

Oct. 18, 1938.

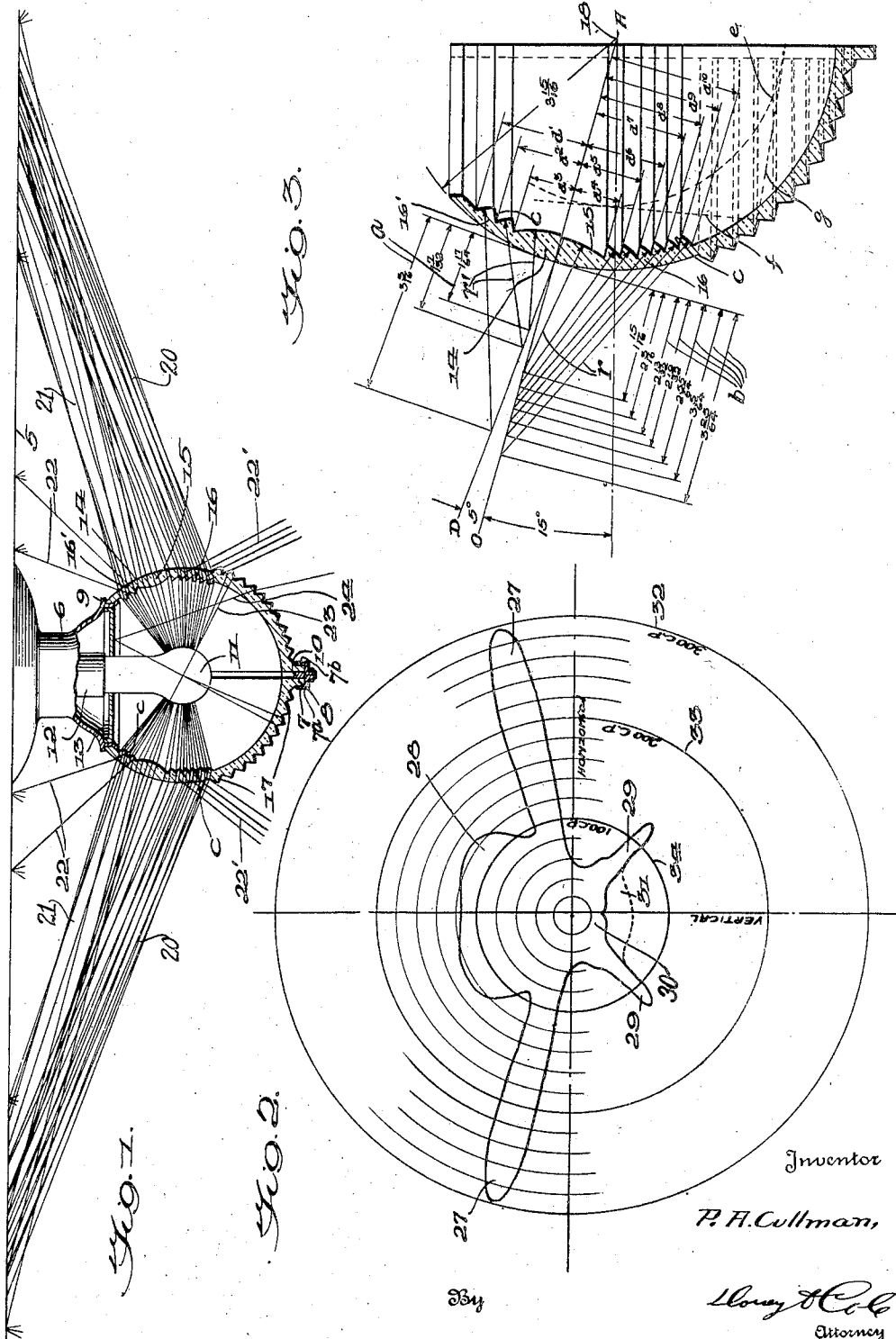
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2,133,378

LIGHTING UNIT

Original Filed Dec. 9, 1933

2 Sheets-Sheet 1



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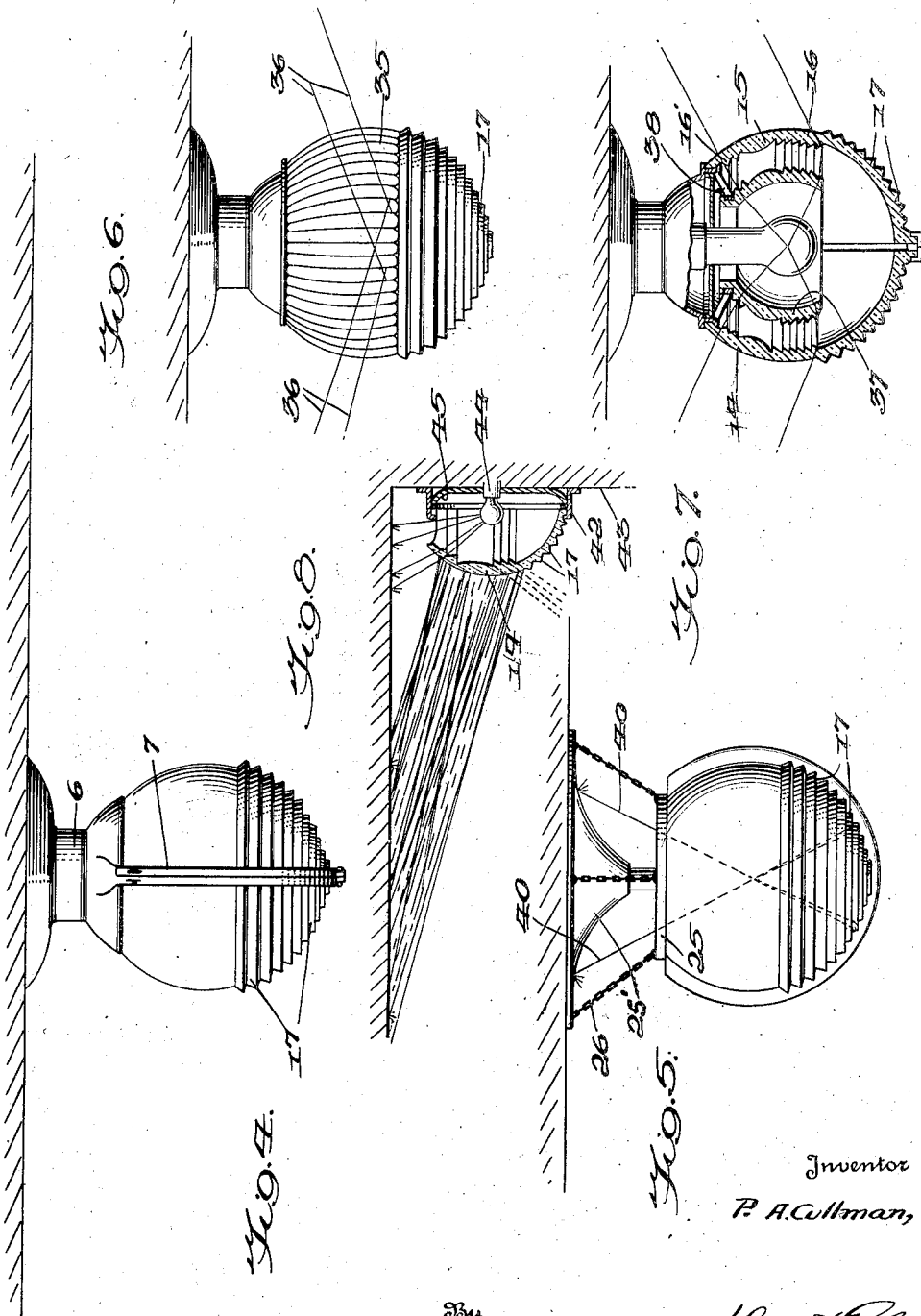
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UNITED STATES PATENT OFFICE

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LIGHTING UNIT

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15 Claims. (Cl. 240—93)

This invention relates to a lighting unit designed for the illumination of interiors of dwelling houses, stores, office buildings, factories, the exterior lighting of buildings, etc., and one of the principal objects thereof is to provide a glass light-projecting globe, which, while directing most of the light upwardly against the ceiling at desired angles, will also provide for a sufficient diffusion and distribution of the light toward the floor below and around the vicinity of the unit.

Another object of the invention is to provide a lighting unit having the characteristics outlined above, in which the light of greatest intensity directed upwardly at angles toward the ceiling and intended to reach the most distant areas on the ceiling to be illuminated, is controlled by a fresnel band lens of modified construction encircling the vertical axis of the unit, while the light which would ordinarily be directed toward the floor is, through the instrumentality of total reflecting prisms arranged below the band lens, re-directed in part to increase the amount of light reaching the band lens directly from the light source, and in part to be either directed upwardly toward the ceiling around the unit, or to be reflected and diffused through the lower part of the unit.

Another object is to provide a lighting unit of the nature above referred to which will occupy relatively small space, which will be economical and easy to manufacture, and in which the lens and prismatic portions of the unit may be simultaneously formed on the glass.

Another object of the invention is to provide a lighting unit which will appear luminous when lighted, and in which the area of light projected downwardly from the unit emanates from parts of the globe the brightness of which does not exceed the limit easily bearable by the eye, and thus harmonizes with the brightness of the ceiling illuminated by the band lens.

With these and other objects in view, which will become more apparent as the description proceeds, reference is had to the accompanying drawings which illustrate some of the various modifications that the invention may assume, and in which,—

Figure 1 represents a vertical sectional view through a lighting unit constructed according to my invention, in which the light distribution is diagrammatically illustrated.

Figure 2 is a distribution curve, illustrating the approximate light distribution taken vertically for the unit illustrated in Fig. 1.

Figure 3 represents a vertical sectional view through one of the globe sections, showing the constructional details thereof.

Figure 4 illustrates on a reduced scale, an elevational view of the unit illustrated in Figure 1.

Figure 5 represents an elevational view of a lighting unit used in connection with a modified form of suspending means in which the majority of the light from the total refracting prisms strikes a reflecting canopy in the area above and around the unit.

Figure 6 represents an elevational view of a modified form of lighting unit, illustrating the use of flutes.

Figure 7 represents a vertical sectional view showing the use of a condensing lens.

Figure 8 represents a vertical sectional view through a globe section mounted against a wall.

Referring more particularly to the drawings, a lighting unit is illustrated in the form of a globe divided vertically and diametrically into two similar sections which are placed edge to edge, and are suspended from the ceiling 5 by a metallic dome 6, having a flanged ring 7 welded or otherwise secured thereto, which ring engages the flanges 8 formed at the adjacent edges of the globe sections. For convenience of assembly, the metallic ring 7 may be made in two sections held together by screws or otherwise. The dome 6 is provided with suitably shaped flanges at 9, to receive the upper edges of the globe sections. When the sections are assembled against the dome, and the ring sections 7^a and 7^b secured together, the unit will be rigidly suspended from the ceiling. A washer 10 of suitable material may be inserted between the flanges 8 of the globe sections to prevent breakage, and to form a cushioning means for the sections.

A lamp 11 is mounted in a socket 12 carried by the dome, the filament of the lamp being positioned in the focal region of the optical elements formed on the globe and to be hereinafter more particularly referred to. Suitably secured, as by welding, for instance, to the dome, is mounted an annular reflecting plate 13 which occupies a position adjacent the upper edge of the globe at right angles to the vertical axis of the globe.

Extending from adjacent the upper edge of the globe to somewhat below the horizontal diameter, is a band lens 14 which extends horizontally around the unit, and which is in the nature of a modified fresnel band, the bull's eye zone and stepped zones 16—16' of which are formed on the inner surface of the glass, the outer surface being plain. Formed on the outer surface

of the glass, and extending from the band lens downwardly, is a series of prisms 17, which occupy horizontal planes successively smaller in diameter as the bottom of the globe is approached.

As an example of one form of construction that the optical elements of the globe may follow, reference is had to Figure 3, in which one of the globe halves is illustrated, it being understood that the opposite half is similarly formed. The construction data is given in inches. In such figure, the focal region in which the lamp filament will be placed, is at 18, and for purposes of discussion, is assumed to be a point, although it will be understood that since the filament of a standard lamp is of appreciable size, the optical elements are designed for use in connection with such filament. It will be understood that the configuration of the globe is generated by the rotation around a vertical axis of the cross section illustrated in Figure 3, and that the globe is therefore symmetrical about its vertical axis, and that the construction illustrated in Figure 3 is common to any section of the globe in a plane containing the vertical axis. In any vertical section, the optical axis O—A of the band lens extends from the focal region 18 upwardly above the horizontal at an angle of about 15°, and along this axis, the faces of the lower half of the bulb's eye zone 15, and the lower stepped zones 16, are struck from centers with increasing radii of curvature, and at increasing distances from the outside surface of the band lens as the zones approach the lower edge thereof, as illustrated by the radii r . The faces of the upper half of the band lens and of the upper stepped zones 16', are struck from centers along a line D intersecting the optical axis at the outer surface of the lens and extending upwardly at an angle thereabove (which angle may be substantially 5°), with increasing radii and at increasing distances from the outer surface of the lens as the upper edge of the lens is approached, as illustrated by the radii r' . The construction data for the inner faces of the various zones of the band lens is indicated generally at a and b , respectively. The various relative distances that the stepped zones are respectively arranged above and below the optical axis are indicated at d_1 , d_2 , et cetera.

By thus forming the zones, the type of light distribution hereinafter set forth from the band lens can be obtained, and at the same time the risers or triangular bodies c of the zones can be formed substantially parallel with a horizontal diameter of the globe, whereby upon the plunger of a glass pressing machine co-operating with a mold in forming the lens surfaces, such plunger, when the glass has set, may be readily withdrawn, it being understood that the plunger will move with respect to the mold along the diameter of the globe section at right angles to the plane along which the two globe halves are separated.

The prisms 17 formed on the outer face of the globe below the band lens extend horizontally, circumferentially of the globe, and the faces of such prisms are disposed tangentially to a circle e , about the focal region, as indicated by the construction lines f and g , the radius of the circle being so chosen that the faces of the prisms 17 are disposed at angles beyond the critical angles of refraction to thus accomplish total reflection within the prisms of rays of light from the focal region incident on the inner surface of the globe.

This inner surface, corresponding to the area

covered by the prisms 17 is smooth, as is the outer surface of the globe corresponding to the area covered on the inner surface thereof by the band lens.

With the optical elements formed as above set forth, and with the light source arranged at the focal region 18, rays of light from such source incident on the inner faces of the zones on the lower half of the band lens (see Fig. 1) will be projected upwardly toward the ceiling in the general direction of the optical axis of the lens as at 20, the light rays emitted from points adjacent to such axis being substantially parallel therewith, while the rays emitted from the points further removed from such axis will gradually converge toward and eventually cross the axis, and these rays will be directed towards the farthest regions of the ceiling it is desired to illuminate, while rays from the light source incident on the zones of the upper half of the lens will be emitted in directions which cross the optical axis from points near the same with a gradually decreasing angle of convergence as the upper edge of the band lens is approached, as indicated at 21, so that the rays from the upper and lower halves are intermingled and merged at a distance from the light unit corresponding to the distant regions of the ceiling to be illuminated, with the rays from the upper portions of the lens gradually approaching along the ceiling toward the lighting unit. Components of the light incident on the risers or triangular bodies c of the upper zones 16', will be refracted upwardly against the ceiling at points closer to the light unit than the areas illuminated by the rays projected through the faces of the zones, to thus illuminate the ceiling closer to the unit than the distant areas above referred to, as illustrated by the rays 22, while components of the light incident on the risers c of the lower zones 16, will be refracted at angles downwardly toward the floor as at 22'.

Rays from the light source incident on the inner surfaces of the prisms 17 adjacent to and below the band lens, will, upon striking the faces of said prisms, be totally reflected and returned in the direction of the light source to become incident on the band lens, as indicated by the ray 23, to thus augment rays direct from the light source incident on the band lens, while rays from the light source incident upon the inner surfaces of the prisms 17 below the prisms which augment the light utilized by the band lens, after total reflection, are directed upwardly and striking the reflector disk 13, are directed downwardly as at 24, and pass through the prisms 17 to be diffused and spread upon the floor beneath and around the light unit.

In case more light against the ceiling in the vicinity of the unit is desired, the globe may be hung by a band 25 suspended by chains or the like 26 (see Fig. 5), or by other skeletonized suspending means which will allow the upper side of the globe to be open, and the reflecting surface 13 may be omitted, to thus allow the light from those of the prisms 17 which do not contribute to the light incident upon the band lens, to pass upwardly through the space bounded by the upper edges of the band lens to the ceiling, and augment the direct rays from the light source incident on the ceiling above the lighting unit. This upwardly passing light instead of striking directly against the ceiling may, if desired, be deflected outwardly and downwardly into the room by a canopy 25' having curved surfaces as indicated

by the rays 40. The canopy may be white, or if preferred, of other color to match the ceiling color.

Due to the filament size, a small percentage of the light incident on the prisms 17 will not be totally reflected, but will pass therethrough, and will be diffused downwardly below the lighting unit, and this will comprise all of the light passing through the prisms if the reflecting surface 13 is omitted.

As an illustration of the distribution through the various sections of the globe of the light, the band lens will receive about 49% of the light from the source, the prisms will receive about 32%, and about 19% goes upwardly toward the top of the globe within the space defined by the upper edges of the band lens and is either allowed to strike the ceiling when the upper portion of the light unit is left open, or is reflected downwardly in case a reflector is used. Of the light received by the band lens, about 40% is direct light from the source, and about 9% is light which has been totally reflected by the prisms. Of the light received by the band lens, about 2% from the risers of the upper zones goes upwardly toward the ceiling, and about 7% from the risers of the lower zones is directed downwardly toward the floor. Of the light received by the prisms they reflect about 22%, about 5% is diffused through them, and about 5% is lost by absorption. Of the light which goes upwardly, part is light which is totally reflected by the prisms lying below those which reflect light from the source into the band lens, and the remainder is direct light from the light source.

A vertical distribution curve illustrating the distribution of the light from the unit is shown in Figure 2, in which the areas 27 illustrate the light from the band lens. The areas 28 illustrate the direct light going upwardly from the light source, and the light directed upwardly from the risers of the zones 16' and from those of the prisms 17 which do not contribute to the light utilized by the band lens, in the case where the reflecting surface is omitted; the areas 29 indicate the light directed downwardly from the risers of the lower set of zones 16; the areas 30, the small percentage of light which passes through the prisms 17 directly from the light source; and the areas 31, the light which passes through the prisms 17 after reflection by the surface 13, where such surface is used.

It will be understood that in case the reflector is used, the area 28 disappears, the light forming such area being directed downwardly, to build up the area 31, and that in case the globe is left open at the top, the area 31 disappears, the light which forms such area being then allowed to emerge upwardly toward the ceiling. The circles 32, 33 and 34 indicate the candle power scale for the curve, a light source of approximately 100 C. P. in the form of a ball three quarters of an inch in diameter for facility in plotting the curve being assumed. The curve is of course illustrated on a greatly reduced scale. It will be noted that the light of highest intensities occurs in the beam from the band lens which is directed to the farthest areas of the ceiling to be illuminated, that the light area of next highest intensity issues from the upper part of the globe against the ceiling, and that the light from the globe extending directly into the room is of comparatively low intensity. The vertical and horizontal lines have been indicated on the curve shown in Figure 2 for clearness of illustration.

It will be understood that the rays of light incident on the ceiling (and on the canopy, where one is used), will be reflected and directed downwardly at various angles into the room, to thus merge with the light directed downwardly from the globe, so that a diffused and soft illumination of the room is obtained. While a little of the light is directed downwardly into the room without reflection from the ceiling, such light as will be noted from Figure 2, is of comparatively small intensity and does not exceed the limit easily bearable by the eye, so that when it reaches levels in the room normally reached by persons occupying the same, it is comparable in softness to the indirect light from the ceiling, and hence produces no objectionable glare.

Thus the illumination of the room is produced by far to the greatest extent, by indirect lighting, only sufficient direct lighting being produced to obtain the effect of semi-indirect lighting.

It will also be understood that the curvatures of the refracting elements may be modified to adjust the angles at which the light rays are directed against the ceiling, to the size and shape of the ceiling area desired to be illuminated, the distance from the ceiling at which it is desired to suspend the lighting unit, and to obtain variations from the intensities indicated in Figure 2, in the light flux produced by the unit, so that the light unit may be modified to accommodate ceiling areas, suspension distances, and room dimensions of varied proportions.

In order to obtain a more even diffusion of light passing through the band lens, than afforded by the zones thereof alone, where such greater diffusion may be desirable, for instance, to accommodate different textures of ceiling surfaces, the outer surface of the globe along the regions occupied by the band lens may be provided with flutings, as illustrated at 35 (Figure 6), in order that the light rays issuing from the band lens as it passes through such flutes may be crossed and intermingled as illustrated by the rays 36. Also greater diffusion may be obtained by subjecting the zones of the lens on the inside of the globe to an etching or frosting process to thus give them a so-called satin or velvet finish.

To increase the amount of direct light from the light source utilized by the band lens, I may mount within the globe, as indicated in Figure 7, an annular condensing lens 37, which will be suitably suspended in properly spaced relationship with the band lens, as for instance, by suitable frame-work 38 from the flanged portions 9 of the dome, being secured thereto in desirable manner. Such condenser will increase the angle of light incident on the band lens, and thus add to the volume of light projected thereby.

In some instances it will be desirable to mount a unit near the end of a room for instance, and under such circumstances only half of a unit need be used, as illustrated in Figure 8. Such half unit may be mounted in a holder 42 secured against the wall 43 of the room. The lamp may be held in a suitable socket 44 mounted against the wall of the room, and a reflector 45 mounted within the holder 42, may be used to reflect outwardly through the globe half, the light which would otherwise strike against the wall and be lost. Obviously a room can be illuminated by using a series of the half units similar to that illustrated in Figure 8, around the walls of the room; or half units, in conjunction with units suspended from the ceiling can be used in obtaining the room illumination desired.

While I have in the foregoing made a detailed exposition of some of the forms which the invention may take, not only as concerns its optical characteristics, but also variations thereof, and the methods of mounting and utilizing the unit, and uses to which it may be put, it will be understood that I do not intend to be limited to the specific examples hereinabove chosen for illustrative purposes, but may make such modifications, changes and re-arrangement of parts, for instance, in the dimensions and radii of the lens zones, and in the angles and disposition of the prisms, in order to vary the light distribution above described, as do not depart from the spirit of the invention, and the scope of the appended claims.

Having thus described my invention what I claim as new, and desire to secure by U. S. Letters Patent is:—

1. In a light projector, a globular glass body having a band lens concentric with the vertical axis of the body formed thereon and provided with refracting zones, the zones in the upper and lower halves being struck from centers substantially along diverging lines, the radii of the respective zones differing in length.

2. In a light projector, a globular glass body having a band lens concentric with the vertical axis of the body formed thereon and provided with refracting zones, the zones in opposite halves of the lens being struck from centers substantially along different lines, the risers of the zones being located substantially at right angles to the vertical axis of said body.

3. In a light projector, a glass body having a band lens extending therearound and provided with refracting zones, the zones in the upper and lower halves being of varying curvature, the risers of said zones being located substantially at right angles to the vertical axis of the body, said lens at any vertical section having an upwardly inclined optical axis.

4. In a light projector, a glass body having a focal region, and a band lens of modified fresnel construction extending there-around and formed thereon and provided with refracting zones, the zones being of varying curvature and refracting powers, in combination with a series of total reflecting prisms formed on the body below said band lens, some of said prisms adapted to reflect light from a light source at said focal region into the zones of said band lens.

5. In a light projector, a glass body having a focal region, and an annular band lens of fresnel construction formed thereon and disposed substantially horizontally, the lens being modified to present refracting zones relatively varying in curvature and refracting powers, in combination with a set of total reflecting prisms formed on the body below said band lens, to reflect light from a light source at said focal region into said band lens.

6. In a light projector, a glass body having a focal region, and an annular band lens of fresnel construction formed thereon and disposed substantially horizontally, the lens being modified to present refractory zones relatively varying in curvature and refracting powers, in combination with two sets of total reflecting prisms formed on the body below said band lens, one set of said prisms reflecting light from a light source at said focal region into said band lens, the other set of said prisms reflecting light from said light source upwardly through the space defined by said band lens.

7. In a light projector, a body having a band lens of modified fresnel construction extending there-around and formed thereon and provided with refracting zones of varying curvature, a series of total reflecting prisms formed on the body below said band lens, in combination with a canopy having curved surfaces disposed above the body and adapted to receive light from a light source therewithin and light reflected there-against by said total reflecting prisms.

8. In a light projecting, a glass body having a band lens of modified fresnel construction extending there-around, said lens being provided with zones of varying curvature, the radii defining such curvature being of relatively different lengths and centers, said zones having risers arranged substantially at right angles to the vertical axis of said body, said body having refracting prisms formed thereon below said band lens.

9. In a light projector, a glass body section comprising surfaces of revolution formed by the rotation of a section around a vertical axis, said section in its upper portion being in the form of a lens of modified fresnel construction having refracting zones of varying curvature in its upper and lower halves, and having an upwardly inclined optical axis, said section in its lower portion being in the form of total reflecting prisms.

10. In a light projector, a globular glass body having the upper portion formed as a band lens concentric with the vertical axis of the body, the band lens having an optical axis inclining upwardly with respect to the horizontal axis of the body, the wall of the body being constructed below the lens section of prismatic form with the prisms serving in part to reflect light to a position to augment the light passing through the lens section and in part to reflect light upwardly and wholly inwardly of the lens section.

11. In a light projector, a globular glass body having the upper part concentric with the vertical axis formed as a band lens having upper and lower zones of varying curvature struck from radii of different lengths and centers, the optical axis of the lens being upwardly inclined with respect to the horizontal axis of the body, the lower portion of the body below the lens being of prismatic form, with the prisms arranged to in part reflect light to augment the light directed through the lens and in part to reflect light directly upwardly through the space included within the lens.

12. In a light projector, a globular glass body having the upper part concentric with the vertical axis formed as a band lens having upper and lower zones of varying curvature struck from radii of different lengths and centers, with the centers of the radii of the respective zones on converging lines, the optical axis of the lens being upwardly inclined with respect to the horizontal axis of the body, the lower portion of the body below the lens being of prismatic form, with the prisms arranged to in part reflect light to augment the light directed through the lens and in part to reflect light directly upwardly through the space included within the lens.

13. In a light projector, a globular body, a light source arranged in the vertical axis of the body, the upper portion of the body presenting an annular lens band formed to direct rays from said light source as a concentrated beam directed beyond the body at an inclination upwardly with respect to the horizontal axis of the body, that portion of the body below the annular lens being formed to direct light from said light source up-

wardly through the space within the body defined by the annular lens.

14. In a light projector, a globular body, a light source arranged in the vertical axis of the body, an annular lens band forming the upper portion of the body and directing light from said light source as an upwardly directed beam for indirect lighting, the lens band being formed in part to direct a relatively small proportion of the light from the light source downwardly relative to the body for direct lighting, that portion of the body below the band lens serving as a total light reflecting area and formed in part to direct the reflected light to augment the indirect lighting of the band lens and further formed in part to direct the reflected light to augment the direct lighting of the band lens.

15. In a light projector, a globular body, a

light source arranged in the vertical axis of the body, an annular lens band forming the upper portion of the body and directing light from said light source as an upwardly directed beam for indirect lighting, the lens band being formed in part to direct a relatively small proportion of the light from the light source downwardly relative to the body for direct lighting, the body of the globe below the band lens presenting two sets of total reflecting prisms, the light from one set of such prisms being directed to augment the indirect lighting of the band lens, the light from the other set of said prisms being directed upwardly within the space defined by the band lens, and means for reflecting the light rays of the latter source to augment the direct lighting of the band lens.

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