G. A. H. KELLNER.

LENS.

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1,021,104. Patented Mar. 26, 1912.

Fig. 3.

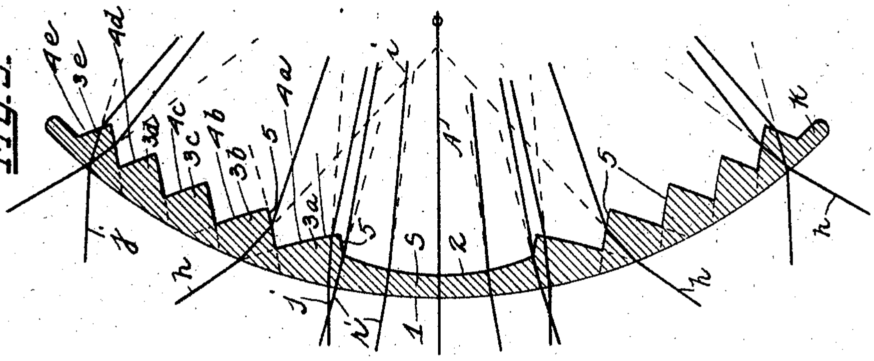


Fig. 1

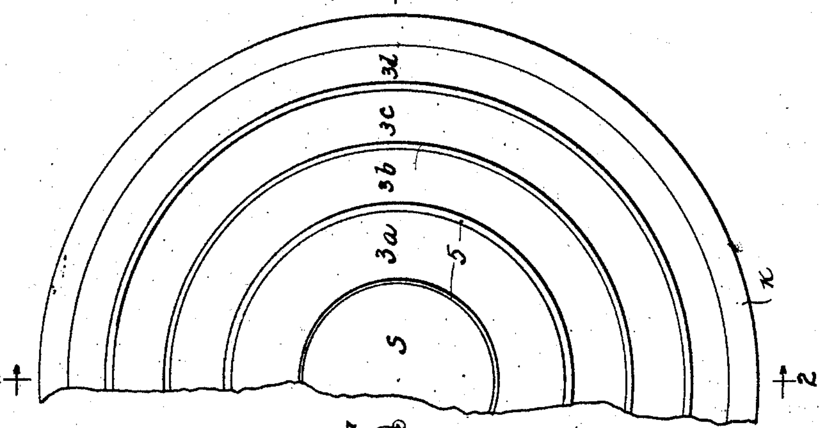
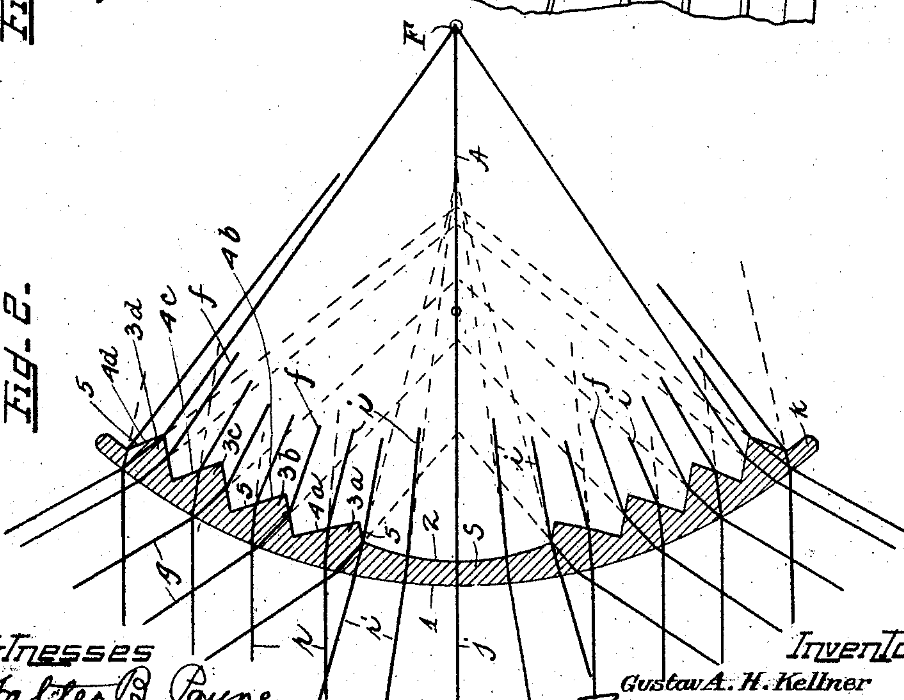


Fig. 2.



Witnesses

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LENS.

1,021,104. Specification of Letters Patent. Patented Mar. 26, 1912.

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To all whom it may concern:

Be it known that I, GUSTAV A. H. KELLNER, a resident of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Lenses, of which the following is a full, clear, and precise specification.

My invention relates to lenses, particularly to those of the Fresnel type and contemplates improved construction which will adapt such lenses for more efficient use on vehicles such as automobiles, railway cars or the like. Lenses of this type comprise a plurality of refracting zones or annuli. In headlights or lamps it is desirable to be able to observe at any time the condition of the light source, particularly where the source is in the form of an oil lamp. It is impossible to obtain a clear-cut image of the flame through the refracting zones and several constructions have been resorted to in the prior art to provide means whereby the flame could be observed through some part of the lens without opening the lamp. In some of these prior constructions a lens is continued beyond the refracting zones to form a plain annular band at the outer edge of the lens through which the flame can be observed. This construction, of course, greatly increases the size of the lens and renders a great per cent. thereof useless for the lighting purposes for which the lens is to be used, this outer annular band in some cases constituting one half of the lens surface. Furthermore, with this construction the flame can be viewed only from an angle. Also in prior lenses of this class no attempt has been made to utilize the base surfaces of the refracting zones, which base surfaces in most cases are parallel with the principal axis of the lens or are only slightly at an angle therewith sufficient to enable the lens to be withdrawn from the mold after casting thereof. In fact, in all these prior lenses the aim has been to retain only such rays as are parallel or approximately parallel to the principal axis and the base faces of the refracting zones have purposely been constructed at a small angle so that incident rays would upon refraction fall within the critical angle and thus be lost for external illumination.

Among the salient objects of my invention are to so construct a lens of this class that the sight section is reduced to a minimum; to arrange this sight section at such part of the lens where a true elevation view can be obtained of the flame or other source; to eliminate the prior art outer sight band of wasteful area and to concentrate the sight section at the center of the lens into a very small area as compared with the entire lens area; to so arrange the optical dimensions of the sight section that a clear elevation image of the flame can be obtained without blinding the eyes while at the same time preventing the loss of any appreciable number of useful light rays emanating through the sight section; to utilize fully the base faces of the refraction zones for attaining divergent emanating rays at proper angles to illuminate the ground directly in front of and at the sides of the path of travel of the vehicle, and to do this without in any way impairing the full efficiency of the axial parallel rays refracted from the inner faces of the refraction zones; and in general to provide improved construction which will materially reduce the size and weight of the lens, yet which will cause the efficiency of the lens to be greatly increased.

Lenses which incorporate the above features of my invention are clearly described in the following specification and shown on the accompanying drawing, in which drawing—

Figure 1 is an interior plan view of a lens with the left half thereof broken away, Fig. 2 is a sectional view taken on plane 2—2, Fig. 1, and Fig. 3 is a similar sectional view but showing a somewhat modified arrangement.

The lens has an outer spherical convex surface 1, and an inner central concave surface 2, the refracting zones or annuli 3 extending from the convex surface 2 to the extreme circumference of the lens.

In Figs. 1 and 2 four refracting zones 3^a, 3^b, 3^c, 3^d, are shown having the inner convex surfaces 4^a, 4^b, 4^c, 4^d, respectively. The radii of these various surfaces are so proportioned with reference to the radius of the surface 1 that all the zones will focus exactly at one point which is the principal focus F in which the flame or other illuminant is situated. The lens, therefore, forms a spherically corrected condenser and all incident rays striking the convex surfaces 4^a, 4^b, 4^c, 4^d, will be refracted into illuminating rays which are parallel or sustantially parallel to the principal axis A. As shown in Fig. 2, the incident rays i emanating from the focal center and striking the convex refracting surfaces are refracted and emerge as the illuminating rays r which are substantially parallel with the principal axis A. The section of the lens bounded by the inner concave surface 2 and the outer convex surface 1 forms a sight section s through which rays emanating from the principal focus are slightly refracted outwardly. As shown, the incident rays i' passing through this sight section emerge as rays r' which deflect slightly from the principal axis. The image of the flame observed through this sight section will be slightly reduced in size but the image will be distinct and clear-cut and can be observed without blinding or undue straining of the eyes. Furthermore, a true elevation view of the flame can be obtained and thus the flame can be adjusted with great precision without opening of the lamp casing. This inner sight section need only be large enough to enable a view of the entire flame, and its area as compared with the entire lens area is very small indeed. In the lens shown in Fig. 2, the sight area involves only about one-thirteenth of the entire lens surface, whereas in prior lenses the sight area which extends about the outer edge of the lens involves about one-half of the total lens area. Although the emerging rays at the sight section slightly diverge, this is no disadvantage, as the diameter of the sight section is small and the parallel rays r from the refraction zone are of sufficient number and intensity to give sufficient forward illumination, while the slightly diverging rays r' through the sight section are more efficiently utilized in illuminating the roadway a short distance ahead of the vehicle and to the sides. In other words, the slight loss of a small core of parallel rays is more than offset by the great advantages obtained by the central sight section which enables vision of a clear-cut elevation view of the flame and which results in decrease in weight and size of the lens.

In prior lenses the base surfaces 5 of the refraction zones are parallel with the principal axis or are given only sufficient angularity with respect to the principal axis to enable the lens to be better drawn from the mold after casting thereof. In such construction, however, incident rays from the focus would be refracted within the critical angles or would emerge at angles which would render them useless for illuminating purposes. In accordance with my invention these base surfaces are given sufficient angularity with respect to the principal axis so that illuminating rays emerge at a useful angle to give diagonal illumination in all directions, which is very desirable on vehicles such as automobiles. As shown, the incident rays f entering the refracting zones at their bases are refracted into diagonal rays g which are parallel or approximately so. In the construction of lens shown the base surfaces are parallel and have angles of ten degrees with the principal axis so that the emergent illuminating rays g are inclined from about fifty-five to sixty degrees with respect to the principal axis. Depending, of course, upon the angle of the base surfaces the resultant emerging rays can be given any angular divergence from the principal axis. Thus in my improved lens not only are all the useful forward parallel rays retained but in addition another useful field of diverging rays is obtained and utilized to the fullest advantage by merely sufficiently increasing the angularity of the refraction zone bases. We have, in fact, three very useful illuminating fields, namely, a field comprising the substantially parallel rays r which illuminate at a distance ahead of the vehicle, a field comprising the rays r' emerging through the sight section and illuminating forwardly and outwardly at a shorter distance from the vehicle, and a field comprising the divergent or diagonal rays g which illuminate forwardly and outwardly close to the vehicle. Thus in my construction as compared with that of the prior art a much greater amount of light is obtainable, a better arrangement of the illuminating rays is possible, and at the same time this is all accomplished by a much smaller and lighter lens and one in which much better observation can be made of the illuminant.

In Fig. 3 is shown a somewhat modified arrangement in that five zones 3^a, 3^b, 3^c, 3^d, 3^e, are provided, thus giving a greater lens aperture. In Fig. 2 the base surfaces of the refraction zones are straight, but in Fig. 3 these surfaces are curved and the curvature could be either convex or concave. As shown in Fig. 3, these base surfaces have spherical convex curvature and the radii of curvature of the various bases may be the same or different. As shown in Fig. 3, the radii of these surfaces are different and the emergent rays h diverge relatively, as shown, and give a wider diagonal field of illumination. The radii of curvature of the inner surfaces 4^a, 4^b, 4^c, 4^d, 4^e of the refracting zones are such that the emergent rays j are substantially parallel with the principal axis A and the ray direction of the sight section s is the same as that shown in Fig. 2. The outer edge k of the lenses forms an annular tongue which is adapted to be received in a suitable annular pocket of the lamp frame to which the lens is applied. The base surfaces of the refracting zones can, therefore, be straight or can be given any form of curvature and a pitch with reference to the principal axis which will cause incident rays to be refracted into useful illuminating rays. The lenses are of practically uniform thickness throughout, the distances between the inner ends of the bases 5 and the outer surface 1 being equal and the axial thickness of the sight section *s* being also equal to these distances. The lens will, therefore, be free from detrimental strains during the formation and cooling thereof.

Modifications can, of course, be made in the construction, which will still come within the scope of my invention, and I do not, therefore, limit myself to the particular construction shown and described, but

I claim the following:

A circular headlight lens having an incident concave surface of one curvature with a small central section of greater curvature, refracting prismatic extensions on the sur^f^ce between the central section and the periphery of the lens, and a common emergent surface for the lens of convex curvature, the surfaces having a common focal point, the inner faces of the prismatic extensions coöperating with the convex emergent surface to refract incident rays into emergent rays substantially parallel with the axis to illuminate at a distance from the lens, the base surfaces of the extensions coöperating with the emergent surface to refract incident rays into divergent rays for illuminating at a short distance in front of the lens, and the central convex concave section refracting incident rays into rays of small divergence for illuminating at an intermediate distance in front of the lens, said lens being of substantially uniform thickness.

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Witnesses:

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