W. CHURCHILL.

FRESNEL LENS.

APPLICATION FILED MAR. 6, 1913.

1,081,210.

Patented Dec. 9, 1913.

2 SHEETS—SHEET 1.

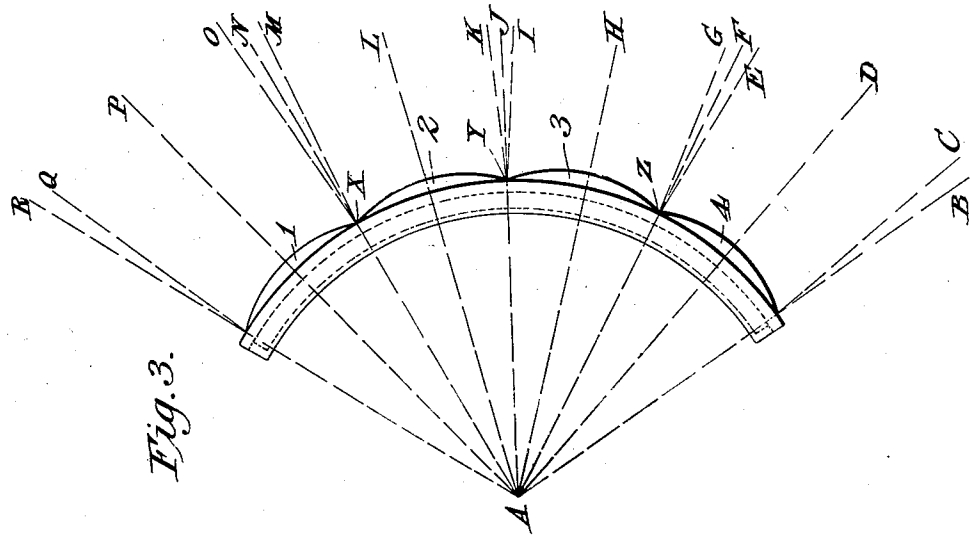


Fig. 3.

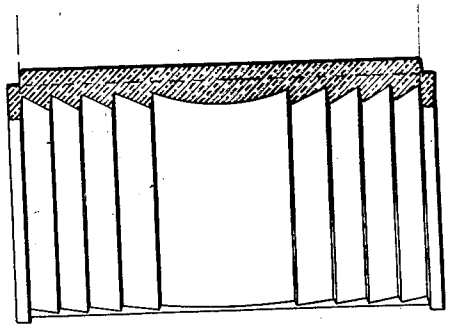


Fig. 2.

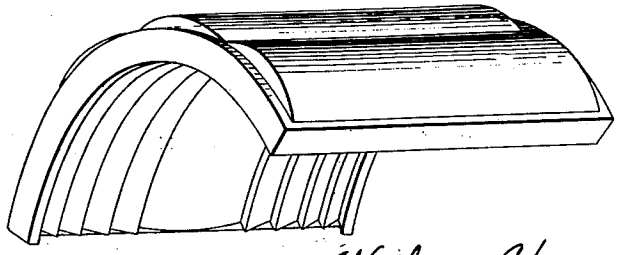


Fig. 1.

Witnesses

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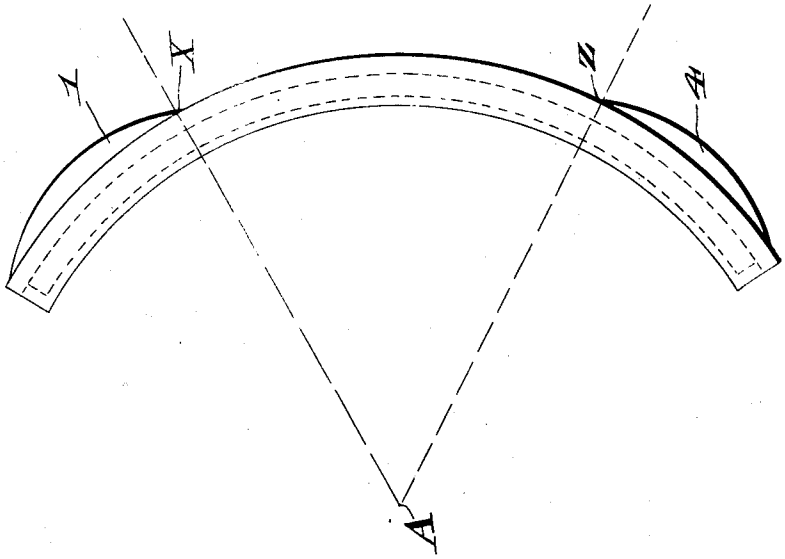


Fig. 5.

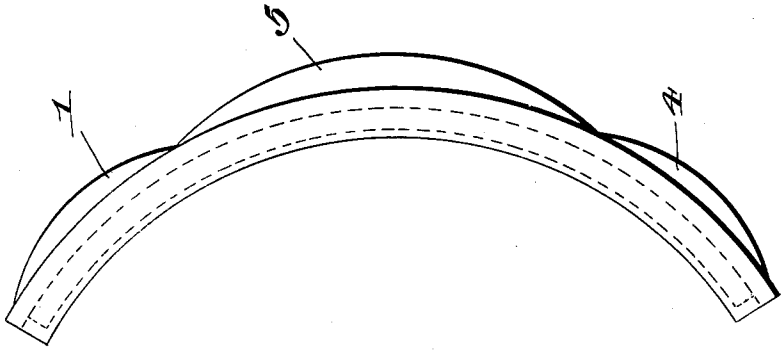


Fig. 4.

Witnesses

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FRESNEL LENS.

1,081,210. Specification of Letters Patent. Patented Dec. 9, 1913.

Application filed March 6, 1913. Serial No. 752,424.

To all whom it may concern:

Be it known that I, WILLIAM CHURCHILL, a citizen of the United States, residing at Corning, in the county of Steuben and State of New York, have invented new and useful Improvements in Fresnel Lenses, of which the following is a specification.

My invention relates to an improvement in the so-called Fresnel type of lens, generally used in marine service for sidelights and masthead lights, also for signal lights upon drawbridges over navigable rivers in conformity with the regulations of the United States Lighthouse Service and occasionally in railroad service for special lamps.

The designation "Fresnel" is commonly confined to lenses consisting of a hollow cylinder of glass or section of a cylinder with corrugations arranged transversely on the outer face, the cylinder or section having a smooth outer face. Such lenses are constructed either by building up a series of separate ground and polished segments of glass held in place by a metal frame, or else the entire lens is pressed in one solid piece in a metal mold. The latter is obviously the less expensive method and the one generally followed where extreme accuracy is not essential.

Lenses of the Fresnel type concentrate the light impinging upon them in a fan shaped beam spreading with approximately equal intensity to all points of the compass covered by the cylinder or section of a cylinder. They are generally placed in lamps so that the cylinder or section stands upright, the prismatic corrugations acting to condense the rays in all planes parallel to the axis of the cylinder, but having no condensing effect in planes perpendicular to the axis.

In my Patent No. 849,977, dated April 9, 1907, is covered an improvement in Fresnel lenses which may be described as follows: The inner cylindrical surface of the lens is made to consist of a series of connected rectangular planes, angularly disposed with respect to each other, each of the said planes being tangential to an inner circle which is concentric with the outer bounding circle of the lens, thereby forming the inner surface of the lens and producing in cross section a polygonal figure, the center of which is the center of curvature of the bounding circle. The optical result produced by such design is that the light emanating from the source of illumination is concentrated with higher intensity along the axial planes bisecting the angular surfaces at right angles. There is—see Fig. 2 of my said patent—a corresponding diminution of intensity along similar axial planes passing through the lines of intersection of the rectangular surfaces. The main advantage of a lens so constructed is, as stated in the said patent, that owing to the higher intensity of the beams in certain planes the range of the light is materially increased along the lines of maximum intensity, and a diminution of intensity in the alternate intervals is not detrimental for the reason that since the light to be observed is usually on a vessel or other moving object in more or less continual motion, and the observer is frequently also upon a vessel or other moving object, the motion in various directions will bring the regions of higher intensity within the range of the observer about as often as are brought to it the regions of diminished intensity, thereby producing an effect approximating to a greater or lesser extent to that of a flashlight.

For certain purposes it is desirable to have a lens of the Fresnel type capable of projecting a series of relatively concentrated beams as described in my said Patent No. 849,977, but having a relatively smooth outer face instead of the series of horizontal prisms usually found on a fresnel. Thus, assuming my present invention to be directed to a lens of the Fresnel type for railroad service, as for example in a classification lamp carried at the head end of a locomotive, I dispose the corrugations which produce concentration in the vertical plane upon the inner surface of the lens instead of upon its outer face, and form the outer face of the lens of a series of panels in the form of cylindrical segments some or all of which have a radius of curvature less than the distance from the source of illumination to the inner face of the lens. These segments being portions of a cylinder necessarily have parallel outlines or sides. I thus produce a lens free from corrugations on the outer face and yet one possessing the advantage to be derived from the condensation of the light in a series of relatively intense beams. A great advantage of the smooth outer face is that the lens can

much more easily be kept clean, there being practically no opportunity for dust and dirt to lodge on the exposed outer face.

In the accompanying drawing, Figure 1 is a view of my lens in perspective. Fig. 2 is a section through the center of one of the segmental panels, in other words, as along the radial line A—H as shown in Fig. 3. Fig. 2 is a top view, and illustrates the action of the lens in producing a series of beams. Figs. 4 and 5 show modifications hereinafter described.

The panels referred to are indicated in the several embodiments of my invention by 1, 2, 3, 4 and 5. In Fig. 3 the planes of maximum intensity are indicated respectively by the radial lines A—D, A—H, A—L, and A—P. The planes of minimum intensity are shown by the lines A—B, A—F, A—J, A—N, and A—R. Accordingly the angles A—C—E, A—G—I, A—K—M and A—O—Q are those covered by the beams of higher intensity, while the angles A—B—C, A—E—G, A—I—K, A—M—O and A—Q—R are those covered by beams of diminished intensity. It is practicable to design and construct the lens so that between the beams of high intensity there are intervals of total darkness. If this result is desired a relatively small number of such segmental panels are provided, this modification requiring that the angle covered by each segment shall be made relatively large and the radius of curvature relatively short. I have, however, found it desirable, in most cases, to employ segmental panels of such size and curvature that with an ordinary source there shall be some illumination at every point of the angle which the lens subtends. It is entirely practicable to obtain such a result, for the series of fan-like beams projected by the lens tend to overlap at their edges. If the source of illumination employed were intensely concentrated so that it approximated a mathematical point, such overlapping of the beams would obviously be practically impossible, and therefore in a lens designed according to my invention we should have a series of zones of total darkness alternating with the zones of maximum illumination. However, with the sources employed in ordinary practice such an effect, though not necessary, can be produced or avoided as may be desired. With the relatively large area covered by a kerosene flame, or an ordinary incandescent lamp filament, the two most common sources of illumination in lamps where fresnels are employed, by modifying the design to meet the special requirements of any given case it is possible to secure any desired distribution of the light within the several beams.

My invention may be modified by using segmental panels of varying radii of curvature on the outer face, or by combining such panels of relatively shorter curvature with others having a center of curvature coinciding with the source of illumination and the sweep of the prisms on the inner face. Thus if it be desired to produce a concentrated beam along the axis A—J of Fig. 3, a single segmental panel, 5, as seen in Fig. 4, may be substituted for the panels 2 and 3 of Fig. 3; or, as shown in Fig. 5, the radius of curvature A—Y as seen in Fig. 3 may be used for the outer face between the points X and Z at the inner sides of the panels 1 and 4, respectively. In the latter case the segment A—X—Z would act as an ordinary Fresnel lens having on each side a beam of relatively high intensity produced by the means described.

A lens designed and constructed according to my invention may be made to cover any angle up to 360 degrees. However, if the angle covered exceeds 180 degrees it is necessary to press the lens in two or more parts and then combine them by cement, metal fittings or other suitable means.

Having thus described my invention, I claim:—

1. A Fresnel lens the outer surface of which is provided with a series of connected segmental panels each having a radius of curvature less than the radius of curvature of the cylinder passing through the points of intersection of said panels, substantially as set forth.

2. A Fresnel lens the outer surface of which is provided with a series of connected segmental panels each having a radius of curvature common to all and less than the radius of curvature of the cylinder passing through the points of intersection of said panels, substantially as set forth.

3. A Fresnel lens the outer surface of which is provided with segmental panels each having a radius of curvature less than the radius of curvature of said outer surface, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM CHURCHILL.

Witnesses:
HENRY PHELPS GAGE,
EMILIO PASCUCCI.