PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in Photographic Objectives.

I, CHRISTOPHER GRAF, a citizen of the United States of America, residing at 1118, Lincoln Way West, in the City of South Bend, in the County of St. Joseph, and State of Indiana, United States of America, 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 has reference to improvements in photographic objectives, and it consists in a photographic lens of the anastigmat type comprising a fixed back combination and an adjustable front combination, each consisting of two lenses separated by an air space, the arrangement being such that when the lenses of the front combination are in their relative positions closest to each other an image of a desired maximum degree of diffusion is produced, and that when they are moved away from each other, an increasingly sharper image is produced.

It has been the general aim of lens designers since the inception of the art of photography to make an objective capable of producing a critically sharp image of an object. Since the invention of the optical glass lens, designers have succeeded in obtaining lens combinations which satisfy all requirements in regard to definition and speed, but it has been found that pictures which have the required degree of sharpness often produce a weird effect For various special purposes lens combinations have therefore been designed which create the impression of depth in contradistinction to the critically sharp, but flat images.

The object of the present invention is to provide an objective which is capable of producing an extremely sharp image and which may be readily adjusted to produce pictures of varying degrees of softness, in other words, to provide a soft-focus objective and a high speed anastigmat in one and the same lens combination. This object is attained by adjusting one element of the lens relatively to other elements, but I wish it to be understood that I make no claim to an adjustable lens *per se*, compound lenses in which one of the glasses can be moved towards or away from the other or others for the purpose of adjusting the focus of the lens being known. My lens is moved bodily to adjust the focus, and the changing of the position of the adjustable element is for the purpose of changing the lens from anastigmat to soft lens.

It has previously been proposed to modify the definition of the image by varying the distance between the components of the lens.

While there is a certain latitude in the construction and arrangement of lenses for carrying out the object aimed at, the two constructions illustrated in the accompanying drawing may be considered as the preferred embodiments of the invention and may be taken as generally representative of the class of combinations involved.

In the said drawing:—

Fig. 1 shows one lens combination embodying the invention, and

Fig. 2 is a modification thereof.

Referring to the drawing, and especially to Fig. 1, 10 designates a lens barrel into one end of which is screwed a lens holder 11 containing a convex lens A of crown glass and a negative lens B of flint glass. While the lens B is fixed in position, the front lens A is adjustable towards and away from lens B. For this purpose the lens A is contained in a separate holder 12 which has an external screw thread fitting a corresponding internal screw thread in the holder 11.

Into the other end of the barrel 10 is screwed a lens holder 13 containing in fixed relation a negative flint lens C and a positive crown glass lens D. The two sets of lenses are separated by the usual diaphragm 14. This lens combination

[*Price* 1/-]

may have an aperture ratio 1:1.9 for objectives of short focal length and an aperture ratio of 1:4.5 to 1:3.5 in objectives of medium and long focal lengths. The axial thickness of the lenses A, B, C and D in the example shown in Fig. 1 is 15 m/m., 5 m/m., 5 m/m. and 15.5 m/m. respectively. All thicknesses may be changed proportionately to focal length.

The diffusion of this objective is variable and a maximum when the lenses A and B are in the positions indicated in full lines, *i.e.* when lens A is close to B. The degree of diffusion is gradually decreased when the lens A is moved outwardly or away from lens B, and critical sharpness or fine definition is obtained when the lens A is in its outermost position, indicated in dotted lines.

The indices of refraction, powers of dispersion, *etc.*, for satisfying the requirements of definition with the lens A in its outer position are a matter of computation.

The combination shown in Fig. 2 is generally the same as in Fig. 1. The lens A however is a negative flint and the lens B a positive crown lens. Other modifications within the scope of the invention will of course suggest themselves to the lens expert.

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:—

1. A photographic lens of the anastigmat type comprising a fixed back combination and an adjustable front combination, each consisting of two lenses separated by an air space, the arrangement being such that when the lenses of the front combination are in their relative position closest to each other an image of a desired maximum degree of diffusion is produced, and that when they are moved away from each other, an increasingly sharper image is produced.

2. A photographic lens combination in accordance with Claim 1, comprising two pairs of lenses mounted on opposite sides of a diaphragm, one pair of lenses and the inner lens of the second pair having a fixed position and the outer lens of the second pair being movable, and means for adjusting the position of said movable lens, the combination being so constructed that it produces an image of extreme sharpness when the movable lens is in its extreme outer position, an image of the desired maximum degree of diffusion or softness when the movable lens is in the other extreme position, and images of different degrees of diffusion when the movable lens is in intermediate positions.

3. A photographic lens in accordance with Claim 2, in which the two inner lenses are negative flints and the two outer lenses are positive crowns, and the thickness of the lenses, in consecutive order, from front to back, is approximately 15 m/m., 5 m/m., 5 m/m., and 15.5 m/m., respectively.

Dated this 19th day of June, 1922.

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

Fig. 1.

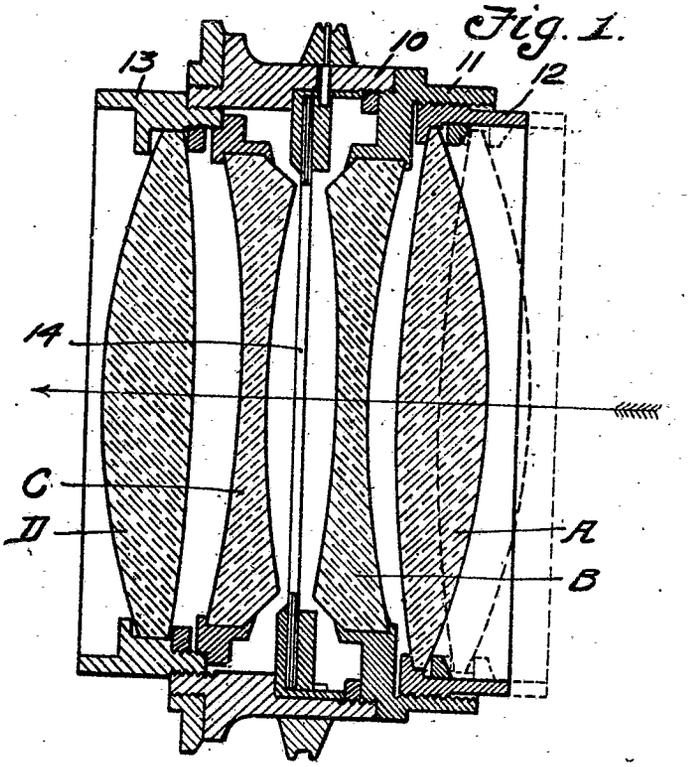
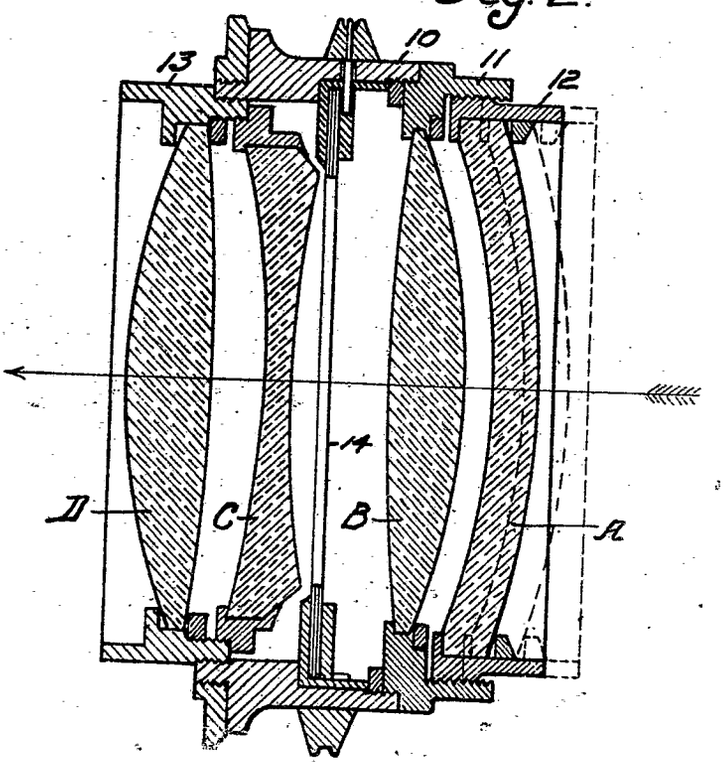


Fig. 2.



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