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W. C. EWING.

APPARATUS FOR PRODUCING IMAGES BY APERTURES.

APPLICATION FILED FEB. 12, 1901. RENEWED APR. 19, 1904.

NO MODEL.

Fig. 1.

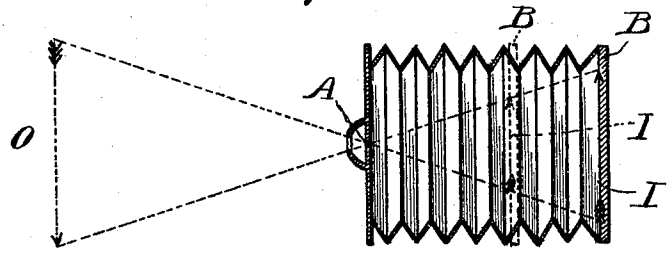


Fig. 2.

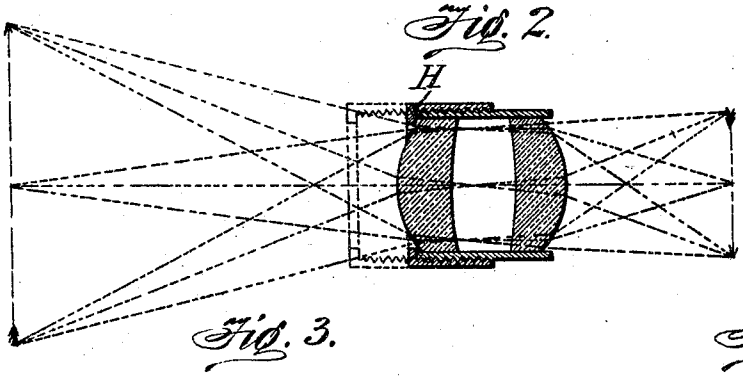


Fig. 3.

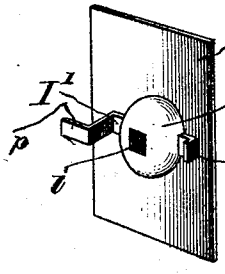


Fig. 4.

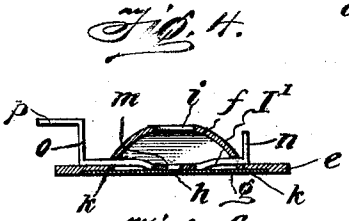


Fig. 5.

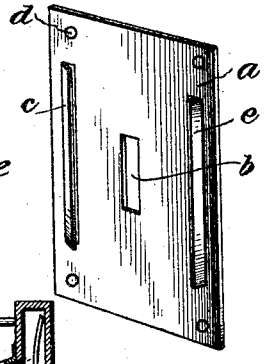
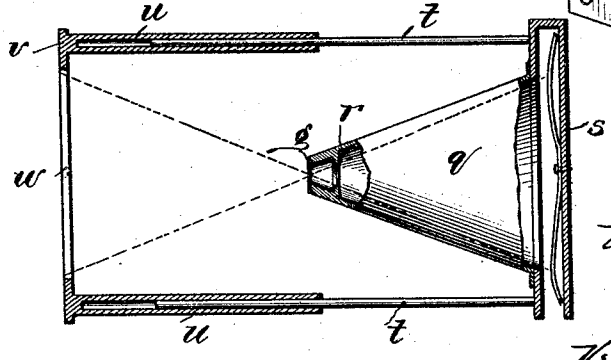


Fig. 6.



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Witnesses

Fenton & Belt.

By

Attorney

No. 773,202. Patented October 25, 1904.

UNITED STATES PATENT OFFICE.

WILLIAM C. EWING, OF YONKERS, NEW YORK, ASSIGNOR TO THOMAS EWING, JR., OF YONKERS, NEW YORK.

APPARATUS FOR PRODUCING IMAGES BY APERTURES.

SPECIFICATION forming part of Letters Patent No. 773,202, dated October 25, 1904.

Application filed February 12, 1901. Renewed April 19, 1904. Serial No. 203,947. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM C. EWING, a citizen of the United States of America, and a resident of Yonkers, county of Westchester, and State of New York, have invented certain new and useful Improvements in Apparatus for Producing Images by Apertures, of which the following is a specification.

My invention relates to certain new and useful improvements in means for obtaining an image without the use of a lens; and for this purpose I make use of an aperture which is, relatively speaking, of small diameter. Such apertures have heretofore been known in the art under the name of "pin-holes," and for convenience I shall designate them by that term.

My invention relates to means for preventing the diminution of the brilliancy of the image by rays falling obliquely through the aperture and then reflected upon the image, the latter being formed by rays passing through the aperture in straight lines without refraction or reflection. The means I have invented for this purpose consists of an apertured hood located adjacent to the pin-hole and axially registered therewith, the size of the aperture in the hood being determined by the line of the converging rays passing through the pin-hole and forming the image.

My invention further consists in a convenient construction of the pin-hole and hood and the support therefor, whereby apertures of various sizes may be readily interchanged.

My invention also further consists in the construction, arrangement, and combination of the various parts of which it is composed, as will be hereinafter more fully described and claimed.

Referring to the accompanying drawings, in which corresponding parts are designated by corresponding marks of reference, Figure 1 is a diagram representing the formation of an image by a pin-hole and further illustrating the use of my hood. Fig. 2 is a diagram illustrating the formation of an image by "lens-doublet." Fig. 3 is a perspective view of a pin-hole plate and mounting therefor in accordance with this invention. Fig. 4 is a central horizontal section thereof. Fig. 5 is a perspective view of the supporting-plate. Fig. 6 is a side elevation, partly in section, of a complete camera especially adapted to copying having a modified form of my invention applied thereto.

While I have in the accompanying drawings shown and shall in the following specification describe my invention as applied to the production of an image for photographic cameras, it will be understood that it is also applicable to the production of images for other purposes.

As illustrated in Fig. 1, all rays issuing from the object O and passing through the aperture A will form an inverted image I on a screen B, placed behind the plate. As will be seen from this figure, each ray passes through the aperture in a straight line with refraction, and therefore each point of the image is formed by the single ray issuing from the object and passing through the pin-hole. From this it follows that with the pin-hole no point of focus, properly speaking, exists and that objects situated at different distances in front of the camera are reproduced with substantially equal definition upon a screen placed at any distance behind the pin-hole. The property of the pin-hole in giving equal definition of objects at various distances renders the pin-hole of great value in many classes of work, and I take advantage of this lack of focus to construct a cheap and simple camera of "universal focus," and this of any desired size, although I may provide for varying the relative position of the plate and pin-hole for the purpose of varying the size of the image relative to the object. Since the image is formed at any point, no ground glass is necessary to determine the point of focus.

While, as before stated, the same aperture can be used at varying distances from the image, it is desirable and convenient at different times to use apertures of different sizes, as the period of exposure varies, other things being equal, as the square of the diameter of the aperture. My experiments have shown that while an aperture one twenty-second of an

inch in diameter produces an image of fair definition an aperture as small as one one-hundredth of an inch may be used without unduly prolonging the exposure and with the result of increasing the definition. These apertures are suitable for a distance between the aperture and plate varying between three and twenty-four inches. As a general rule the smaller aperture should be used with the shorter distances, as smaller pictures require greater definition.

In the embodiment of my invention shown in Figs. 3, 4, and 5 I use a supporting-plate *a*, having an elongated aperture *b* centrally disposed therein and having flanges *c* struck up from the metal of which the plate is composed. Perforations *d* are formed in this plate to permit its attachment to the front board of a camera or other similar instrument. A base-plate *e* of a suitable size and shape to fit between the flanges *c* of the supporting-frame has a centrally-apertured boss *f* struck up thereon, the boss being substantially hemispherical in shape and forming a hood, as will be hereinafter more fully described. The supporting-plate and base-plate may be of any thickness of any suitable metal; but I cover the cavity of the boss by a thin diaphragm *g*, inset into the base-plate and united thereto by soldering or brazing. As the diaphragm is centrally apertured, as at *h*, to form the pin-hole, it is desirable that it be thin, as were it of any considerable thickness it would, as the pin-hole itself is of small diameter, form a cylindrical aperture, which would at its opposite ends intercept all but the substantially axial rays of light. By the construction here shown I am enabled to use a diaphragm of but slight thickness, as it is supported at its edges and carried by the base-plate, the boss of which protects it from injury. The boss *f* is centrally apertured, as at *i*, the aperture in the boss registering with the pinhole aperture in the diaphragm, the size of the aperture *i* being determined by the lines passing through the pin-hole and falling upon the edge of the plate which it is desired to expose, thereby shutting off the more oblique rays and preventing the fogging of the plate by the light reflected from the interior of the camera. As it is generally desired to expose the whole of the plate and as these are rectangular, I prefer to make the aperture in the boss of that shape. Moreover, to provide for the reversibility of the plate in the camera in respect to the front without cutting off any portion of the plate when reversed I also prefer, as shown, to make the aperture in the boss square, the length of the sides of the square being determined by the length of the longer edge of the plate to be covered. As it may be desired to use the same hood at different distances from the sensitive plate, I prefer to determine the size of the aperture therein by the lines converging upon the edges of the plate at the minimum distance at which the plate will be placed from the aperture. The boss is slotted at diametrically opposite points near its base, and through these slots extends a shutter I′ in the form of a strip, having an aperture *m*, which in one position of the shutter registers with the pin-hole aperture *h*. The ends of the shutter-strips are bent, as at *n* and *o*, to limit the movement of the shutter, and the end *o* is further provided with a handle *p*, whereby the shutter may be shifted to open and close the pin-hole aperture in making an exposure. The shutter, as shown in the drawings, is dished, so as to bear against the diaphragm-plate at its center, making a tight joint therewith, which not only prevents the leakage of light into the aperture, but also holds the shutter in place by friction. It will be obvious that the base-plates having pin-hole apertures of various sizes may be provided and used with the same supporting-plate, whereby the size of the pin-hole may be conveniently adjusted to the character of the picture to be taken.

In Fig. 6 I have shown a form of my invention in which the camera is in the form of a cone *q*, having the pin-hole diaphragm *g* at the forward end thereof, the cone having formed within it and in the diaphragm an annular flange *r*, serving as a hood. The position of the edges of this flange are determined by the rules above given. As a convenient structure I have shown the camera-cone *q* as rigidly attached to a back *s*, adapted to receive a plate-holder, this being carried by legs *t*, telescoping into sockets *u*, mounted upon a base *v*, having a central aperture *w*. In the use of this form of my invention, which is especially adapted for copying and enlarging work, the object to be photographed is placed beneath the base, which serves as a retaining means therefor, the central opening permitting the exposing of the part of the object to be copied.

As will be seen from an inspection of Fig. 1, the size of the aperture in the hood is determined by the lines joining the pin-hole aperture and the edges of the plate, in practice the aperture in the hood being slightly larger than the figure formed by such lines or continuations thereof to provide for inaccurate registration of the aperture in the hood with the pin-hole aperture and, further, to provide for variation in the angle subtended by the plate due to its varying distance from the pin-hole and to permit a displacement of the pin-hole in respect to the plate. In this aspect my invention differs from the use of hoods as before applied to lenses, as with the latter the position of the hood is determined by the curvature of the lens and the refraction-power thereof, the hood in the latter case being so positioned as to permit a uniform illumination by the object of the anterior face of the lens—that is to say, to expose all parts of the

lens equally to the object. This position of a hood with a lens is illustrated diagrammatically in Fig. 2, in which the hood H is shown in full lines at its proper position when used with a lens and in dotted lines in the position it would have if placed in accordance with the directions of this application for use with a pin-hole. It will be noted that in the latter case the rays from the edges of the object, and which would otherwise fall upon the adjacent edge of the lens, are intercepted by the projecting hood, whereas none of the rays from the center of the image are so intercepted thereby, thereby producing an unequal illumination of the image.

It will be seen that between the pin-hole diaphragm and the hood-forming shield, which in Figs. 3 and 4 is the boss and in Fig. 6 the flange *r*, a cavity is formed, the sides of which are set back from the path of the rays passing without reflection through the apertures therein, whereby oblique rays falling into such cavity are reflected from the sides at some distance back from the axial line and if reflected to the aperture at all fall therethrough at such an angle to the normal as to be unable to affect the formation of the image. Moreover, I prefer to blacken the inside of the cavity thus formed. It will also be seen that in Figs. 3, 4, and 5 the hood is curvilinear in cross-section, so that the oblique rays falling on the interior surface thereof are reflected toward the outer edges of the diaphragm *g* and not toward the center thereof.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a photographic apparatus, the combination with a base-plate having a portion of its central part struck up to form a boss and apertured at its top to form a hood, of a diaphragm closing the central cavity in the boss, the diaphragm having an image-forming aperture therein registering with the aperture in the hood, substantially as described.

2. In a photographic apparatus, the combination with a base-plate having a portion of its central part struck up to form a boss and apertured at its top to form a hood, of a diaphragm thinner than the base-plate closing the cavity in the boss and protected by the hood, the diaphragm having an image-forming aperture therein registering with the aperture in the hood, substantially as described.

3. In a photographic apparatus, the combination with a base-plate having a portion of its central part struck up to form a boss and apertured at its top to form a hood, of a diaphragm inset into the base-plate over the cavity of the boss, the diaphragm having an image-forming aperture therein registering with the aperture in the hood, substantially as described.

4. As a new and improved article of manufacture, the hereinbefore-described article, consisting of a base-plate having a boss struck up therefrom and centrally apertured to form a hood, a diaphragm covering the opening in the cavity of the boss and having an image-forming aperture therein, in combination with a shutter working in front of the image-forming aperture and within the cavity of the hood, substantially as described.

5. The combination of a base-plate having a boss struck up therefrom and centrally apertured to form a hood the hood being provided with diametrical apertures near its base, a diaphragm covering the cavity of the boss and having an image-forming aperture therein, and a shutter passing through the diametrical apertures in the hood, substantially as described.

6. The combination of a base-plate having a boss struck up therefrom and centrally apertured to form a hood, the hood being provided with diametrical apertures near its base, a diaphragm covering the cavity of the boss and having an image-forming aperture therein, and a shutter passing through the diametrical apertures in the hood and having its ends bent to form limit-stops and a handle, substantially as described.

7. The combination, with a diaphragm having an image-forming aperture therein, of a hood having an aperture registering with the aperture in the diaphragm and forming a cavity, the side walls of which are set back from the apertures, substantially as described.

8. The combination with a diaphragm having an image-forming aperture therein, of a hemispherical boss forming a hood and mounted in front of the said diaphragm, substantially as described.

9. The combination of a base-plate having a boss struck up thereon and apertured to form a hood, the hood being provided with diametrical apertures near its base forming guideways, and a thin diaphragm covering the cavity in the boss and having an image-forming aperture therein, substantially as described.

Signed by me at Washington, District of Columbia, this 11th day of February, 1901.

WILLIAM C. EWING.

Witnesses:
VERNON M. DORSEY,
EDWIN WM. HUGHES.