(No Model.) 2 Sheets—Sheet 1.

J. K. INGALLS.

ILLUMINATING ROOFS, &c.

No. 271,854. Patented Feb. 6, 1883.

Fig. 1.

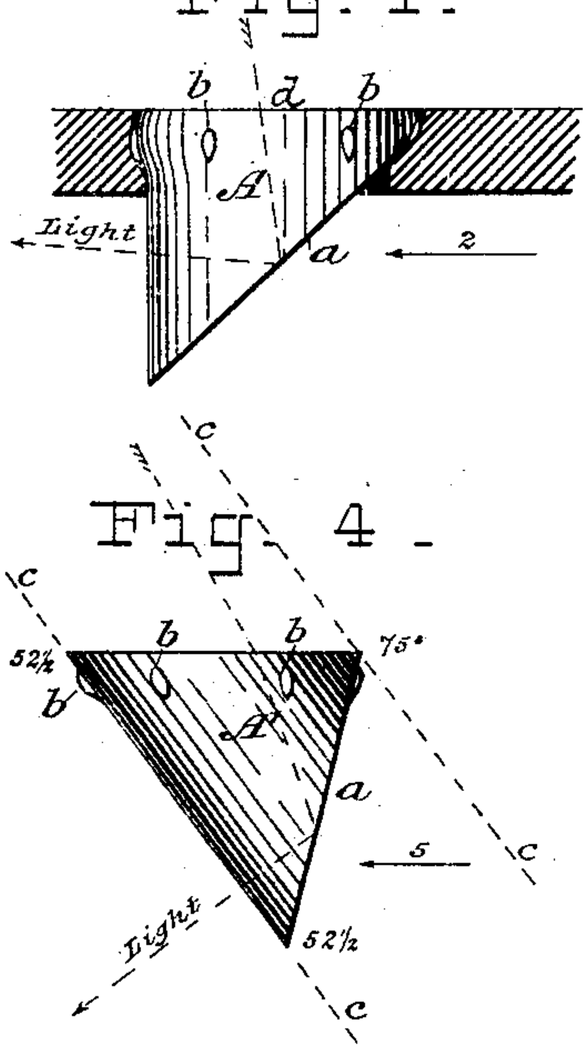


Fig. 2.

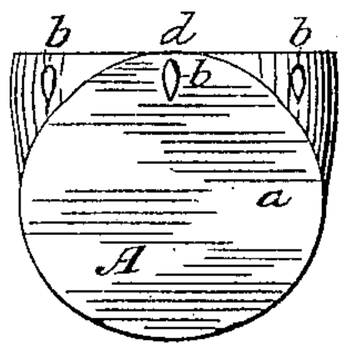


Fig. 3.

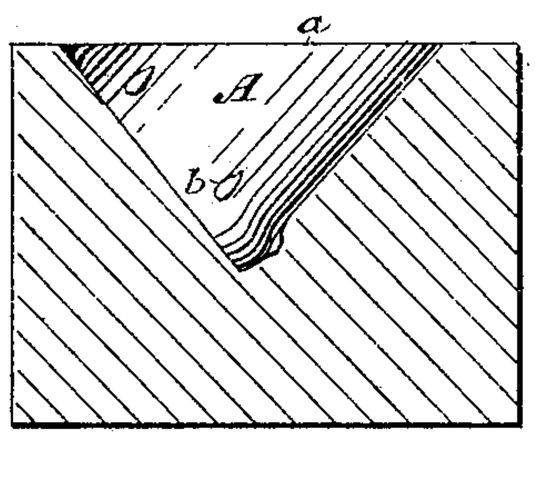


Fig. 4.

Fig. 5.

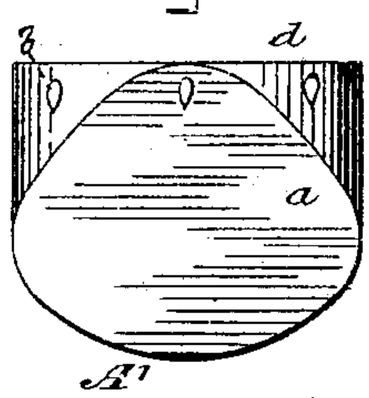
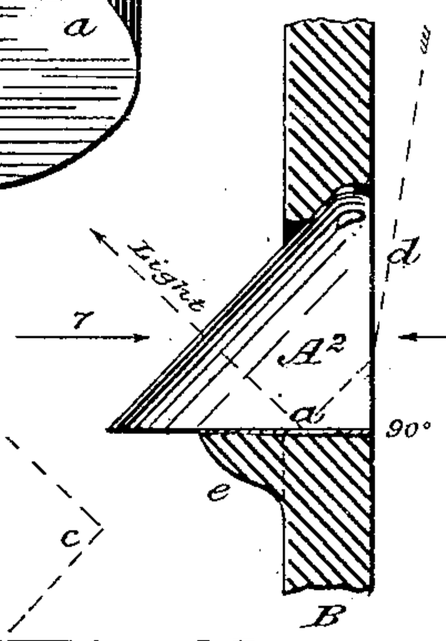


Fig. 6

Fig. 7.



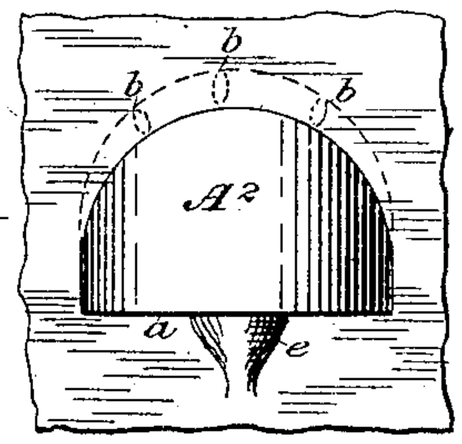


Fig. 8.

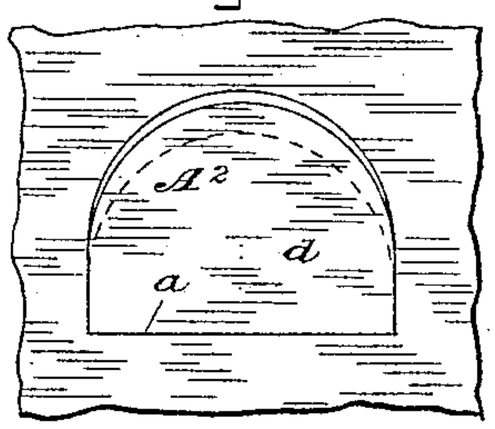


Fig. 9.

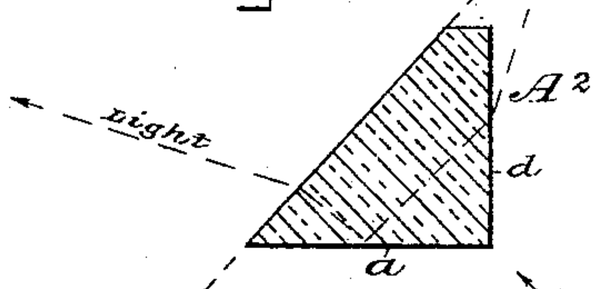


Fig. 10.

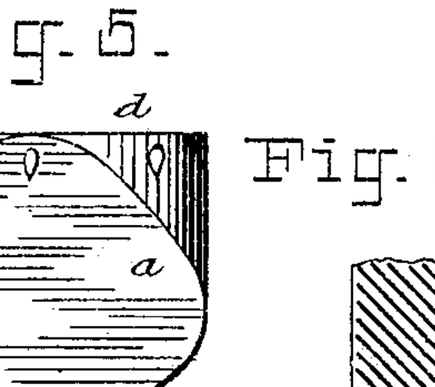


Fig. 12.

Fig. 11.

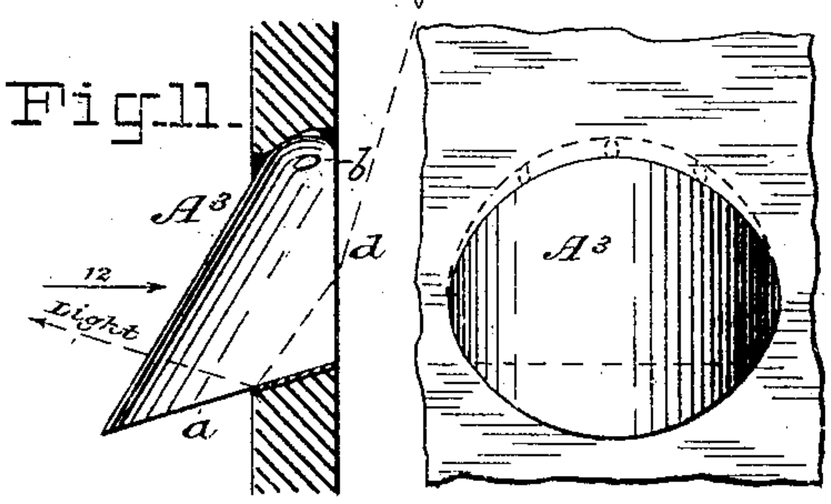
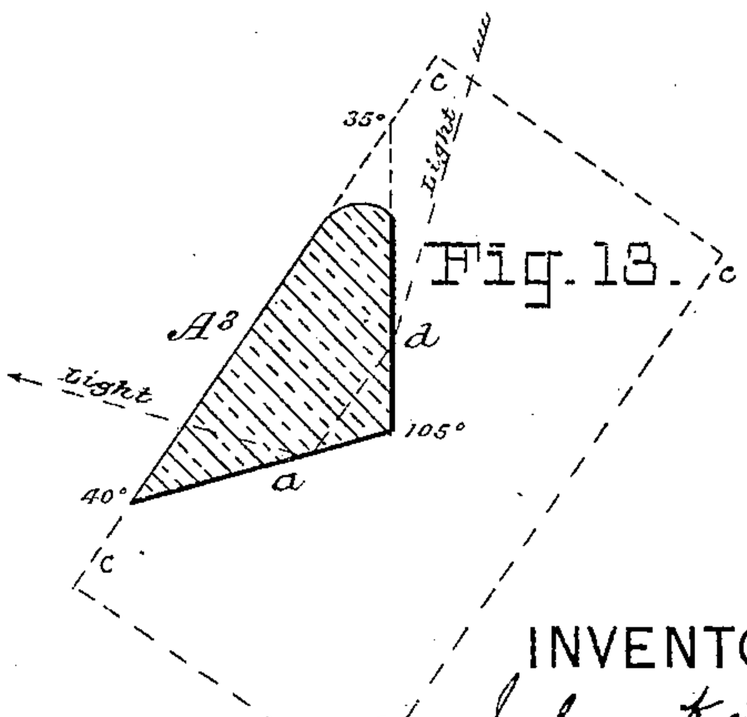


Fig. 13.



WITNESSES:

E. B. Bolton

Geo. H. Fraser.

INVENTOR:

Joshua K. Ingalls

By his Attorneys,

Burke, Fraser & Connicks

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Fig. 14.

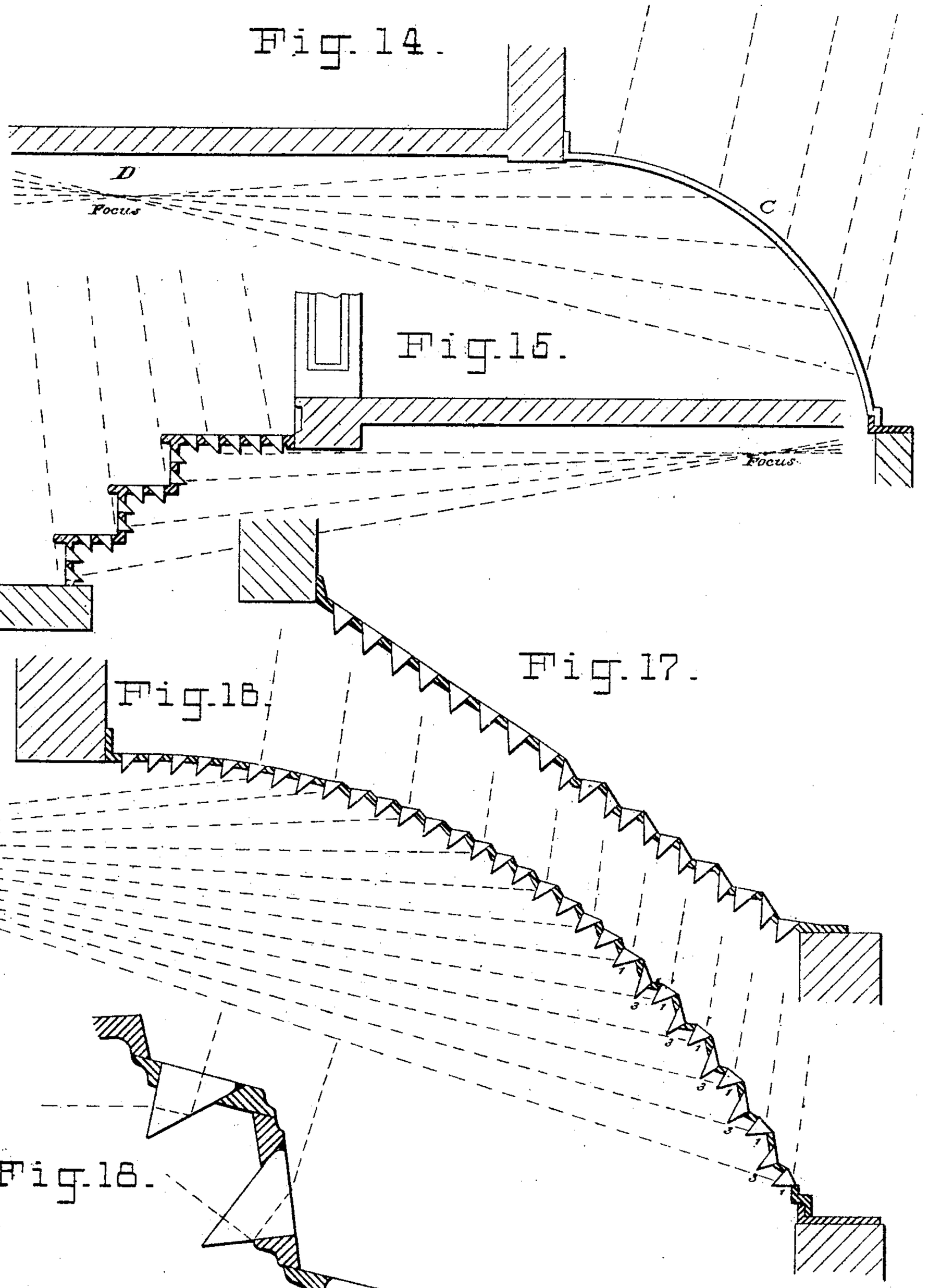

Fig. 15.

Fig. 16.

Fig. 17.

Fig. 18.

WITNESSES:

E. B. Bolton

Geo. H. Fraser.

INVENTOR:

Joshua K. Ingalls.

By his Attorneys,

Burke, Fraser & Bonnell.

UNITED STATES PATENT OFFICE.

JOSHUA K. INGALLS, OF GLENORA, NEW YORK.

ILLUMINATING-ROOF, &c.

SPECIFICATION forming part of Letters Patent No. 271,854, dated February 6, 1883.

Application filed October 17, 1882. (No model.)

To all whom it may concern:

Be it known that I, JOSHUA K. INGALLS, a resident of Glenora, in the county of Yates and State of New York, have invented certain new and useful Improvements in Illuminating-Roofs and other Surfaces, and in reflecting-lenses therefor, of which the following is a specification.

This invention relates to vault-lights, roof-lights, area-lights, illuminating-steps, &c., where the lenses or glass plugs employed serve not only to admit, refract, and diffuse the light, but also to reflect it wholly or partially and direct it back into the more remote and darker portions of the building. A lens of this character is shown in my Patent No. 258,232, dated May 23, 1882; and one part of my present invention consists in an improvement in the form of that lens, and in its manufacture.

Another part of my invention consists in a lens to be set in vertical walls or risers of steps, and to be used with the aforesaid lens; and the third part of my invention consists in an improved form and construction of rear extension-roofs and other roofs, and illuminating plates, surfaces, and coverings, and in a novel arrangement of different kinds of lenses therein, whereby a thorough and economical illumination of remote portions of apartments is the better attained.

In the accompanying drawings, Figure 1 is a side elevation of a reflecting-lens somewhat similar to that shown in and protected by my said Patent No. 258,232, and a cross-section of a portion of the plate in which it is set. Fig. 2 is a rear elevation of the lens detached. Fig. 3 is a vertical mid-section of the mold in which this lens is formed. Fig. 4 is a side elevation of a lens similar to that shown in Fig. 1, but designed to direct the light at a different angle. Fig. 5 is a rear elevation thereof. Fig. 6 is a side elevation of a lens set in a vertical plate, as the riser of a step, showing a portion of the plate in section. Fig. 7 is a rear or inside elevation of the lens and plate. Fig. 8 is a front or outside view of the same. Fig. 9 is a longitudinal mid-section of the lens. Fig. 10 is a diagonal or oblique elevation of the lens, looking in the direction of the arrow 10 in Fig. 9. Fig. 11 is a view corresponding to Fig. 6, and showing a modified form of lens designed to direct the light at a different angle. Fig. 12 is a rear or inside view of this lens and a portion of its plate, and Fig. 13 is a section thereof corresponding to Fig. 9. Fig. 14 is a section of the rear portion of the basement or the lower portion of a store or other building, showing the curved extension-roof. Fig. 15 is a similar section of the front of a basement. Fig. 16 is a view similar to Fig. 14, but more in detail, showing the setting of the lenses. Fig. 17 shows the arrangement of the lenses in an inclined or pitched roof. Fig. 18 shows a fragment of a roof detached and enlarged to show the jagged or step-like construction.

Referring to Figs. 1 and 2, A is the lens, and B the plate in which it is set. The lens is substantially a cylindrical ungula in form, its plane oblique surface *a* forming the reflecting-surface of the lens. This lens differs from that shown in my said Patent No. 258,232 only in that the reflecting-surface is straight or plane instead of curved, and that it extends up into the socket in which the lens is set, instead of terminating below the socket. This upward extension of this surface causes it to gather and reflect to the desired portion of the apartment a greater quantity of light. The slight nibs or projections *b b* bear against the socket, as described in my said patent, and one of them, as shown in Fig. 2, extends over a portion of the reflecting-surface. Fig. 3 shows the mold in which this lens is formed. Heretofore, so far as I am aware, lenses of this general character have been made in a mold with the same side up as that shown in Fig. 1, the plunger entering the mold and shaping or forming its top surface. I find that lenses made in this way contract unequally in cooling, owing to their being chilled by the metal of the mold, and the reflecting-surface *a*, which by this method is in contact with the mold, comes out so rough and dull that a considerable portion of the light which should be reflected is lost, necessitating the smoothing of the lens by "fire-polish" to render it effective. To avoid these difficulties I employ a mold like that shown in Fig. 3, preferably open and without a plunger, and simply pour the molten glass into the mold until it is filled. The sur-

plus is then removed and the surface rubbed over with a piece of wood, which imparts a high degree of polish. Thus it will be seen that by my method the lens is molded with its reflecting-surface *a*—the only surface requiring a polish—uppermost and out of contact with the mold. If a plunger be employed, this is the surface that will be in contact therewith; but the plunger is not apt to chill and deaden the glass. The mold may be made in sections, as usual, for convenience in removing the lens. The other forms of lenses shown will all be made in this way, in each case the surface *a* forming the open top of the mold.

The lens A′ (shown in Figs. 4 and 5) is designed to be set in a horizontal or substantially horizontal plate, the same as that shown in Fig. 1, but to direct the light to a different angle, as indicated by the dotted lines marked "Light" in Fig. 4. This lens consists of a section of a cylinder, the cylinder from which it is cut being indicated by the dotted lines *c c*. Its reflecting-surface *a* extends quite to its top surface, *d*, which it meets at an angle of about seventy-five degrees, while the axis of the cylinder is inclined to the top surface at an angle of about fifty-two and a half degrees in the opposite direction.

Figs. 6 to 10 show a lens, A^2, set in a vertical plate, as the riser of a step, and to direct the light, as shown in Fig. 9. It is a section of the half of a cylinder, the outlines of the entire cylinder being denoted by dotted lines *c c* in Fig. 9. Its bottom side is flat and stands horizontally, forming the reflecting-surface *a*. The front or outside surface, *d*, forms a right angle with the surface *a*, and the axis of the cylinder is inclined to it at an angle of forty-five degrees. The front of the lens is in outline approximately a half-circle or half-ellipse. The socket in the plate B′ is flat on its bottom, and curved above to conform to the lens and to keep the latter in place when set. It has or may have a toe or projection, *e*, cast on it, which extends backward or inside the building, and on which the bottom surface, *a*, of the lens rests, as on a bracket. The lens has usually but three projections, *b b*, as shown in dotted lines in Fig. 7, all being arranged on the upper side of the lens.

The lens A^3 (shown in Figs. 11 to 13) is also a section of a half-cylinder, as denoted in Fig. 13, and is also shown set in a vertical plate, B′, as illustrated in Figs. 11 and 12. It is like the lens A^2, except that the axis of the cylinder is inclined to the front surface, *d*, at an angle of about thirty-five degrees, and the reflecting-surface *a* forms an angle of about one hundred and five degrees with the front surface. This obtuse angle causes the light to be directed at a lower angle, as denoted in Fig. 13. Both of these lenses A^2 and A^3 are designed to collect the nearly vertical rays of light striking the plate B′ at an angle diverging but slightly from it, and to throw them back into the building in the same manner and for the same purpose as the lens A. They are chiefly useful where it is necessary to set the plates nearly vertical and it is desirable to reflect the light in a nearly horizontal direction. Either of my lenses may be used in a more or less inclined plate, in which case the direction in which the light is sent will be correspondingly changed. By choosing among these four lenses, any inclination ordinarily adopted may be so fitted with lenses as to direct the greater portion of the light to any desired part of the room. I have shown and described these lenses as being sections of cylinders; but they may instead be sections of square or polygonal prisms, if preferred; but I prefer the cylindrical form, because it gives a more compact form to the lens and does not weaken the socket-plate as much as other forms.

I will now describe the applications of my lenses to the various forms of roofs, &c.

Fig. 14 shows the back part of a basement having a convex or curved "basement extension-roof" or "lean-to," C, which is supposed to be set with my lenses. The lenses are so chosen and set at such angles that the parallel rays of light descending at the rear of the building are refracted and reflected into the basement, and are caused to cross each other at a common focal level or line, D, within the building, and at a short distance below the ceiling—say, for instance, one foot below. After crossing at this common point on line the rays separate, and most of them strike the ceiling toward the center and darker portion of the basement at different angles, and are thence reflected downward to various parts of the room. By thus arranging a focal line and causing the rays of light to cross it the greatest practical advantage of the illumination is secured. In Fig. 15 the same arrangement is shown as applied to the front of a basement where the light passes through illuminating steps and risers. Here the lenses are shown or indicated on a small scale.

It will be understood that in referring in this specification to the rays of light passing through and directed by the lenses I refer to the principal portion of the light, that which is actually reflected as described, and not that smaller portion which passes through without reflection or is otherwise diffused or scattered. Fig. 16 shows more in detail how the several sets of lenses are to be arranged to accomplish this result. The upper portion of the lean-to roof, where it is nearly horizontal, is set with lenses A A. As the inclination becomes gradually steeper the axes of these lenses are gradually more inclined, thereby reflecting the light up at successively higher angles until a point is reached where the surface *a* is presented so abruptly to the rays of light that it no longer reflects them, but permits them to pass through. At that point, or just before that point is reached, the lenses A′ A′ are substituted, or else the curved roof is broken up in partial steps, so that the lenses

A can be set at an angle so little inclined that they will still reflect the light. Even if this latter course be followed, as shown in the lower portion of the roof in this figure, a point will eventually be reached where it is advisable to substitute the lenses A′ A′. When these steps or jogs become sufficiently well defined to have risers wide enough to admit lenses they are set with lenses A^2 or A^3, depending upon the angle. If the risers are nearly vertical, lenses A^3 are used. If more inclined, lenses A^2 are preferable, due regard being had to the direction in which it is desired to send the light. It is best in a curved roof to combine all four forms of lenses, as shown.

Fig. 17 shows a straight inclined roof or lean-to embodying two methods of arranging the lenses. The upper half is a straight inclined plate set only with lenses A′ A′. The lower half is an angular plate broken up into partial steps or jogs, in which are set lenses A and A^3 or A^2. Fig. 18 shows a fragment of a roof-plate of this angular construction, and illustrates one method of constructing or forming it. The pattern is made in strips or bars, each having a row of sockets in it, and which are set together edge to edge, as shown, and at any desired angles, according to the slope or curvature of the roof and the lenses to be used, and are supported, when the casting is made, on a follow-board, in the usual manner. They are shown as arranged at a suitable angle for lenses A and A^2.

I have described four lenses having their reflecting-faces arranged at different angles with respect to the lens-axis; but I wish it understood that these are only examples. I may employ lenses of this character having their reflecting-faces arranged at angles with their axes, varying from these according to the exigencies of the particular case.

I claim as my invention—

1. A reflecting-lens for an illuminating-plate, consisting of a section of a cylinder or other prismatic solid having a reflecting-surface extending in a plane obliquely to the axis thereof, and a top or outside surface meeting said reflecting-surface at an angle, substantially as set forth.

2. A reflecting-lens consisting of a section of a longitudinal half of a cylindrical or other prism, having outside and reflecting surfaces extending in planes crossing the axis thereof obliquely, substantially as set forth.

3. A reflecting-lens the oblique reflecting-surface of which extends entirely through the socket and meets the outside face of the lens, substantially as set forth.

4. A lens having a flat reflecting-surface extending to and meeting its outside face, in combination with an illuminating-plate having a socket flat on one side to receive such reflecting-surface, and otherwise conforming to the said lens, substantially as set forth.

5. The combination, with a reflecting-lens whose reflecting-surface extends through its socket, of a plate having a socket to receive such lens, and provided with a toe or bracket, *e*, to support the lens, substantially as set forth.

6. The combination of a plate having a half-round socket with a lens made half-round where it enters said socket, and having slender projections on its convex side opposite its flat side, substantially as set forth.

7. An illuminated front or rear area or basement extension-roof set with reflecting-lenses arranged to converge the principal reflected rays of light on or near a focusing line or level extending beneath the ceiling of the room and parallel with said roof, substantially as set forth.

8. An illuminating front or rear area or extension roof formed with alternate salient and re-entering angles or approximately vertical and horizontal portions, and set with reflecting-lenses in both such portions, the reflecting-surfaces of the lenses set in such approximately vertical portions presenting a different angle to their outside surfaces from those set in the approximately horizontal portions, whereby the light reflected by each row or series of lenses is sent in the same general direction as that from the adjoining rows, substantially as set forth.

9. A curved roof or other surface formed with alternate salient and re-entering angles, with alternating rows of sockets, the successive rows set with reflecting-lenses of successively different reflecting angles, whereby the light is reflected in varying directions to focus the rays thereof, substantially as set forth.

10. As an illuminating-plate or part thereof, a plate arranged vertically, or nearly so, formed with a row or rows of half-round lens-sockets, the bottoms thereof being straight and set with reflecting-lenses whose reflecting-surfaces extend into said sockets and rest on the flat sides thereof, substantially as set forth.

11. The improvement in the art of manufacturing a reflecting-lens from glass, which consists in casting it with its reflecting-surface out of contact with the surface of the mold, substantially as set forth, whereby the chilling and deadening effect of the mold on said surface and the after process of "fire-polishing" are avoided.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JOSHUA K. INGALLS.

Witnesses:
JAS. G. COOPER,
HENRY CONNETT.