O. E. CONKLIN.
HEADLIGHT LENS.
APPLICATION FILED MAY 5, 1919.

1,399,749.

Patented Dec. 13, 1921.

2 SHEETS—SHEET 1.

Fig. 1.

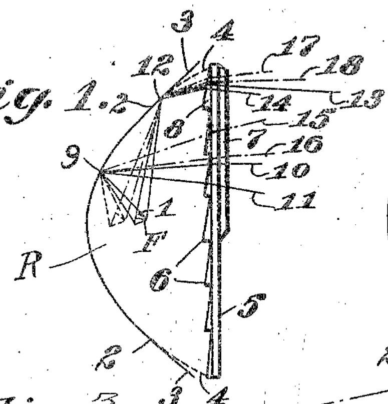


Fig. 2.

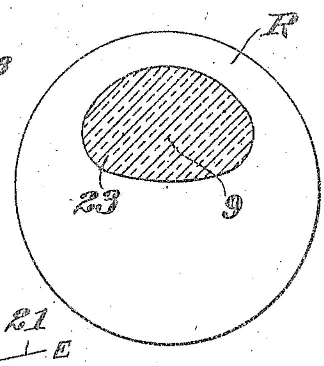


Fig. 3.

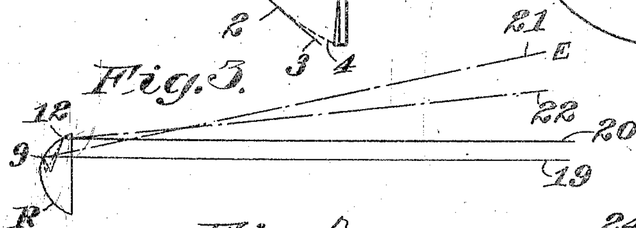


Fig. 7.

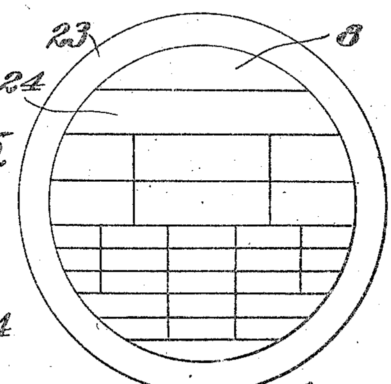


Fig. 4.

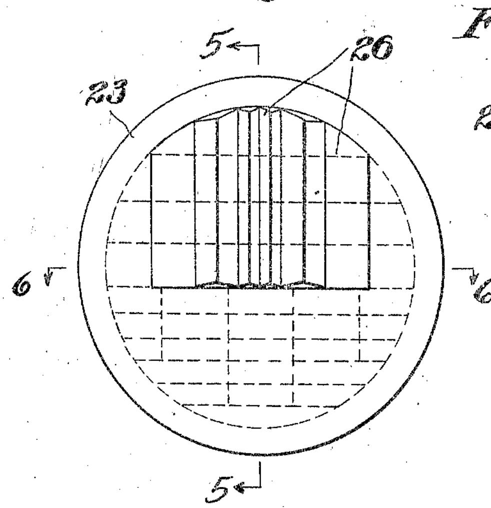


Fig. 5.

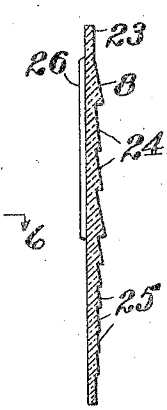


Fig. 8.

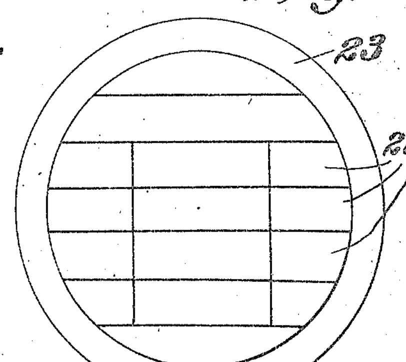
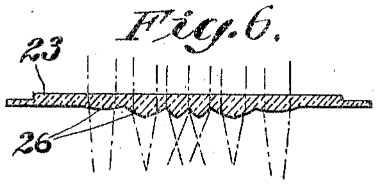


Fig. 6.



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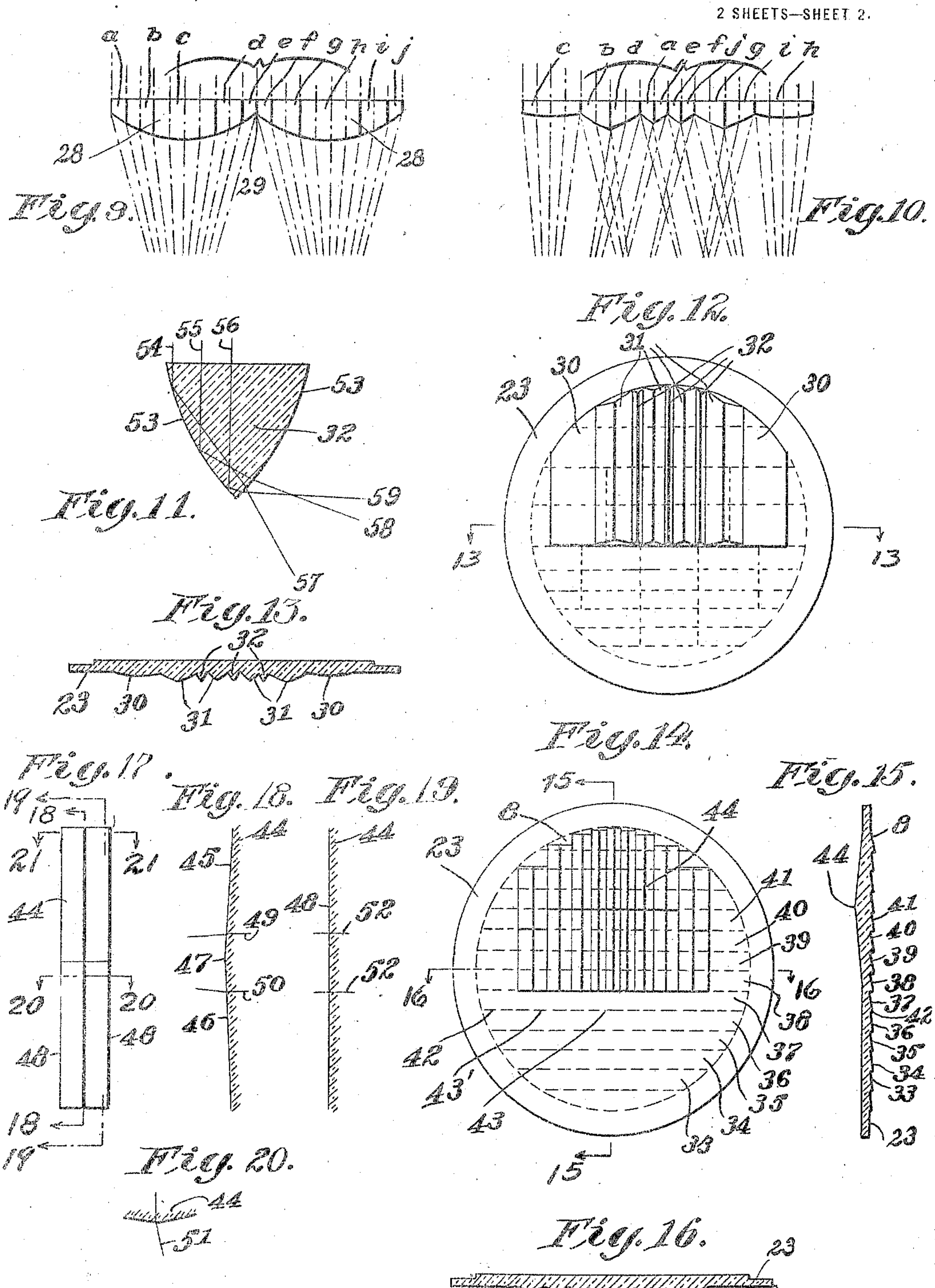
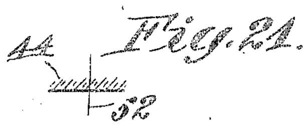
2 SHEETS—SHEET 2.





Inventor
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his Attorneys

UNITED STATES PATENT OFFICE.

OLIVER E. CONKLIN, OF BOSTON, MASSACHUSETTS.

HEADLIGHT-LENS.

1,399,749. Specification of Letters Patent. Patented Dec. 13, 1921.

Application filed May 5, 1919. Serial No. 294,906.

To all whom it may concern:

Be it known that I, OLIVER E. CONKLIN, a citizen of the United States, and resident of Boston, in the county of Suffolk and State of Massachusetts, have invented new and useful Improvements in Headlight-Lenses, of which the following is a specification.

This invention relates to headlight lenses of the type intended to obviate glaring or dazzling effects and more particularly to headlight lenses of the character disclosed in my former application Sr. No. 241,500, filed June 24, 1918.

The principal object of the invention is substantially to eliminate the upward glare from headlights and at the same time to improve the distribution of the light throughout the distant and nearer portions and the side or sides of the roadway, especially for automobile use. Another object is to obviate the glare which is peculiar to V-shaped filaments or filaments having V-shaped sections, when such filaments are placed in various positions in the headlights. A further object is to eliminate the glare which results from the flare ordinarily given to the marginal portions of headlight reflectors when formed by the usual methods.

As disclosed in my aforesaid application I have discovered the following concerning headlight glare. When the usual forms of lamp filaments are employed in the ordinary commercial headlight which is approximately but not accurately paraboloidal, most of the upward glare comes from the central region of the reflector. For example, with a V-shaped filament disposed substantially in the vertical axial plane of the reflector, symmetrically to the axis of the reflector, the glare spot, that is the area of the reflector from which most of the upwardly inclined rays are reflected, is confined to the axial region of the reflector. With the filament shifted about its axis into the horizontal axial plane, the glare comes principally from two glare spots located in the vertical central region of the reflector, one above and the other below the axial region of the reflector.

As further disclosed in my aforesaid application the glare from all over the headlight may be eliminated for a definite position of the light source by means of horizontal prisms, and additional protection against glare may be obtained by covering the glare spots with vertical ribs which deflect the light from the glare spots out of the central part of the beam. The advantage of this additional protection against glare is that it permits a certain movement of the light source in all directions from the position in which the horizontal prisms alone are sufficient to protect from glare, thus avoiding the necessity of accurately positioning the light source. This additional protection however has the disadvantage of rendering the headlight less effective for long distance illumination.

By my present invention I propose to correct the entire surface of the headlight for glare for one longitudinal position of the light source and for several vertical positions by the use of horizontal prisms, and to employ vertical ribs as additional protection over the upper of the glare spots above referred to. Thus while my present invention corrects for less inaccuracy in the positioning of the light source it affords a much greater long range illumination.

I have also discovered from a careful examination of a great many headlight reflectors that they depart from a perfect paraboloidal form by flaring outwardly near the rim and that the effect of this outward flare is to cause glare principally at the top of the reflector. In order to eliminate the glare which arises from this source, I propose to provide the headlight lens near its upper edge with a horizontal prism of high refractive power thus bending downwardly the glare producing rays which are reflected from the upper edge of the reflector.

It is often desirable to extend the lateral width of the beam in order that the sides of the road may be properly illuminated directly in advance of the headlight. As vertical refracting prisms will not give a wide lateral distribution of the light rays, I therefore propose to employ internal reflecting prisms for this purpose.

My invention is particularly exemplified in the accompanying drawings in which—

Figure 1 is a schematic drawing of a vertical section through a reflector having an outward flare at its edge, showing the location of the upper glare center;

Fig. 2 is a schematic front view of the reflector of Fig. 1, showing the approximate shape and location of the upper glare spot;

Fig. 3 is a schematic drawing of a vertical longitudinal section of the reflector, showing the course of several rays when the light source is moved rearwardly from the focus;

Fig. 4 is a front view of one embodiment of my invention;

Fig. 5 is a section on line 5—5 of Fig. 4;

Fig. 6 is a section on line 6—6 of Fig. 4;

Fig. 7 is a front view of a lens showing one arrangement of horizontal prisms;

Fig. 8 is a front view of a lens showing a modified arrangement of horizontal prisms;

Fig. 9 shows cylindrical lenses which may be used as vertical lens ribs to distribute light laterally;

Fig. 10 is a modified arrangement of cylindrical lens ribs;

Fig. 11 is a section of an internal reflecting prism which may be used as a vertical lens rib;

Fig. 12 is a front view of an embodiment of my invention in which vertical internal reflecting prisms and refracting prisms are alternated;

Fig. 13 is a section on line 13—13 of Fig. 12;

Fig. 14 is a front view of a preferred embodiment of my invention in which the vertical ribs are flexed;

Fig. 15 is a section on line 15—15 of Fig. 14;

Fig. 16 is a section on line 16—16 of Fig. 14;

Fig. 17 is a detail of one of the ribs shown in Fig. 14;

Fig. 18 is a section on line 18—18 of Fig. 17;

Fig. 19 is a section on line 19—19 of Fig. 17;

Fig. 20 is a section on line 20—20 of Fig. 17; and

Fig. 21 is a section on line 21—21 of Fig. 17.

Three factors must be considered in the correction of headlights to eliminate glare or the upward tendency of some of the light rays. These factors are the shape of the light source, its position with respect to the focus, and the inaccuracy of the reflector.

The light source which is most commonly used in headlights is the Mazda "C" miniature lamp having a spiral filament which is bent into a V-shape. In practice, the plane of the V may be either horizontal or vertical, or may take any angular position between the horizontal or vertical, the position depending upon the position of the lamp bulb in its socket. In order however to correct the beam for glare regardless of the angular position of the V it is necessary to design the lens upon the assumption that the light source is a cone of light generated by rotating the filament about its bisector.

In Fig. 1, I have diagrammatically shown a cross-section through a reflector R of the ordinary paraboloidal type having an outward flare at the rim between the points 2 and 3. This outward flare departs from the true paraboloidal surface which would follow the dotted lines 2—4. This outward flare I find is a very common inaccuracy in the design of reflectors ordinarily found on the market. A lens 5 having horizontal refracting prisms 6 and vertical prisms 7, is secured in the reflector in any suitable manner, the horizontal prisms having decreasing refracting power from the center of the lens upwardly and downwardly. The prism 8 at the extreme upper edge of the reflector, however, is provided with high refracting power to correct for the outward flare of the reflector. The source of light is represented at 1, in full lines, as a conical figure, and is located at its proper position with its axis coincident with the axis of the reflector and its base at the focus F. The source 1 is also represented by dotted lines displaced backwardly along the axis of the reflector. With the light source positioned as shown in full line, the rays from the rear portion of the light source 1, and incident to the reflector at point 9 on the reflector, are bent downwardly and emerge from the lens at 10 producing no upward glare. A ray from the apex of the source, also incident at 9, emerges from the lens at 11 in a downwardly direction. Rays from the rear and apex of the source, which are incident on the flaring portion of reflector R at 12, are bent downwardly by the upper horizontal prism 8 and emerge at 13, 14 respectively. Thus with the source 1 properly positioned, all rays incident to the reflector are bent downwardly and glare is eliminated.

When, however, the light source is improperly positioned back of the focus F, as shown in dotted lines, rays from the source incident to the reflector at points 9 and 12 emerge as indicated at 15, 16, 17 and 18, and are all directed upwardly. Thus it is clear that all rays in the upper half of the reflector R will be displaced upwardly when the light source is moved backward from the focus. This upward displacement, I have found, is greatest at the point 9 whose distance above the axis of the reflector is $\sqrt{\frac{4}{3}}$ times the focal length of the reflector. In order to understand the full significance of this fact, suppose the vertical prisms 7 of the lens 5 are omitted, and one is looking into the headlight from a considerable distance ahead with his eye at point E, as shown in Fig. 3, then with the light source properly positioned in the reflector R, rays incident to the reflector R at points 9, 12 are directed by the horizontal prisms below the level of the eye as indicated by full lines 19, 20. If now the light source is pushed backwardly, the ray incident at the point 9 is not refracted sufficiently to be directed below the level of the eye, but reaches the eye at E as shown by the dotted line 21, and thus the eye looking along the ray 21 sees a glare spot at 9. On the other hand the ray incident at 12, although upwardly directed, passes below the level of the eye at E, and the eye therefore does not receive any light from 12, and therefore the glare spot does not extend from point 9 to the point 12. Accordingly the glare area does not cover the entire upper half of the reflector but is of limited extent. For a definite position of the light source this glare area will have the general position and shape shown by the shaded area 23 of Fig. 2. If the light source is moved away from the focus the area 23 becomes larger and if moved nearer the area 23 becomes smaller.

By covering this area with vertical refracting or reflecting elements designed to diffuse the light laterally to the sides of the road, the glare thus caused by the improper position of the light source may be reduced and can be entirely eliminated from the central portion of the beam for a substantial displacement of the light source. In Figs. 4, 5 and 6, I have shown one embodiment of my invention for thus laterally diffusing the light. The lens 23 is provided with horizontal prisms 24 and 25 which have flat surfaces and preferably decrease in refractive power from the center of the lens both upwardly and downwardly, and laterally on either side of the center. The number of horizontal prisms 25 on the lower half of the lens 23 have been increased relatively to the number of prisms 24 on the upper half of the lens in order to give a more exact correction of the beam of light incident from the lower half of the reflector, and in consequence provide better long distance illumination, inasmuch as the light from the lower half of the reflector is depended upon for long distance illumination. In Fig. 4 I have indicated the arrangement of the horizontal prisms by dotted lines and in Fig. 7 by full lines. It is to be noted that the upper horizontal prism 8 is of relatively high refractive power for the purpose of correcting for the outward flare of the reflector as has been hereinbefore pointed out. The upper portion of the lens is also provided with vertical cylindrical ribs 26 of the special type disclosed in Fig. 10. As the glare first appears in the upper vertical central region of the reflector, the refractive power of these ribs is therefore greatest at the center and decreases laterally outwardly toward the edges of the lens as clearly shown by the sectional view, Fig. 6. These ribs are located on the face of the lens opposite the horizontal prisms and extend only slightly below the horizontal center line of the lens. They could of course extend over the entire face of the lens, but as the principal glare spot is above the center and as the light from the lower part of the reflector is used for long distance illumination, it is preferable to allow the light to pass through the lower half of the lens without lateral diffusion. The light lines in Fig. 6 indicate the path of light rays through the vertical ribs of the lens.

As a concrete example of one form which the lens of Fig. 7 may take for a specified shape and position of the light source, the horizontal prisms may have the angles of slope given in degrees in the following table, the prisms being taken in order downwardly and from left to right: 10; 4; 4.5, 6.5, 4.5; 5, 7, 5; 3.25, 5.75, 6.5, 5.75, 3.25; 2.75, 4, 4.25, 4, 2.75; 2, 3.4, 3.9, 3.4, 2; 2.9, 3.3, 2.9; 2.4, 2.5, 2.4; 2.

In Fig. 8 I have disclosed an alternative arrangement of horizontal prisms 27, in which the prisms are all of substantially the same width, the number on the lower portion of the lens being substantially the same as the number on the upper portion of the lens. It is obvious that this arangement of horizontal prisms 27 can be used with any of the embodiments of vertical prisms herein disclosed.

For a specified shape and position of the light source the horizontal prisms may have the angles of slope given in degrees in the following table, the prisms being taken in order downwardly and from left to right: 6.5; 2.5; 4.5, 6.5, 4.5; 5, 7, 5; 4.5, 6.5, 4.5; 4, 6.5, 4; 4.25.

It is well known that cylindrical lenses provide one of the best means for distributing light laterally as they diffuse it smoothly and without striæ, *i. e.* without alternate dark and light areas. In Fig. 9 I have disclosed two such cylindrical lenses or ribs 28 which might be employed as vertical ribs to cover the upper portion of a headlight lens. Such lenses however when of short radius, as would be necessary over the center of the glare spot, would require a considerable thickness of glass in order that the headlight lens might not be weak at the junction 29 of the cylindrical ribs. To overcome this difficulty the lenses 28 may be divided up into parts as indicated at *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, and *j* and rearranged as shown in Fig. 10. The arrangement of Fig. 10 has the additional advantage in that the rays which have the greatest tendency to glare receive the greatest deflections. In both Figs. 9 and 10 the rays of light have been indicated by light lines, incident to the flat face of the lenses and deflected by the cylindrical faces. The rays inclosed by brackets are those having the greatest tendency to glare. While I have illustrated convex lenses, I wish it to be clearly understood that concave lenses could be used in the same manner.

Fig. 11 shows a cross-section of an internal reflecting element 32 comprising two cylindrical surfaces 33 meeting at an acute angle. Light rays 54, 55 and 56 are shown reflected by the internal surface of the member and emergent at 57, 58 and 59 respectively. It is evident from a study of Fig. 11 that if the entire glare area of a headlight lens were covered with members similar to 32 that the light rays which would have a tendency to produce glare would be widely diffused and the width of the beam extended to nearly 180°. Such construction would not however be practical because the grooves between adjacent elements 32 would be relatively deep and would collect dirt very easily. I therefore propose to employ such internal reflecting members 32 in combination with cylindrical lens ribs such as disclosed in Fig. 10. This embodiment is illustrated in Figs. 12 and 13, in which 23 is a headlight lens having cylindrical lens ribs 30 and 31 and internal reflecting members 32 arranged in alternation with the ribs 31. It is understood that these vertical ribs may be used in combination with any of the sets of horizontal ribs herein illustrated.

Figs. 14 to 21 inclusive illustrate the preferred embodiments of my invention in which the lens 23 is provided with horizontal ribs 33 to 41 inclusive which are of the flexed type disclosed in my co-pending application above referred to. The remaining horizontal ribs are flat, as no particular advantage is gained in making them flexed. The top rib 8 is of high refractive power for the purpose of correcting for the inaccurate flare of the reflector as hereinbefore mentioned. The edges 42 of the flexed ribs are convex at the center 43 and concave near the ends 43. By means of these flexed ribs it is possible to obtain better long range illumination and at the same time avoid glare. The vertical ribs 44 are also of the flexed type shown more in detail in Figs. 17 to 21 inclusive. These ribs 44 are so designed and placed on the lens that the refractive power decreases in all directions from a point substantially in front of the glare center. Thus the greatest possible illumination along the axis of the beam is obtained consistent with adequately covering the upper glare area. In case more lateral illumination is needed the refractive power of the vertical ribs 44 may be varied upwardly and downwardly only, or laterally only. In the latter case the ribs would not be flexed, but of the form disclosed in Figs. 4, 5 and 6, or the form shown in Figs. 11, 12 and 13.

In Figs. 17 and 21 inclusive I have illustrated in greater detail a vertical rib 44 of the flexed type such as is employed in the embodiment illustrated in Figs. 14, 15 and 16. The center line of the rib is flexed as shown by the section view Fig. 18, such flexed edge being made up of two straight lines 45 and 46 which join at a point 47 which is at the approximate center of the longitudinal length of the rib. The edges 48 of the rib are straight throughout their length as shown by the sectional view Fig. 19. Thus the rib 44 has considerable depth at its center line 20—20 as shown in Fig. 20 and no depth at its ends as shown in Fig. 21. Thus, referring to Figs. 18 and 20 a ray 49 incident to the rib above its vertical center is deflected downwardly and a ray such as 50 incident to the rib below its center is deflected upwardly, but both of these rays would be deflected laterally as at 51 in Fig. 20. A ray incident to the rib near its edges 48 would be very slightly deflected either upwardly or downwardly as is illustrated at 52 in Figs. 19 and 21. For similar reasons a ray incident to the rib near its ends would be only slightly deflected laterally. Intermediate sections of these ribs will deflect light rays by varying amounts, so that each rib distributes light continuously and without striæ.

Vertical ribs of this character have three distinct advantages: In the first place they cover the upper glare spot in the most efficient manner; secondly, they distribute the light laterally without striæ, and thirdly, they meet the surface of the lens at their ends so that there are no rough places or creases to collect dirt.

The terms horizontal, vertical, etc, are not necessarily to be construed in their narrow and exact sense but are preferably to be construed to include directions and positions which are approximately horizontal, vertical, etc.

I claim:

1. In a headlight having a reflector substantially paraboloidal but inaccurately shaped at its edge, the combination of the reflector, and a lens having horizontally disposed prismatic ribs on one face thereof, the refractive power of which decrease from the center of said lens outwardly, the rib at the top edge of said lens of higher refractive power than the other ribs arranged to correct for the inaccurate shape of the edge of said reflector.

2. In a headlight having a reflector substantially paraboloidal but inaccurately shaped at its edge, the combination of the reflector, and a lens having flat-faced horizontal prismatic ribs on one face thereof, the refractive power of which decrease from the center of said lens outwardly in all directions, the rib at the top edge of said lens of higher refractive power than the other ribs arranged to correct for the inaccurate shape of the edge of said reflector.

3. In a headlight having a reflector substantially paraboloidal but inaccurately shaped at its edge, the combination of the reflector, and a lens having horizontally

disposed prismatic ribs on one face thereof, the refractive power of successive ribs decreasing from the center of said lens outwardly, the number of said ribs disposed below the horizontal center line of the lens being greater than the number disposed above such center line, certain of said ribs comprising a plurality of laterally disposed sections having different refractive powers, the refractive power of each rib being greatest at the vertical center line of said lens and the uppermost rib having high refractive power arranged to correct for the inaccurate shape of the edge of the reflector.

4. A headlight lens having horizontally disposed prismatic ribs on one face thereof, vertically disposed ribs having cylindrical surfaces covering a portion of the other face of said lens, and vertically disposed internal reflecting members arranged in alternation with certain of said vertical ribs.

5. A headlight lens having vertically disposed ribs having cylindrical surfaces covering a portion of one face of said lens, and vertically disposed internal reflecting members arranged in alternation with certain of said vertical ribs.

Signed by me at Rochester, New York, this 29th day of April, 1919.

OLIVER E. CONKLIN.