PATENT SPECIFICATION

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335,696

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COMPLETE SPECIFICATION.

Improvements in or relating to Method of and Apparatus for Producing Photographic Images.

I, HOWARD DWIGHT BEACH, a citizen of the United States, of 469, Virginia Street, Buffalo, New York, 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 relates to a novel method for producing improved rendition of images of scenes, portraits and other subjects by photography, and to lenses for effecting such results.

It is well known that certain limitations exist in photographic lenses now in use, due in part to a restricted depth of focus, so that, particularly when used at full aperture, certain portions of the image of a subject are not rendered sharply. That is, if the lens is focused, for example, upon the middle ground or plane of the subject, then the background and the foreground are more or less out of focus, and these portions are further depicted in incorrect perspective, and are out of correct scale or proportion to each other and to the image of the middle ground, as seen by the eye. The sharpness of the image of the foreground and background can be improved by stopping down the lens, that is, reducing the size of the diaphragm opening or lens aperture, which, however, increases the length of exposure. This latter procedure is generally objectionable for various obvious and well known reasons.

Taking a concrete example, if a lens of 8" equivalent focus is to be used to produce a photograph of an outdoor scene, and is focused on infinity, or those portions of the subject 100 feet or more away, then the conjugate foci of the light rays from this portion of the subject will fall on and be sharply rendered upon a picture plane about 8" back of the lens. The conjugate foci of the rays from the middle ground and foreground of the subject will, however, fall on different planes, and the resulting image of these portions as seen or rendered on the picture plane will not be sharp, being what is known as out of focus, and will also be depicted in incorrect perspective and proportion. However, a progressive draw or adjustment of the lens beyond its equivalent focal length relative to said picture plane, or away from the latter, will successively bring the middle ground and foreground sharply into focus, when the remaining portions or planes of the subject will in turn become out of focus, and the perspective and proportion will be still incorrectly and differently depicted.

The same conditions are present in studio work, wherein the different portions of a person or subject, and the parts of the studio or accessories in front of and back of the subject are also rendered out of focus, and in incorrect perspective and proportion in different degrees according to the relative position of the lens to the picture plane and the subject.

An important object of my invention is to provide a novel photographic method, and a lens for use in connection therewith, whereby the aforementioned objections and limitations of lenses in use prior to my invention will be overcome, and whereby sharp images will be rendered, regardless of the lens aperture, of the various portions or planes of a subject before said lens.

Other objects are the provision of a composite lens, or a group of two or more lenses, of different equivalent foci, each of which is adapted to cause the conjugate foci of the rays of light from a different plane of the subject to fall sharply on a single picture plane; and also to provide a lens of this character which will produce an image in which correct perspective and proportion of a scene or subject will be rendered, and which will produce improved stereoscopic effect by giving greater value to the third dimension, that is the dimension of objects along or in the direction of the optical axis of the lens.

Various other objects and advantages will be apparent from the following description of the invention, the novel features of which will be set forth in the appended claims.

In the accompanying drawings:

Fig. 1 is a diagrammatic view illustrating the use of a composite lens embodying my invention and adapted to carry

out the method of my invention, and showing the paths of light rays from different planes of a subject through the lens to a picture plane

Fig. 2 is a front view of the lens of Fig. 1;

Figs. 3, 4 and 5 are sections of three different modified forms of lenses embodying my invention;

Figs. 6 and 7 are face views of two other modified forms of lenses;

Fig. 8 is a diagrammatic illustration of a group of three separate lenses of different equivalent foci arranged lengthwise of a common axis.

Figs. 9 and 10 are diagrammatic views showing the results attained by the use of three separate lenses of known form, compared with a lens group of the same equivalent foci arranged and used in accordance with this invention.

In practicing my invention, a plurality of lenses, whether composed of separate pieces or consisting of different portions of a single lens body or piece, and each of which has a different equivalent focus, may be grouped in one or another of various different ways. For example, in Fig. 1, there is shown a composite lens 10 consisting of a single transparent body or piece of optical glass composed of three lenses or lens portions x, y, and z arranged with their curved front portions or faces 11, 12 and 13 concentrically one about another with reference to the optical axis o—o.

Each lens or lens portion x, y and z has a different equivalent focus, represented in Fig. 1 by the points 15, 16 and 17, respectively. Each face therefore has a curvature different from the others. The vertical lines a, b and c represent planes in the background, middle distance, and foreground respectively of a subject before the lens 10, while the vertical line d represents a picture or focal plane behind the lens 10 upon which an image of the subject is to be projected by said lens.

In the arrangement shown in Fig. 1, the equivalent focal length of the central lens portion x is the longest, and that of the outer portion z is the shortest, while the intermediate portion y has an intermediate length, and by an appropriate disposition of these portions relative to their focal lengths, said lens portions will receive and focus sharply upon the single plane d, the objects in and about the respective subject planes a, b and c. For example, a pencil or cone of light rays a^1 emanating from a point on the plane a, when passing through the lens portion x will converge, in the form of a pencil or cone a^2 to a point a^3 representing the conjugate foci of the rays a^1 upon the plane d. Likewise rays b^1 from the middle ground plane b passing through the lens portion y will converge as a pencil of light b^2 to a point b^3 on the plane d, while rays c^1 from the foreground plane c similarly converge as rays c^2 to a point c^3 upon said plane d.

It has been found that three lenses or lens portions of different equivalent foci will serve to give entirely satisfactory results, but any number, two or more, may be employed, and by appropriate grouping together of lenses or lens portions of suitable focal lengths, the resulting composite or lens group will be adapted for different purposes, such as for landscape work, or for studio photography.

Fig. 3 shows another composite lens having curved faces x^1, y^1 z^1, similar to the faces x, y and z of the lens 10, shown in Fig. 1, the different faces, however, being formed on separate disks 18, 19 and 20 respectively. These disks are arranged one in front of the other along a common optical axis and may have contacting cemented faces 21.

Another arrangement is shown in Fig. 4, wherein the lens portions y^2 and z^2 are formed of separate rings 22 and 23 arranged concentrically about a central cylindrical lens portion x^2, the three parts being preferably cemented together on the annular contacting walls or surfaces 24.

Fig. 5 shows a composite lens which, like the lens 10 of Fig. 1, is formed of a single piece of optical glass, but instead of having the three concentric faces 11, 12 and 13 ground on its front convex face, as in Fig. 1, the lens of Fig. 5 has concentric faces or lens portions x^3, y^3 and z^3 ground on its rear concave face.

Other ways of forming these composite lenses or lens groups are shown in Figs. 6 and 7. In Fig. 6, the lens is composed of a plurality of sectors 25—28, each having a different equivalent focus, cemented together to form a circular disk, while in Fig. 7 is shown a lens comprising a plurality of segments 29—34 also forming a circular disk.

Separate lenses 35, 36 and 37 can also be arranged in spaced relation along their common optical axis, as shown in Fig. 8 to effect the desired result, those portions of the two larger lenses which project beyond the circumference of the respective smaller lenses acting to project the desired planes of the subject upon the picture plane.

The principle upon which the lenses or lens groups of this invention operate may be illustrated by the comparative diagrams, Figs. 9 and 10.

Supposing a subject to be photographed is a scene having three principal planes or objects 40, 41 and 42, see Fig. 9, one at 25 feet and beyond, one at 10 feet, and one at 5 feet, and that the subject is to be photographed consecutively by the use of three lenses 43, 44 and 45 of any ordinary prior type of say 12″, 10″ and 8″ equivalent focus respectively.

If the 12″ lens is focused sharply on the 25 feet or infinity plane 40, an image of this plane will be projected sharply on the picture plane 46, and the lens will be approximately 12″ from said picture plane. The planes 41 and 42, however, will be out of focus, the conjugate foci of light rays therefrom falling at one side of the picture plane 46. In order to obtain a sharp image of these two planes on the same picture plane, the 12″ lens must be moved farther away from the picture plane in proportion to the nearness of said planes. The same is true of the 10″ and 8″ lenses 44 and 45, as indicated by the broken lines.

If, however, the 12″ lens 43 is focused on the plane 40 and allowed to remain in this position at say 12″ from the picture plane, or in the lens plane 47, and the 10″ lens 44 is focused sharply on the plane 41, the lens 44 will be adjusted away from the picture plane 46 beyond its 10″ distance therefrom where it also falls approximately in the plane or position 47. Likewise if the 8″ lens is focused sharply on the nearest plane 42, it will be advanced beyond its 8″ distance, a further relative distance from the plane 46 until it also falls in the plane 47. Thus the three lenses will all be occupying approximately the same plane or position, and two at least of these lenses 43, 44 and 45 will be occupying positions in advance of their focal length in accordance with the draw required to permit them to render sharp images of the corresponding near planes 41 and 42 on the picture plane 46.

Fig. 10 illustrates three lenses or portions 43*a*, 44*a* and 45*a* having equivalent foci corresponding to the lenses 43, 44 and 45 of Fig. 9 arranged concentrically about one another in the plane 47*a* to form together a composite sharp image of the subject planes 40, 41, 42 on the picture plane 46*a*. This composite lens is in effect the same as the lens 10 of Fig. 1, or the lenses of Figs. 3—5.

It follows that as the image formed on the picture plane is the composite of the several sharp images of the different subject planes projected by the composite lens or lens group, this composite image will be shown in greatly improved perspective as compared to a single image of the same subject made by the use of prior types of lenses. This is for the reason that each lens part projects its portion of the subject in the scale in which a separate lens of the same focus would project said portion if it was focused sharply on that particular portion or plane.

Likewise the stereoscopic effect or rendition of the third dimension is improved, due to the virtual absence of fore-shortening or incorrect rendering of perspective.

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 method of producing a sharp photographic image of a subject having parts at different distances which consists in so disposing a lens unit having lens components or lenses of different focal lengths, between said subject and a picture plane that light rays from the differently spaced parts of said subject will respectively pass through different lens components or lenses and be sharply focused on said picture plane.

2. A lens unit comprising a number of lenses, lens sections or lens surface portions which are of different equivalent focal lengths and are adapted to project sharp images of different planes of a subject upon a common picture plane.

3. A lens unit comprising a number of lenses, lens sections or lens portions arranged about a common optical axis and each so formed as to project a sharp image from a different plane of a subject upon a common picture plane.

4. A lens unit comprising a number of lenses or lens portions having different formulæ or different equivalent foci and so arranged that when the respective lenses or lens portions are focused on points at different distances from a common picture plane, the conjugate foci of said points will fall on a common picture plane.

5. A lens unit according to claim 4, in which the lenses or lens portions are arranged so that a portion of the light rays from the subject passing through any one lens or lens portion, passes only through that lens or lens portion.

6. A lens unit comprising a number of lenses or lens portions having different equivalent focal lengths and so disposed relative to their respective focal lengths that one lens or lens portion will sharply focus rays from points in a predetermined plane of a subject upon a picture plane, and each of the other lenses or lens portions will respectively sharply focus rays from points in a different plane of said subject upon the same picture plane.

7. A lens unit according to claim 4, in which the component lenses or lens portions are so constructed and arranged relative to their focal lengths and the respective planes of the subject that each occupies a position corresponding to the draw required for a lens or lens portion of its particular focal length to produce a sharp image of its related subject part upon a common picture plane.

8. A method of producing a sharp photographic image of a subject having parts at different distances substantially as set forth.

9. A lens having lens components constructed and arranged substantially as described with reference to the accompanying drawings, for the purpose specified.

Dated the 27th day of August, 1929.

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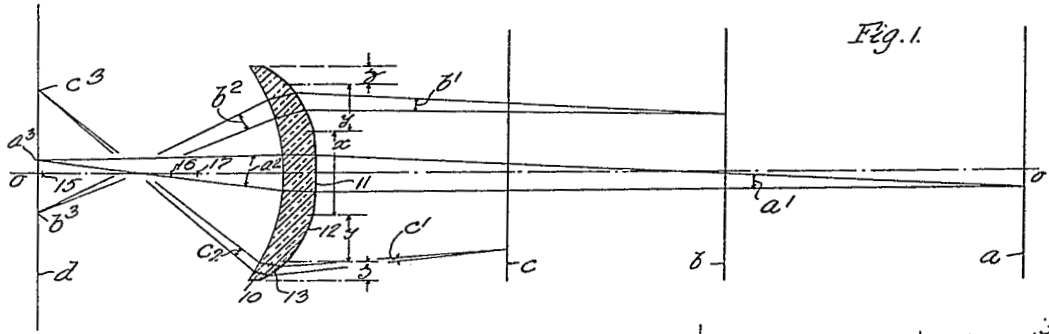


Fig. 1.

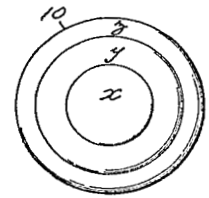


Fig. 2.

Fig. 3.

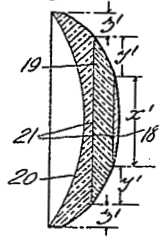


Fig. 4.

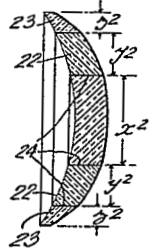


Fig. 5.

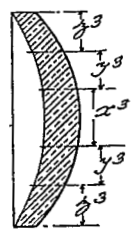


Fig. 6.

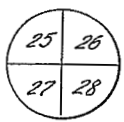
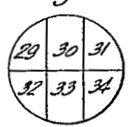


Fig. 7.



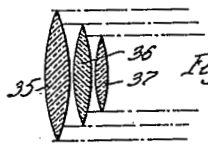


Fig. 8.

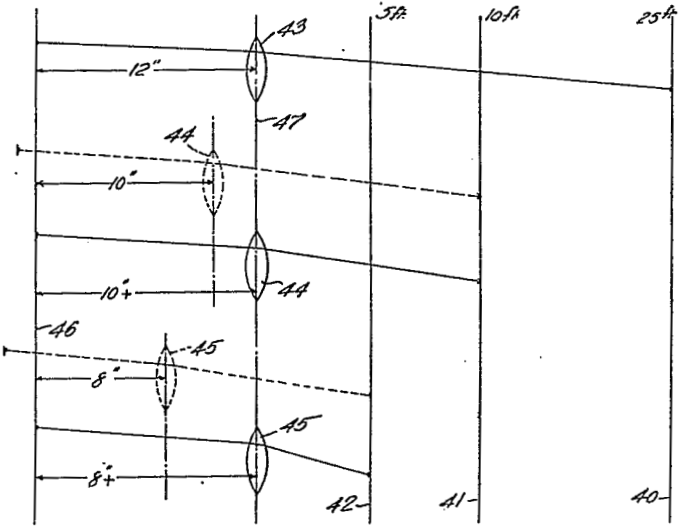


Fig. 9.

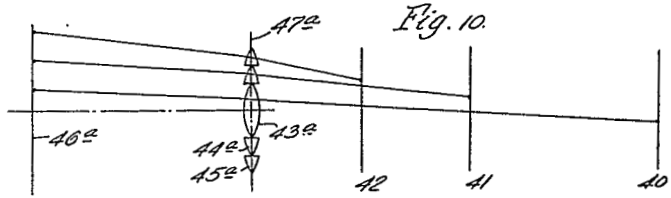


Fig. 10.

Charles & Read Ltd. Photo Litho