a much

	Radii of curvature.	Distances between surfaces.	Refractive Index of Glass (D).	Dispersion of Glass.
25	$r_1 = +8.25$	$d_1 = .15$	$\mu = 1.5407$	$v = 59.4$
	$r_2 = +1.90$	$d_2 = 1.95$	Air	
	$r_3 = -6.35$	$d_3 = .08$	$\mu = 1.6214$	$v = 36.1$
30	$r_4 = +6.35$	$d_4 = .05$	Air	
	$r_5 = \infty$	$d_5 = .25$	$\mu = 1.5215$	$v = 59.4$
	$r_6 = -1.00$			

The majority of the total reduction in the angle of view produced by the entire optical system takes place at the lens *a*, before the light reaches the aperture or stop *b*, which limits the size of the individual pencils of rays while the function of the lenses *c*, and *d*, in connection with the surfaces of the lens *a*, is to so focus the light of each small pencil that it comes to a sharp focus upon the flat surface of the plate *e*.

The invention may be carried out with an achromatic combination in place of the lens *a*, and with various types of photographic lenses to take the place of lenses *c* and *d*.

It is obvious that in order to photograph an angular view of the order of 180 degrees in extent upon a flat plate, some form of distortion is necessary and the nature of this distortion can be varied by suitable variation in the curves of the lens *a*, and the position of the limiting aperture *b*. In our invention such distortion is preferably stereographic or equidistant projection or an approximation to such forms. When this apparatus is used to photograph clouds in the sky, we prefer to use colour filters placed close to the limiting diaphragm *b*, and a shutter for making or regulating the exposure may be placed near this position.

Two of these cameras may be used at a considerable distance apart for making stereoscopic photographs of the clouds, aeroplanes or other objects.

Having now particularly described and ascertained the nature of our said inven-

tion and in what manner the same is to be performed, we declare that what we claim is:—

reduced angle. For instance, a view which subtends an angle of 180 degrees, that is to say the axes of the marginal pencils of light are incident upon the lens *a*, at 180 degrees may emerge from the lens *a*, at an angle of 100 degrees and pass through a small aperture *b*, through the lenses *c* and *d*, to a photographic plate situated at *e*.

The optical data are:—

1. An optical combination in which there is a divergent element nearest the view which reduces the angle and a more highly convergent element nearer the photographic plate which produces an image for the purpose of taking a photograph on a flat plate of a view which subtends an angle which exceeds 125 degrees.

2. An optical combination as claimed in Claim 1, in which the surface nearest the view is convex.

3. An optical combination as claimed in Claim 1, in which the majority of the total reduction in the angle of view produced by the entire optical system takes place before the light reaches the aperture or stop which limits the size of the individual pencils of rays.

4. An optical combination for photographing a view which subtends a large angle so made that it possesses distortion which will give on a flat plate approximately either stereographic or equidistant projection.

5. An optical combination substantially as described.

Dated the 15th day of September, 1924.

ROBIN HILL.

R. & J. BECK, LIMITED.

The seal of the Co. was affixed to this document in the presence of

CONRAD BECK,  
Chairman and Director.

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

