June 19, 1928. 1,674,165

W. A. DOREY

LUMINAIRE

Filed June 15, 1927 3 Sheets-Sheet 1

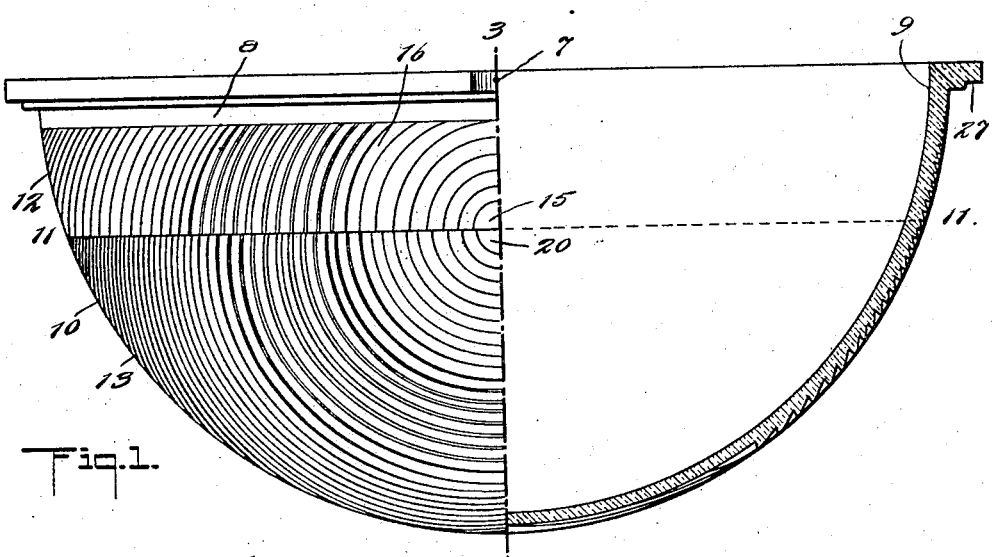

Fig. 1.

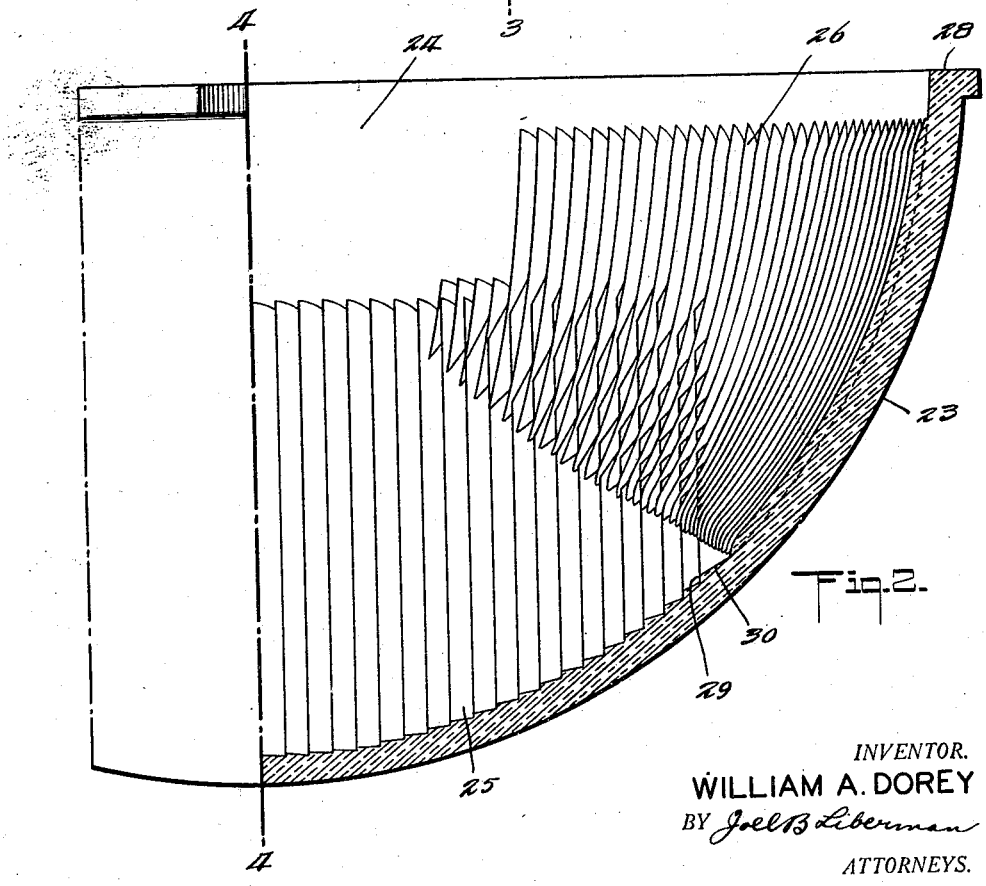

Fig. 2.

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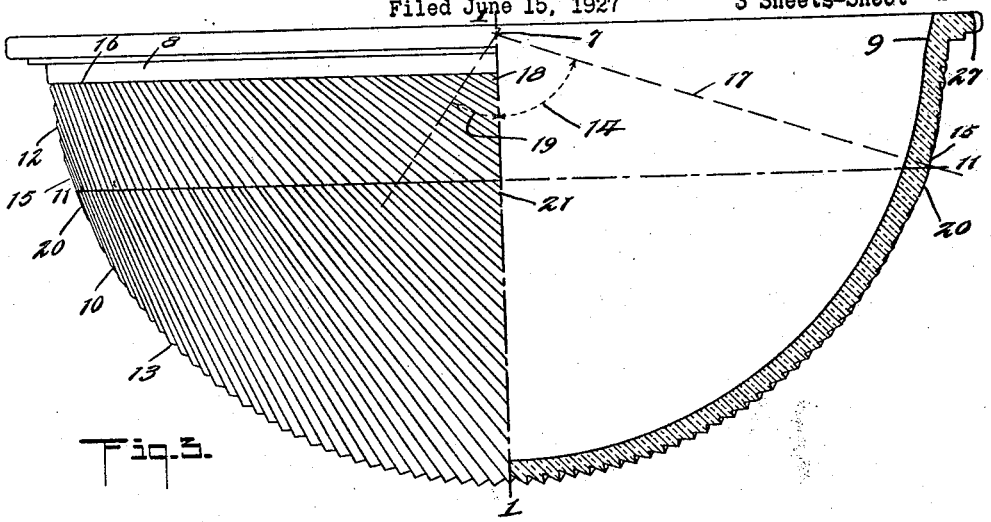

Fig. 5.

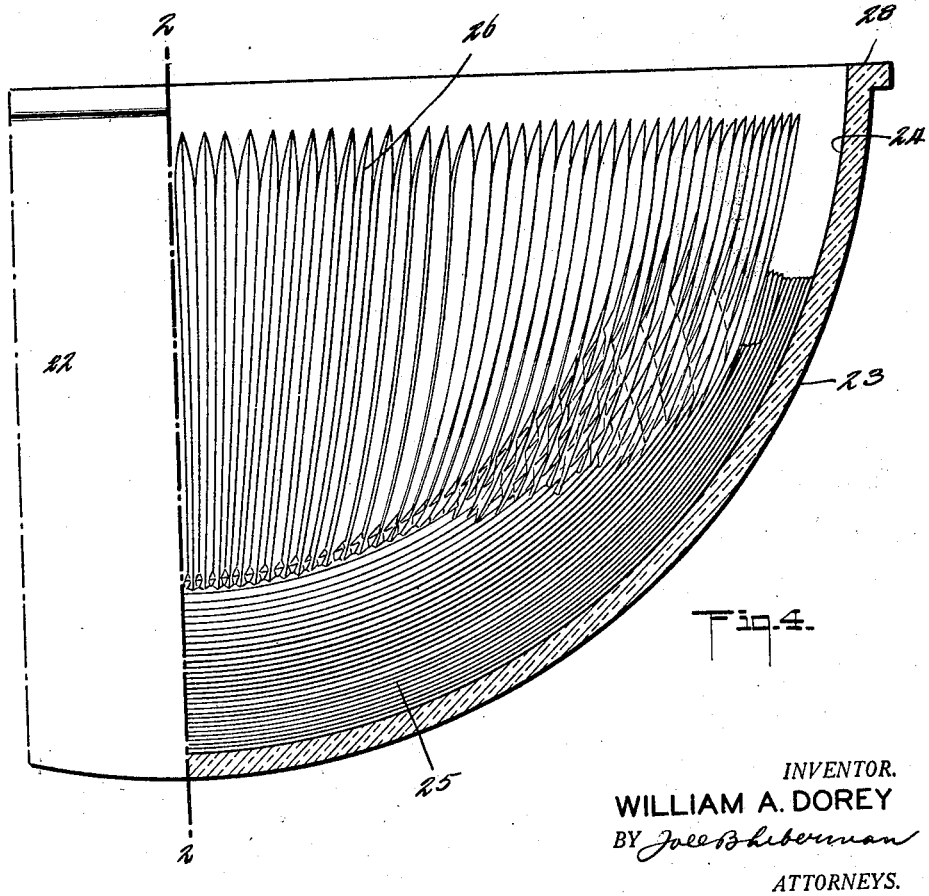

Fig. 4.

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LUMINAIRE

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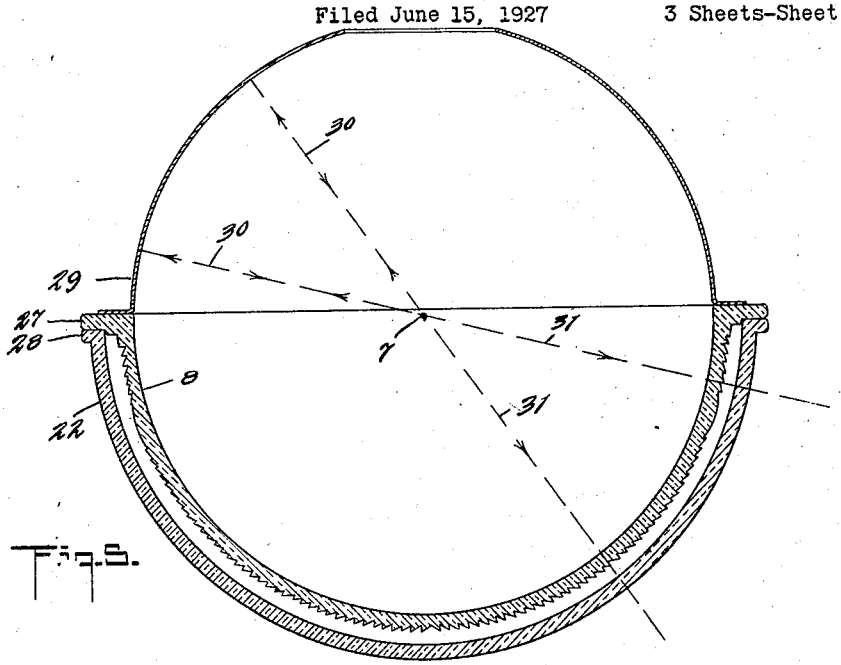

Fig. 5.

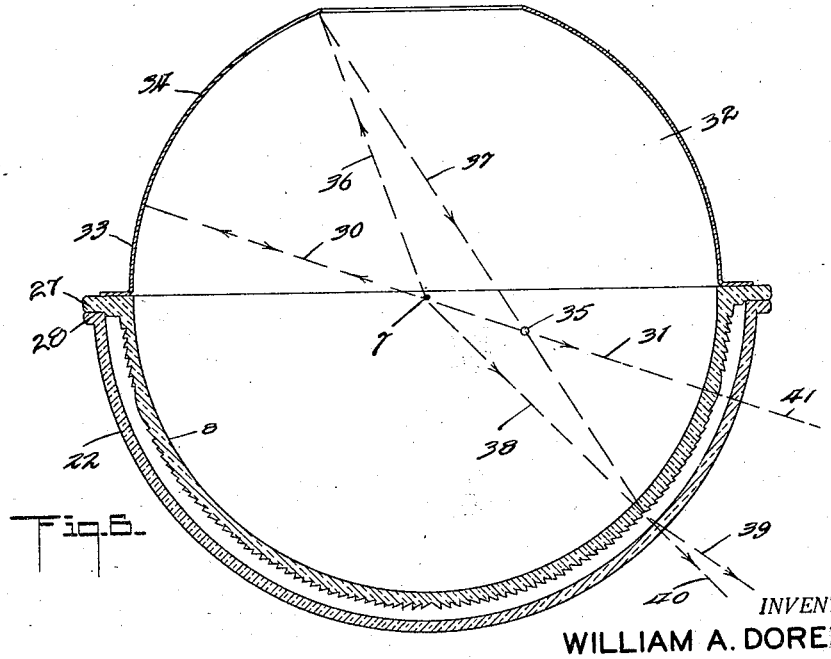

Fig. 6.

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Patented June 19, 1928. 1,674,165

UNITED STATES PATENT OFFICE.

WILLIAM A. DOREY, OF NEWARK, OHIO, ASSIGNOR TO HOLOPHANE COMPANY, INC., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

LUMINAIRE.

Application filed June 15, 1927. Serial No. 198,998.

The object of the present invention is the construction of a prismatic globe in which substantially all of the light from the lamp emitted below the horizontal is gathered into a comparatively narrow strip and directed to the road surface to produce a reasonable approximation of uniform intensity. This is accomplished by means of a combination of annular lens forms with their axes set at varying inclinations in a vertical plane co-operating in part with prisms parallel to the plane of the lens axes and in part with vertical prisms, both the parallel and vertical prisms being adapted to refract the light toward the vertical plane through the lens axes. The proportion of parallel and vertical prism forms will depend largely on the mechanical limitations imposed on the parallel prisms by the requirements of mold relief. While the invention has been described with reference to highway or street lighting, it is adapted to many other luminaires where directional light is desired, that is to say, where it is desired to light a plurality of defined areas.

The globe is primarily designed for use in combination with a reflector, placed above the globe and intercepting the upward light from the lamp and reflecting it to the globe at angles permitting efficient transmission. Such a reflector will be approximately hemispherical in shape with the center of the sphere at or near the center of the light source so that the reflected rays will pass back through or near the light source and therefore be transmitted by the globe in much the same directions as light rays proceeding direct from the source to the globe. In some cases it will be desirable that portions of the vertical contour of the reflector will vary from a hemispherical shape toward ellipsoidal or hyperbolic contour so as to smooth out the beams from the combination or build up the intensity at certain portions of the illuminated strip or widen out the strip of light at angles where the direct light only gives insufficient width.

In the drawings the invention has been shown for convenience in a two-piece hemisphere consisting of inner and outer glasses but for some requirements the various prismatic constructions can be formed on a single piece of glass as long as similar relationships to those shown herein are maintained.

In the drawings, Fig. 1 is an elevation of the inner hemisphere of the globe in a plane of symmetry of the structure bisected to show the prismatic formation in cross section.

Fig. 2 is an elevation of the outer hemisphere in the same plane as Fig. 1 similarly bisected.

Fig. 3 is an elevation of the inner hemisphere in the plane 3—3 of Fig. 1 bisected to show the prismatic formation in cross section.

Fig. 4 is an elevation of the outer hemisphere in the plane 4—4 of Fig. 2 similarly bisected.

Fig. 5 is a vertical cross section in the same plane as Figs. 1 and 2 showing the globe used in connection with a hemispherical reflector.

Fig. 6 is a similar cross section in which the contour of the reflector has been modified.

In Figs. 1, 2, 3 and 4, the construction is symmetrical with respect to vertical planes 3—3, 4—4, 1—1 and 2—2 respectively, the whole combination forming two special light directing constructions, aimed oppositely toward the roadway. In the following description, therefore, reference made to details in the cross section will apply with equal force to corresponding points in the corresponding elevation and references to the elevation will apply to corresponding points in the corresponding cross section.

In Figs. 1 and 3, 7 is a light source shown for simplicity as a point and located at the center of a hemispherical bowl 8, having a smooth interior surface 9, and on its outer surface a series of annular lens surfaces 10. At 11—11 the lens construction on the outer surface is divided into an upper section 12 and a lower section 13. The location of the plane of division 11—11 is determined by the vertical angle 14, Fig. 3 and is the angle at which it is desired to deliver the maximum intensity of light from the luminaire.

Lens surfaces 15 and 16 in upper section 12 and all those lying between them are formed about the axis 17, Fig. 3, and designed to refract light parallel to that axis. In order to obtain efficient transmission of light it is desirable that the lens surfaces lying between surface 16 and the extreme lens surface 18 shall not make a greater angle with the spherical surface of the bowl

than is the case with surface 16 and therefore it is not possible for these surfaces to deviate the light sufficiently to be emitted parallel to axis 17. It is important, however, that the final emission of the light rays received from the source 7 shall not be at a greater vertical angle than 14 and this is accomplished by giving the axis of these lens surfaces successively lower inclinations so that the angle of the axis of the extreme lens surface 18 is at extreme vertical angle 19, Fig. 3.

In lower section 13, lens surface 20 immediately adjacent to surface 11 in the upper section is formed about axis 17 and designed to emit light rays parallel to that axis. The lens surfaces between 20 and the extreme lens surface 21 are formed about axes of successively lower inclination and the angularity of the surfaces with reference to the spherical surface of the bowl is increased gradually but at a more moderate rate of increase than in the upper section so that the light rays are bent toward the axis 17 but at increasingly divergent angles with reference to it as the extreme surface 21 is approached and owing to the systematic lowering of the angle of the axes of these lens surfaces this divergence is greater vertically than laterally thus bringing the resultant distribution of light into a wide strip in line with the roadway but not sufficiently concentrated for the best efficiency.

In Figs. 2 and 4, 22 is a hemispherical bowl having a smooth outer surface 23 and having on its inner surface smooth sections 24, and sections 25 provided with prisms parallel to plane 4—4 and sections 26 provided with prisms radial about the vertical axis of the bowl. This outer bowl is designed to envelope the inner bowl Figs. 1 and 3. The lower surface of flange 27 bowl 8, Figs. 1 and 3 rests on the upper surface of the flange 28 bowl 22, Figs. 2 and 4. Section 25 is opposed to the central portion of section 13, Fig. 3 and the prism structure on section 25 is designed to receive the refracted light rays from the lower part of the inner bowl and deviate them still more toward the axial plane so as to bring them within the beam strip required for lighting the part of the road nearest to the luminaire. It is not possible to use this structure over the whole surface opposed to the lower section 13 of Fig. 3 because the plunger pressing this inner surface of bowl 22 operates vertically and separating surfaces between the operative refracting surfaces must relieve vertically. The extreme separating surface 29 Fig. 2 receives a portion of the light from the inner bowl and refracts it outward from the plane 4—4 and the resultant emission is not in a useful direction, the refracting surface 30 receives a much greater portion of the light from the inner bowl and refracts it toward the plane 4—4 and the resultant emission is useful. If this construction were carried higher in the side of the bowl the prism angle would be increased and the proportion of light wasted on surfaces such as 29 would increase rapidly so that at the upper side limit Fig. 2 opposed to the upper side limit of section 13 Fig. 1, a greater proportion of light would be wasted than usefully refracted by surfaces such as 30. Section 24 is opposed to that portion of section 12 Fig. 1 lying between the lens surfaces 15 and 16. The light received by it is already deviated sufficiently so this section of the outer bowl is left smooth. Section 26 is opposed to that part of section 12, Fig. 1 lying between lens surface 16 and extreme lens surface 18. Light rays received by section 26 are already depressed to the required vertical angle and are refracted transversely by the vertical prisms thereon so that they are concentrated toward the plane 4—4 and assist in lighting the road strip more distant from the luminaire. In order to take care of the light from section 13, Fig. 1 which cannot be handled by section 25, section 26 is extended below the horizontal plane of division 11 in Figs. 1 and 3 to join the prismatic construction on section 25. Section 25 and section 26 merge as shown in order to merge the resultant beams from the two sections.

Such a construction as that described will have a tendency to reduce the light emitted directly downward to somewhat too great a degree. This is readily taken care of, however, by cutting away a small portion of the lens surfaces in the very lowest part of the inside bowl so that a certain portion of the light rays will be transmitted without vertical deviation.

In Fig. 5, 29 is a reflector of hemispherical contour with its centre at the centre of the light source 7. Typical light rays proceeding upward from the source 7 are reflected back on their paths through the source and to the globe along the same path as typical light rays 31, transmitted downward direct from the source. The reflector, therefore, increases the intensity of the light delivered by the globe without changing its distribution.

In Fig. 6, 32 is a reflector having a lower part 33 of hemispherical contour with centre at 7 and typical ray 30 is reflected back through the source to coincide with direct ray 31, and both direct and reflected rays will be emitted by the globe in direction 41. The upper part 34 of reflector 32 is a surface of revolution the contour of which in vertical section is that of an ellipse with 7 as one focus and 35 as its second focus. Typical ray 36 proceeding upward from the source 7 will be reflected back in direction

37 through the second focus 35 and will strike the globe at a lower angle than ray 38 direct from the source. Ray 38 will be refracted and emitted in direction 39 and ray 37 from the reflector will be emitted in the lower direction 40. Such a reflector serves to intensify the beam at intermediate angles in greater proportion than at high angles and does not contribute anything to the beam at low angles.

I claim:

1. A luminaire of spherical formation having on one surface a series of annular refracting ribs with axes lying in the same plane and opposed thereto a series of prismatic ribs decreasing in angularity toward the plane of the axes and lying parallel thereto, the apices of such prisms being pointed toward such plane and adapted to give a lateral concentration to the cones of light produced by the annular ribs.

2. A luminaire of spherical formation having on one surface a series of annular refracting ribs with axes lying in the same plane and of successively increasing inclination with reference to the innermost annulus and opposed thereto a series of prismatic ribs decreasing in angularity toward the plane of the axes and lying parallel thereto, the apices of such prisms being pointed toward such plane and adapted to give a lateral concentration to the cones of light produced by the annular ribs.

3. A luminaire of spherical formation having one surface divided into upper and lower sections each section provided with annular ribs with their axes inclined to the vertical, the ribs forming the upper section being adapted to concentrate the light rays toward the axial plane and to depress them below a definite angular limit, the lower section having ribs thereon adapted to deflect the light toward the axial plane with a more moderate degree of concentration, and opposed to such annular ribs a series of prismatic ribs decreasing in angularity toward the plane of the axes and lying parallel thereto, the apices of such prisms being pointed toward such plane and adapted to give a lateral concentration to the cones of light produced by the annular ribs.

4. A luminaire of spherical formation having on one surface a series of annular refracting ribs with axes lying in the same plane and opposed to such annular ribs a central zone having prismatic ribs decreasing in angularity toward the plane of the axes and lying parallel thereto, the apices of such prisms being pointed toward such plane, and adjacent to such central zone, zones of vertical radial prismatic ribs of similar characteristics, such opposed zones being adapted to give lateral concentration to the cones of light produced by the annular ribs.

5. A luminaire of spherical formation having one surface divided into upper and lower sections each section provided with annular ribs with their axes inclined to the vertical, the ribs forming the upper section being adapted to concentrate the light rays toward the axial plane and to depress them below a definite angular limit, the lower section having annular ribs thereon adapted to deflect the light toward the axial plane with a more moderate degree of concentration and opposed to such annular ribs a central zone having prismatic ribs decreasing in angularity toward the plane of the axes and lying parallel thereto, the apices of such prisms being pointed toward such plane, and adjacent to such central zone, zones of vertical radial prismatic ribs of similar characteristics, such opposed zones being adapted to give lateral concentration to the cones of light produced by the annular ribs.

Signed at Newark, in the county of Licking and State of Ohio, this 10th day of June, 1927.

WILLIAM A. DOREY.