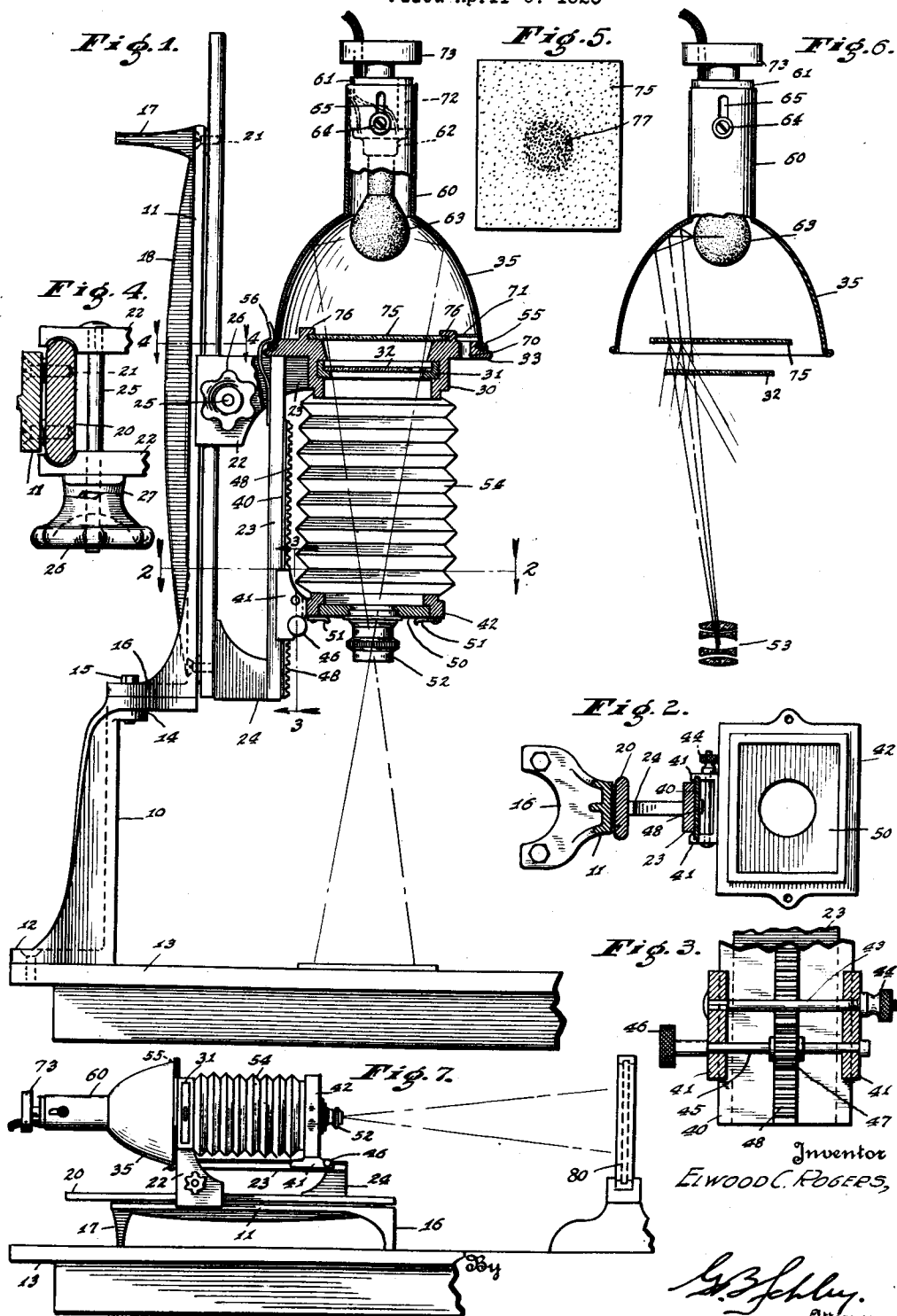


June 21, 1927.

E. C. ROGERS
PHOTOGRAPHIC ENLARGER

Filed April 8. 1926

1,633,228



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Patented June 21, 1927.

1,633,228

UNITED STATES PATENT OFFICE.

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PHOTOGRAPHIC ENLARGER.

Application filed April 8, 1926. Serial No. 100,537.

It is the object of my invention to produce a photographic enlarger of the reflector type which is more economical to manufacture, and more effective in use, and more easily operated than other enlargers of this type heretofore made. More specifically it is my object to construct an enlarger which will evenly illuminate the negative and the projected field, which will avoid uneven heating of the negative and consequent warping of film negatives or possible breaking of glass negatives; which will produce an evenly illuminated field irrespective of the distance between the negative and the lens; and which will employ usefully a larger proportion of light rays emitted from the light source than will other enlargers of the reflector type heretofore used. A further object of my invention is to produce an enlarger which may be used to project either vertically or horizontally.

I accomplish the above objects by employing an enlarger with the usual lens, and a source of light in the form of a frosted or etched or coated light bulb. I provide for this light bulb a non-diffusing reflector (or polished reflector surface) and between such reflector and the negative I interpose a screen adapted to correct inequalities in the light rays which otherwise would pass through the negative. By the term non-diffusing reflector is meant a reflector having a highly polished reflecting surface. A reflector of this type reflects more light than it intercepts or absorbs. I mount such an enlarger upon a two-part support which when both support-parts are used holds the enlarger in a vertical position to project vertically and one part of which may be employed to hold the enlarger in a horizontal position to project horizontally.

The accompanying drawing illustrates my invention: Fig. 1 is a side elevation of my enlarger in partial section showing the enlarger in its vertical position; Fig. 2 is a horizontal section on the line 2—2 of Fig. 1; Fig. 3 is a fragmental vertical section on the line 3—3 of Fig. 1; Fig. 4 is a fragmental horizontal section on the line 4—4 of Fig. 1; Fig. 5 is a plan view of the screen which is interposed between the negative and the reflector; Fig. 6 is a somewhat diagrammatic elevation illustrating the path of light rays through my enlarger; and Fig. 7 is a side elevation of my enlarger in use in a horizontal position.

The support for my enlarger comprises two parts, a base 10 and a stand 11 to which the enlarger proper is attached. The base 10 is provided with a foot 12 adapted to be secured to table-top 13 or any other horizontal surface. Near its top, the base 10 has a part 14 which projects parallel to the plane of the foot 12 and horizontally outward oppositely to the foot 12 and is adapted to have attached to its upper face, as by screws 15, a foot 16 at one end of the stand 11. At its opposite end, the stand 11 is provided with a second foot 17 and between the feet 16 and 17 is preferably a reinforcing rib 18. The stand 11 may be removed from the base 10 and placed in a horizontal position, as indicated in Fig. 7, with the feet 16 and 17 resting on the table top 13, the foot 16 being bifurcated as is clear from Fig. 2 in order that a stable support for the enlarger may be provided.

A longitudinal slide 20 is affixed to the stand 11 in any suitable manner such as by means of the screws 21. Desirably the sides of the slide 20 are rounded, as is clear from Fig. 4, in order that the slide may be received in grooves located in the inner faces of guides 22 which project from one side of the enlarger frame 23. At its opposite end the enlarger frame 23 is provided with a foot 24 which may rest on the face of the slide 20.

Passing through both guides 22 preferably close to the slide 20 is a bolt 25 and on the screw-threaded end of such bolt is mounted a nut 26 of a type adapted to be tightened by hand. The nut 26 does not bear directly against the adjacent guide 22, but bears against a part 27 which is affixed to the outer side of such guide. The adjacent faces of the nut 26 and the part 27 are provided with helical cam surfaces opposite in inclination to the threads of the bolt 25 and nut 26 and having a relatively greater pitch than such threads. This construction facilitates the adjustment of the enlarger proper on the slide 20, for the nut 26 can be operated to clamp or unclamp the guides 22 on the slide 20 with but a fraction of a turn of the nut.

Rigid with the frame 23 and conveniently forming a part thereof is a negative-holder support 30 which is provided with a central opening for the passage of light. On opposite sides of this central opening are grooves for the reception of the negative holder 31

which is adapted to receive and support the negative 32. Near its top, the support 30 is provided with a circular flange 33, the top edge of which is rabbetted to receive the lower edge of the reflector 35.

A longitudinally extending guide plate 40 is affixed to the enlarger frame 23 in any suitable manner. The edges of the guide plate 40 are received in parallel grooves in guides 41 carried by a lens-board support 42. A bolt 43 extends between the guides 41 and is provided with a knurled clamping nut 44 which when tightened serves to hold the lens-board support 42 stationary relative to the enlarger frame. Preferably, a shaft 45 provided with a knurled operating knob 46 is rotatably mounted in the guides 41 and at an intermediate point is provided with a pinion 47 which meshes with a rack 48 carried by the guide plate 40. The lens-board support 42 may be adjusted longitudinally of the enlarger frame by rotating the knob 46; and when the desired position of adjustment is reached, the lens-board support 42 may be clamped in such position by means of the nut 44.

The lens-board support 42 has a central opening for the reception of a lens-board 50 which may conveniently be held in place in the support 42 by means of suitable clips 51. In the center of the lens-board 50 I provide a lens-mounting 52 which contains any suitable lens system 53. Extending between the two supports 30 and 42 is the collapsible bellows 54.

The reflector 35 is of ellipsoidal shape and its interior surface is highly polished so that it will reflect light-rays with substantially no diffusion. Such a reflector is conveniently and economically stamped or spun from some suitable metal, after which the interior surface is silvered and polished to provide the desired non-diffusing reflecting surface. The reflecting surface of the interior of the reflector is preferably protected from tarnish by means of a thin coating of clear transparent lacquer. The lower, or free, edge of the reflector is rolled to form a reinforcing bead as is clear from Figs. 1 and 6. The reflector may be held in place on the flange 33 by a pin 55 mounted in the flange 33 in position to project outward through a hole in the reflector 35 and by a leaf spring 56 carried by the enlarger frame 23 and adapted to engage the bead at the edge of the reflector.

Projecting axially upward from the ellipsoidal reflector 35 is a cylindrical tube 60 which receives a base 61 for a light-socket 62. The base 61 is desirably slidable in the tube 60 in order to vary the longitudinal position of light bulb 63 which is mounted in the socket 62. To retain the base 61 in any desired position of longitudinal adjustment, a screw 64 may be provided which passes

through a slot 65 in the tube 60 into the base 61.

Desirably, air admission openings 70 are provided in the flange 33. To prevent light from emerging from such openings, they are covered with hoods 71, conveniently made of metal and so arranged as to permit admission of air into the interior of the reflector but to form a light trap to prevent direct rays of light from passing through the holes 70. The air admitted through the holes 70 passes out through one or more longitudinal passages or holes 72 in the light socket base 61. To prevent direct rays of light from emerging through the holes 72 such holes are also covered with a light trap which will allow the free passage of air. This light trap is preferably in the form of a flange 73 on the protruding end of the base 61 and is slightly larger in diameter than the diameter of the tube 60, so that it will also form a light trap for any rays emerging between the wall of the tube 60 and the base 61. This arrangement permits a circulation of air through the reflector and around the light bulb and thus keeps the reflector, light bulb, and adjacent parts at a low temperature.

The light bulb 63 is a frosted, etched, or coated bulb the surface of which acts to diffuse emitted light. The use of such a bulb with a non-diffusing reflector produces substantially even illumination of the negative and projected field except for a centrally located spot which is caused by the direct rays of light from the bulb. To prevent this over-illumination of the central portion I interpose between the reflector and the negative a screen 75 which is conveniently a piece of glass held in place by cleats 76 on the support frame 30. This glass screen 75 is preferably made by sand blasting or blasting with fine particles of hardened steel. The entire surface of this glass is lightly blasted or grained, giving it a substantially even blasting except for a round spot 77 in the center of the screen which spot has a rougher and much heavier blasted surface than the remainder of the screen. In certain instances it may be desired to make the surface of the screen 75 slightly less rough near its edges and the corners than it is in the vicinity of the spot 77; but even if such is the case a well defined spot 77 in the center of the screen is desirable.

The extra illumination of the negative and projected field can be eliminated by darkening or making more opaque the lower part of the light bulb; but this is not as desirable as the spotted glass screen. Any method which would screen or diffuse the central or direct rays of light would accomplish the desired result but I have found the blasted glass to be practical, economical, and permanent.

The diameter of the spot 77 is substantially equal to that of the image of the light-bulb, and hence prevents excessive illumination of the negative in the center thereof.

5 This result is accomplished in two ways. The heavier graining of the screen 75 within the borders of the spot 77 renders such spot more opaque than is the remainder of the screen; and in addition, this heavier grain-
10 ing causes a larger proportion of the light incident upon the spot 77 to be diffused at such an angle that it strikes and is absorbed by the blackened interior of the enlarger.

The ground glass screen 75 is mounted
15 sufficiently far above the negative 32 so that the grain of the ground glass will not be seen in the projected image of the negative.

To avoid shadows on the negative it is necessary that the central opening in the
20 support 30 be of such dimensions at all points that its walls will not intercept any useful light rays which would otherwise fall on the negative. As the useful rays falling on the negative near its edges are at an ap-
25 preciable angle to the axis of the light system of the enlarger, I prefer to taper the walls of the opening through the support 30, as in this way I make the opening of sufficient size at all points so that intercep-
30 tion of useful light rays is eliminated, and I accomplish this result without making the bottom end of the opening through the frame 30 excessively large. This feature of my invention becomes more important when
35 the support 30 is relatively thick axially of the enlarger or when the useful light rays at the negative margin have a relatively large angle with respect to the axis.

If enlargements are desired of a size which
40 cannot be readily attained with the enlarger in the vertical position shown in Fig. 1, the enlarger and stand 11 can be removed from the base 10 and placed in a horizontal position as illustrated in Fig. 7. Any suitable
45 frame or easel 80 may be then provided for the carrying of the sensitized paper.

The use of the frosted light bulb 63 in conjunction with the non-diffusing reflector
50 35 produces substantially even illumination and heating of the negative, particularly when the screen 75 is employed. It is impractical and expensive to attempt to produce a perfect reflector 35; and the spinning process which appears to be the most eco-
55 nomical method of making such reflector inevitably leaves in the reflector irregularities in the form of ring-shaped ridges in the reflecting surface. If a clear light bulb were used in place of the diffusing bulb 63,
60 these inequalities in the reflecting surface would be evident in the illuminated field; but when a frosted bulb is used these inequalities in the illumination of the field disappear. I have found that a reflector
65 having a non-diffusing reflecting surface is

more efficient than one which diffuses the light rays incident upon it; as with a diffusing reflector a relatively large proportion of light falling on the negative strikes
70 at such an angle that it is lost on the blackened inner surface of the bellows. In addition the total amount of light reflected from a diffusing surface is less than that reflected from a highly polished surface.

In an enlarger of the type I have de-
75 scribed the frosted light bulb has another advantage aside from preventing ill effects from imperfections in the reflector.

With the light source of considerable size, such as a frosted bulb, the distance between
80 the negative and lens can be varied through a wider range to produce enlargements of different sizes without varying materially the intensity of the projected field. If a
85 light source of small area is employed with a polished reflector there will be one position of the lens at which substantially all the reflected light rays will pass through the
90 lens. For this one position of the lens, the enlarger would be very efficient, but if the lens were moved from this position a marked
95 falling off in the intensity of the projected field would occur. This constitutes a real defect in an enlarger, for in operation the axial position of the lens must be varied in
100 producing enlargements of different sizes, and it is desirable that the adjustment have no effect on the intensity of the projected field. This defect can be partially although
105 not entirely overcome by readjusting the light source whenever the lens is moved, but this is impracticable and troublesome. When the light-source is of considerable size there
110 is no position of the lens in which all the reflected light passes through it. If the lens is moved along the axis, some of the light rays which previously passed through the
115 lens will now miss it and others which previously missed the lens will pass through it. Thus, without the necessity for adjusting
120 the light, the lens can be moved axially without varying materially the intensity of the projected field.

The distance through which the lens may
be moved without affecting the intensity of
125 the projected field varies with the axial position of the light-source as well as with its size. This is so because the greater the distance between the light source and a point in the reflector the smaller will be the angles
130 of convergence and divergence respectively of the pencils of rays incident upon and reflected from such point, and the more nearly will such reflected rays cross the re-
135 flector axis in a common point. I have found that the best results can be obtained with my enlarger by constructing it so that the light bulb filament is substantially in one focus of the ellipsoidal reflector and the lens is in or near the other focus.

In the above description of my invention, I have used the expression "light source" to indicate the whole light bulb, such as the frosted or etched light-bulb which I prefer to employ. Actually, of course, the light emanates from the filament if a filament-type bulb is used, but the light is so diffused at the glass of the bulb that the bulb becomes for all practical purposes the effective light source. In the claims, also, I have used the expression "light source" to designate generically any actual or effective source of light. Where it becomes necessary in the claims to distinguish between the actual element from which light originally emanates and the diffusing means (the glass of the light bulb) which diffuses the light before it strikes the reflector, I have used the term "light element" to designate the original light-producer, such as the filament or its equivalent.

I claim as my invention:

1. In a photographic enlarger, the combination with the usual negative holder and lens, of an electric light bulb having a light-diffusing surface, an ellipsoidal reflector for said light bulb, said reflector having a non-diffusing reflecting surface, and a diffusing glass screen mounted in position to intercept direct and reflected light rays from said bulb before they pass through a negative in said negative holder, said glass screen having a central spot within the borders of which the graining of the glass is appreciably heavier than on the remainder of the screen.

2. In a photographic enlarger, the combination with the usual negative holder and lens, of an electric light bulb having a light-diffusing surface, an ellipsoidal reflector for said light bulb, said reflector having a non-diffusing reflecting surface, and a light-transmitting screen mounted in position to intercept direct and reflected light rays from said bulb before they pass through a negative in said negative holder, said screen having a portion which transmits to the lens a proportion of the light falling upon it smaller than that proportion of the light falling on the remainder of the screen and transmitted to the lens.

3. In a photographic enlarger, the combination with the usual negative holder and lens, of a light source, an ellipsoidal reflector for said light source, said reflector having a non-diffusing reflecting surface, and a diffusing glass screen mounted in position to intercept direct and reflected light rays from said light source before they fall on a negative in said negative holder, said glass screen having a central spot within the borders of which the graining of the glass is appreciably heavier than on the remainder of the screen.

4. In a photographic enlarger, the combination with the usual negative holder and

lens, of a light source, a reflector for said light source, said reflector having a non-diffusing reflecting surface, and a light-transmitting screen mounted in position to screen direct and reflected light rays from said light source before they fall on a negative in said negative holder, said screen having a portion which transmits to the lens a proportion of the light falling upon it smaller than that proportion of the light falling on the remainder of the screen and transmitted to the lens.

5. In a photographic enlarger, the combination with the usual negative holder and lens, of an electric light bulb having a light-diffusing surface, a reflector for said light bulb, and a light-transmitting screen mounted in position to screen direct and reflected light rays from said bulb before they fall on a negative in said negative holder, said screen having a portion which transmits to the lens a proportion of the light falling upon it smaller than that proportion of the light falling on the remainder of the screen and transmitted to the lens.

6. In a photographic enlarger, the combination with the usual negative holder and lens, of a light source, a reflector for said light source, and a light-transmitting screen mounted in position to screen direct and reflected light rays from said light source before they fall on a negative in said negative holder, said screen having a portion which transmits to the lens a proportion of the light falling upon it smaller than that proportion of the light falling on the remainder of the screen and transmitted to the lens.

7. In a photographic enlarger, the combination with the usual negative holder and lens, of a source of light, a reflector therefor, and a light-transmitting screen mounted in position to screen light rays falling on a negative in said negative holder, said screen having a portion which transmits to the lens a proportion of the light falling upon it smaller than that proportion of the light falling on the remainder of the screen and transmitted to the lens.

8. In combination with a photographic enlarger, a stand therefor, said stand having a longitudinal slide on which said enlarger is slidable, said enlarger having two guides arranged to receive said slide between them, a clamping bolt extending between said members and through and beyond one of them, a nut screw-threadedly mounted on said bolt, and a part carried by the guide adjacent said nut, said nut and said part having engaging helical surfaces opposite in inclination to the screw-threads of said nut and bolt.

9. In a photographic enlarger, the combination with the usual negative holder and lens, of an electric light bulb having a light diffusing surface, an ellipsoidal reflector for said light bulb, said reflector having a non-

diffusing reflecting surface, and a diffusing glass screen mounted in position between the negative holder and light bulb, so that light rays from said light bulb must pass through said screen before passing through the negative, said diffusing glass screen having a central spot which intercepts more light and diffuses to a greater degree the light rays incident upon it than does the remainder of the field of said diffusing glass.

10. In a photographic enlarger, the combination with the usual negative holder and lens, of a light source, an ellipsoidal reflector for said light source, said reflector having a non-diffusing reflecting surface, and a diffusing glass screen mounted in position between the negative holder and light source, so that light rays from said light source must pass through said screen before passing through the negative, said diffusing glass screen having a central spot which intercepts more light and diffuses to a greater degree the light rays incident upon it than does the remainder of the field of said diffusing glass.

11. In a photographic enlarger, the combination with the usual negative holder and lens, of a light source, a reflector for said light source, said reflector having a non-diffusing reflecting surface, and a diffusing glass screen mounted in position between the negative holder and light source, so that light rays from said light source must pass through said screen before passing through the negative, said diffusing glass screen having a central spot which intercepts more light and diffuses to a greater degree the light rays incident upon it than does the remainder of the field of said diffusing glass.

12. In a photographic enlarger, the combination of a lens, a negative holder, a light element, a non-diffusing reflector therefor, and means for diffusing light-rays emitted from said light element before they strike the reflector.

13. In a photographic enlarger, the combination of a lens, a negative holder, a light element, a non-diffusing reflector therefor, means for diffusing light-rays emitted from said light element before they strike the reflector, and additional means for diffusing light rays from said light element before they pass through a negative in said negative holder and thence through the lens.

14. In combination with a photographic enlarger, a stand therefor, lateral projections on said stand adapted to serve as legs to hold the enlarger in a horizontal position, a base having a foot adapted to be secured to a horizontal surface, said base also having near its top a horizontal projection which projects beyond the limits of said foot, and means for securing one of the lateral projections on said stand to the horizontal projection on said base to hold the enlarger in vertical position.

15. In combination with a photographic enlarger having the usual light source, negative holder, and lens, a light-transmitting screen interposed between the light-source and negative holder, said screen having a central area adapted to intercept a larger proportion of light-rays incident upon it than is intercepted by the remainder of the screen, said central area being substantially concentric with the axis of the enlarger.

16. In a photographic enlarger, the combination with the usual negative holder and lens, of a light element, a reflector for said light element, said reflector having a non-diffusing reflecting surface, and light-diffusing means between said light element and said reflector to diffuse light rays before they are reflected by said reflector to pass through a negative in the negative holder. :

17. In a photographic enlarger, a negative holder, a lens, a light bulb having a light-diffusing surface, a reflector for said light bulb, the light-diffusing surface of said light bulb being located to intercept light rays from the bulb to the reflector, said reflector having a non-diffusing reflecting surface and being arranged to reflect rays of light from the light bulb through a negative in the negative holder and thence through the lens.

18. In a photographic enlarger, the combination of a source of diffused light, a non-diffusing ellipsoidal reflector for the diffused-light source, a lens through which said reflector directs light from said diffused-light source, and means for supporting a transparent picture between said diffused-light source and said lens and between the reflector and the focus thereof distant from the light source, so that an image of said picture may be produced on the other side of the lens.

19. In a photographic enlarger, the combination of means for supporting a light element, a non-diffusing concave reflector for the light element, a lens through which said reflector directs light from said light element, means for supporting a transparent picture between said light element and said lens, so that an image of said picture may be produced on the other side of the lens, and means between the light element and the reflector for diffusing the light from the light element.

20. In a photographic enlarger, the combination of means for supporting a light element, a non-diffusing concave reflector for the light element, a lens through which said reflector directs light from said light element, means for supporting a transparent picture between said light element and said lens, so that an image of said picture may be produced on the other side of the lens, light-diffusing means located between the light element and the reflector, and addi-

tional light-diffusing means located between the reflector and the lens.

21. In a photographic enlarger, the combination of the usual negative holder and lens, a light element, a concave reflector having a non-diffusing reflecting surface arranged to reflect rays from said light element through the negative holder and lens, and a light-diffusing enclosure for said light element, said enclosure being arranged to diffuse light emitted from said light element before it falls on said reflector, so that for a given position of the light element relative to the reflector the size of said enclosure determines the apical angle of the cones of light incident upon and reflected from a point in said reflector.

22. In a photographic enlarger, the combination of the usual negative holder and lens, a light element, a concave reflector having a non-diffusing reflecting surface arranged to reflect rays from said light element through the negative holder and lens, and a light-transmitting enclosure in which said light element is located and at points on a surface of which enclosure light from said light element radiates so that the light element and enclosure together serve as a source of diffused light, whereby for a given position of the light element relative to the reflector the size of said enclosure determines the apical angle of the cones of light incident upon and reflected from a point in said reflector.

23. A photographic enlarger as set forth in claim 35, with the addition that the enclosure for said light element is of size sufficient that a cone of light reflected from a given point in said reflector will have in the vicinity of the lens a diameter greater than that of the lens in order that axial adjustment of the lens may be accomplished without producing a material variation in the strength of the projected field.

24. In a photographic enlarger, the combination with the usual negative holder and lens, of a non-diffusing concave reflector, a light element associated with said reflector,

said negative holder being between the light element and the lens on the axis of the reflector and substantially perpendicular to such axis, so that both direct and reflected rays of light pass through the negative holder and thence through the lens, and light-screening means for screening the light rays which pass from the light element through the opening of the negative holder and thence through the lens, said light-screening means having greater light-transmitting capacity for the light directed toward the outer part of said opening than for that directed toward the central portion of said opening, so that the combined direct and reflected rays which pass through the negative holder when it is empty and thence through the lens are substantially evenly distributed over the opening through the negative holder.

25. In a photographic enlarger, the combination with the usual negative holder and lens, of a source of diffused light, and a concave reflector having a non-diffusing reflecting surface and having its larger end larger in diameter than the greatest dimension of the opening of the negative holder; said light source being located between said reflector and said negative holder, and said negative holder being located between said light source and the lens, so that the apical angles of the two cones of light from the light source respectively incident upon and reflected from a point in said reflector depend upon the size of the light source and vary directly with such size; and said light source, reflector, negative holder, and lens being so arranged that light rays from said light source falling upon said non-diffusing reflecting surface are convergently reflected toward an area of greatest concentration located on the opposite side of said negative holder from said reflector.

In witness whereof, I have hereunto set my hand at Indianapolis, Indiana, this 6th day of April, A. D. one thousand nine hundred and twenty six.

ELWOOD C. ROGERS.

CERTIFICATE OF CORRECTION.

Patent No. 1,633,228.

Granted June 21, 1927, to

ELWOOD C. ROGERS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, line 36, claim 23, for the numeral "35" read "22"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of August, A. D. 1927.

Seal.

**M. J. Moore,
Acting Commissioner of Patents.**