

1,404,440.

Patented Jan. 24, 1922.

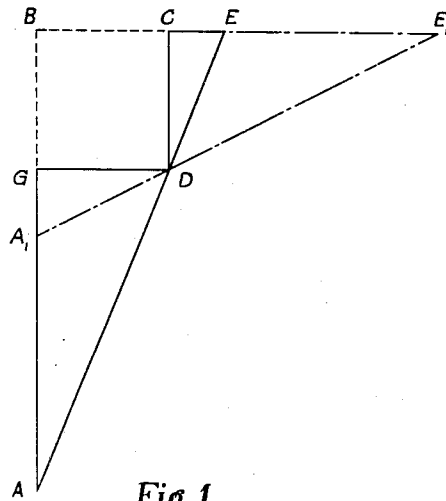


Fig. 1

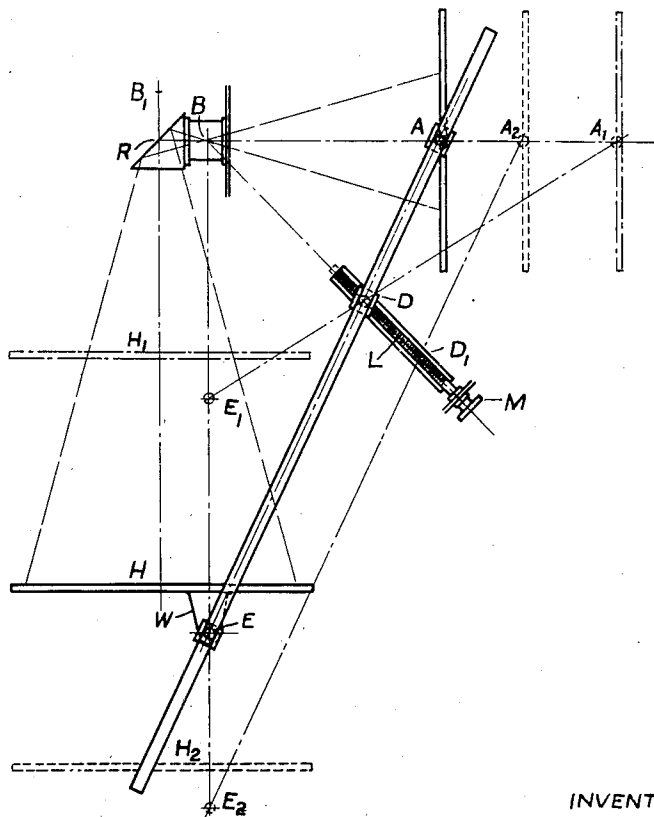


Fig. 2

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FOCUSING DEVICE.

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Specification of Letters Patent. Patented Jan. 24, 1922.

Application filed September 16, 1920. Serial No. 410,664.

To all whom it may concern:

Be it known that I, AUGUST F. JOBKE, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Focusing Device, of which the following is a specification.

My invention relates to a focusing device, the object of which is to automatically keep a photographic lens, a plane surface corresponding to an object to be projected and a plane surface corresponding to a screen or projecting surface in such positions relative to one another, that the image produced through the lens is sharp at any ratio of magnification as well as reduction.

Another object of this invention is, to make it adjustable to such an extent as to render it applicable not only to the use of a single lens of a certain focal length, but to the focal length of any other lens chosen, thus giving it a usefulness highly desirable in all kinds of reproduction, and facilitating its manufacture, since a single model may cover a long range of different focal lengths.

In the common way of reproduction it is very difficult to get a perfectly sharp image and practically impossible, if a weak light source is used, the reproduction is nearly to the same size, or if the negative happens to be dense. In such cases one can improve results by stopping the lens down, which has the disadvantage of requiring a longer exposure. This device is to overcome these disadvantages, allowing the use of a full lens opening, thus permitting much faster work.

Being of a very simple construction, based on a simple geometric configuration, this invention permits an exact adjustment of its several elements, and therefore perfectly accurate results can be obtained through its application.

I attain these objects by applying a mechanism, the principal part of which is a straight lever, and I use the angular position of this lever relative to the optical axis of the combination to establish both conjugate focal distances.

The nature of my invention will be more fully disclosed and made understood in the

following description, where reference is had to the drawing, in which:

Figure 1 is a configuration intended to explain geometrically the relations existing between the different parts of my invention:

Figure 2 is a diagrammatic view of the focusing device applied to the elements of an optical combination.

Since this invention permits a broad application and will find varied uses in the field of optical projection, I shall not describe it in connection with specific apparatus, but refer only to those elements which are necessary to project an image through a lens.

In explaining the working of this focusing device I refer to Figure 1, in which ABE is a rectangular triangle and GDC a right angle, the arms of which are parallel to the catheti of the triangle. The hypotenuse AE may be movable angularly about D as its fulcrum. It can be shown, that $AG:GD=DC:CE$, or $A_1G:GD=DC:CE_1$. If we select $GD=DC$ —the focal length of a lens, the two dimensions AG and CE or A_1G and CE_1 are reciprocals to each other as factors of the focal length; in other words, they are equivalents of extrafocal distances to the lens, and AB and BE, or A_1B and BE_1 respectively are conjugate focal distances, and the angular position of the hypotenuse determines the ratio of the corresponding projection. If the angle at A or E is 45° , then the projection is of the ratio=1, and assuming that A be the position of the projecting surface and E that of the object to be projected, an angle at A smaller than 45° corresponds to enlarging, while an angle larger than 45° corresponds to reduction. Generally speaking, the tangent of the angle at E is the factor of projection for E as the object.

Figure 2 shows an optical combination as used by photo-engravers to obtain a reversed negative with a sensitive plate in the normal position, or a right-faced negative may be obtained in placing the sensitive plate in a reversed position. This combination consists of a plane surface at A, representing an object to be projected, a lens B, equipped with a prism or reflector R, and

a plane surface H representing an easel or sensitive medium. The reflector R turns the optical axis AB through 90° . Since the central point of reflection is at R, instead of the optical center B, the conjugate focal distance is BH plus RB (or RB_1), and the bracket W is to provide the second member to have $BE =$ the conjugate focal distance.

10 A straight lever AE, adapted to be movable angularly about its fulcrum D, which is located one focal length from a line AB, parallel to the optical axis, and from a line BE, normal thereto, slides in pivoted bearings A and E, which are movable on the lines mentioned. Any angular motion of this lever will produce conjugate focal lengths AB and BE, or A_1B and BE_1 respectively.

20 In order to vary the arrangement for a different focal length, the fulcrum D is mounted upon a nut, sliding in a slot placed at 45° to the lines AB and BE and adjusted by means of the screw L, which for convenient handling has the thumbhead M. The equal focal distance of any point D_1 from AB and BE is therefore always maintained. If the projection from A to H is in the ratio of 1:2 and the lever in the position of the fulcrum at D_1 is kept parallel to AE, it can easily be seen, that the ratio of projection must be the same since the triangle, A_2BE_2 is similar to ABE. The plane H will be removed to the position H_2 , since BH_2 is equal to the corresponding major focal distance.

The application of a movable fulcrum as shown is of greatest commercial importance, since the exact focal length of a lens may not be given, or only assumed to be of a certain magnitude. It would be commercially impossible to manufacture a focusing device for every focal length used in practice, since every style of lens has a different focal length, eventually varying little from a similar competing one. In varying the position of the fulcrum of the lever, it can be adjusted to a great range of lenses and a sharp image always be secured.

30 While AE is the position of the lever for a projection of 1:2, which in this case is magnification, the opposite, i. e., reduction of 2:1 will be secured with the position A_1E_1 . The position of the plane H in H_1 will result then in the conjugate focal distance $BA_1 = 2BE_1$.

In the description of this arrangement it must be understood, that the locations of the different parts given are "ideal" ones, giving the simplest form of combination. Any changes of positions relative to the center lines of the lens must be made up by additional members or a change in dimensions of those used, and since the arrangement shown is only one of those possible to

use, I declare such variations as being within the scope of my invention.

What I claim and desire to secure by Letters Patent, is:

1. In a focusing device a lens and a reflector adapted to reflect a ray of light through the optical axis at 90° , a plane representing an object to be projected and a plane adapted to receive an image therefrom located at conjugate focal distances from the optical center of the lens, a straight lever movable about a fulcrum located one focal length of the said lens from two lines parallel to the two branches of the optical axis and adapted to cut both lines at conjugate focal distances from the point of their intersection, and means to move the said two planes simultaneously with the points of intersection of the lever and the said lines.

2. In a focusing device a lens and a reflector adapted to reflect a ray of light through the optical axis at 90° , a plane representing an object to be projected and a plane adapted to receive an image therefrom located at conjugate focal distances from the optical center of the lens, a straight lever movable about a fulcrum located one focal length of the said lens from two lines parallel to the two branches of the optical axis, two pivoted bearings sliding on the arms of the said lever and along the said two lines, their centers establishing conjugate focal distances on the two lines from the point of their intersection, and means to move the said two planes simultaneously with the said pivoted bearings.

3. In a focusing device a lens and a reflector adapted to reflect a ray of light through the optical axis at 90° , a plane representing an object to be projected and a plane adapted to receive an image therefrom located at conjugate focal distances from the optical center of the lens, a straight lever movable about a fulcrum located one focal length of the said lens from two lines parallel to the two branches of the optical axis, the fulcrum being adjustable along a line of 45° between the said lines and from the point of their intersection, two pivoted bearings sliding on the arms of the said lever and along the said lines, their centers establishing conjugate focal distances on the said lines from the point of their intersection, and means to move the said two planes simultaneously with the said two pivoted bearings.

4. In a focusing device a lens and a reflector adapted to reflect a ray of light through the optical axis at 90° , a plane representing an object to be projected and a plane adapted to receive an image therefrom located at conjugate focal distances from the optical center of the lens, a straight lever movable about a fulcrum located one

focal length of the said lens from two lines parallel to the two branches of the optical axis, the fulcrum being adjustable along a line at 45° between the said lines and from
5 the point of their intersection, two pivoted bearings sliding on the arms of the said lever and along the said lines, their centers establishing conjugate focal distances on the
said lines from the point of their intersection, means to move the said two planes 10 simultaneously with the said two pivoted bearings, and means to change the position of the fulcrum to suit lenses of different focal lengths.

In testimony whereof I affix my signature. 15
AUGUST F. JOBKE.