Oct. 15, 1929. W. A. DOREY 1,731,714

LUMINAIR

Filed June 26, 1928 2 Sheets-Sheet 1

Fig. 1

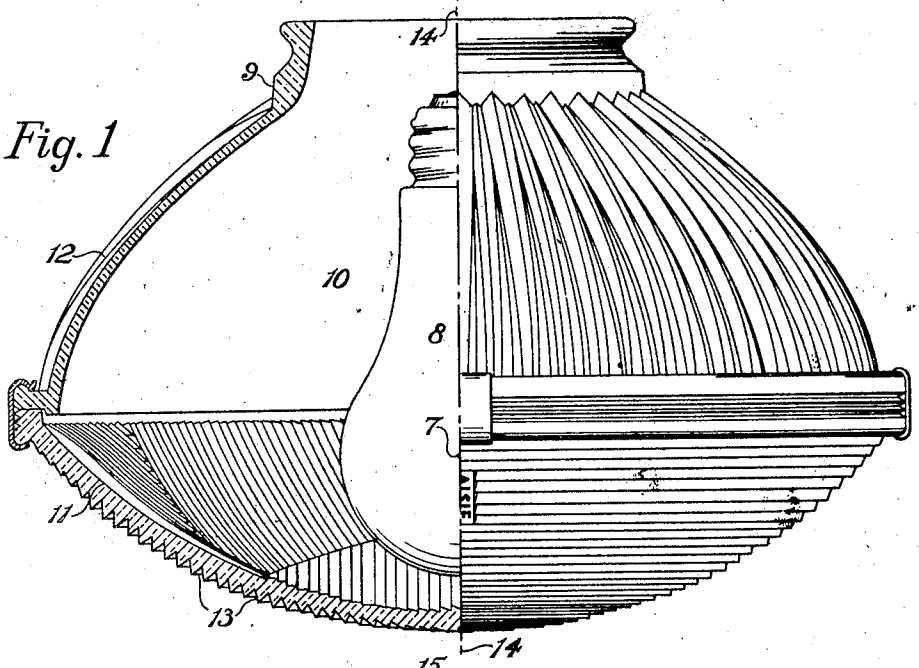
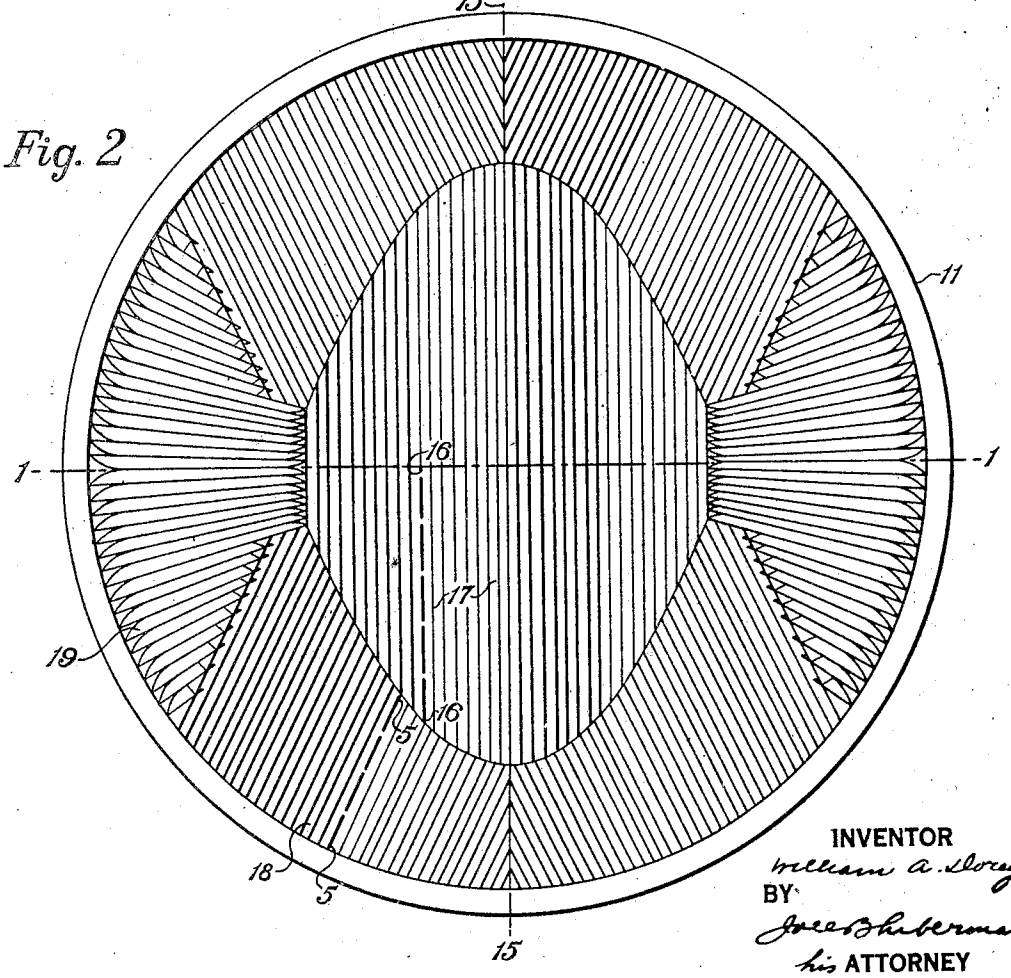


Fig. 2



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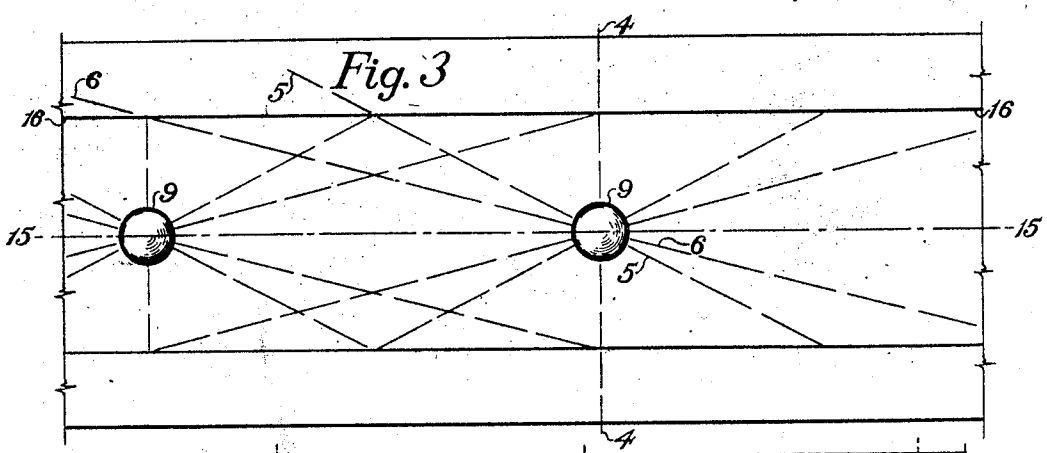


Fig. 3

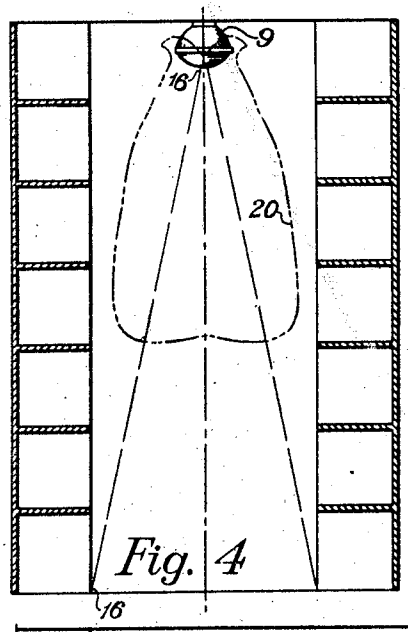


Fig. 4

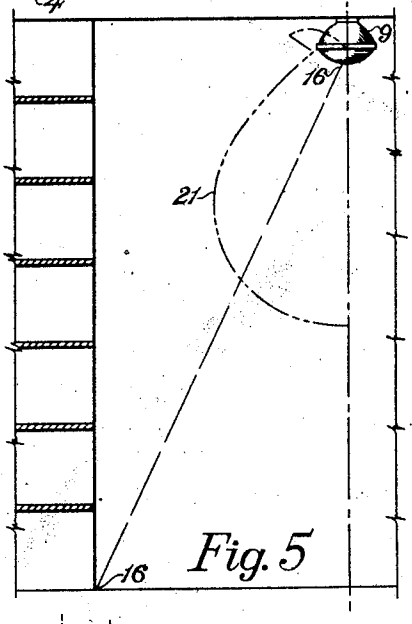


Fig. 5

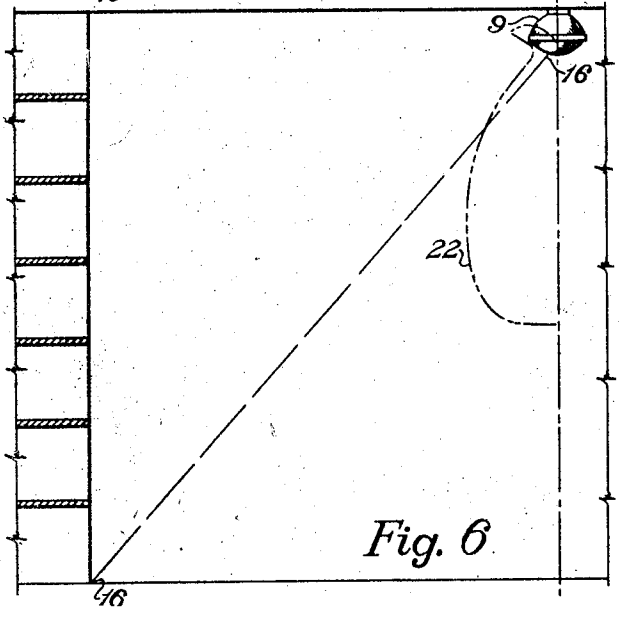


Fig. 6

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UNITED STATES PATENT OFFICE

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LUMINAIR

Application filed June 26, 1928. Serial No. 288,490.

The object of this invention is to construct a luminair provided with a combination of light refracting surfaces which will distribute light with reasonable uniformity over the vertical surfaces of books arranged in stacks at each side of a narrow aisle the light sources being mounted overhead at the centre of the aisle and at the level of the top shelf of the stacks.

In all libraries it is important that storage space be economized to the greatest degree consistent with convenience in reading the book titles when they are in place, removing the books from any of the shelves, examining them when they are removed; and sufficient head room allowance to permit a tall adult to pass down or stand in any part of the aisle in comfort. This has led to a close standardization of all dimensions in book spaces with strict reference to the size of a large adult. It has been found that the aisles between book stacks vary little in width from an average of three feet, that the height of the stack tiers from floor to ceiling varies little from seven and one half feet and that the shelving is continuous from floor to ceiling.

The normal location of light sources is overhead and in the central line of the aisles. If the light sources are spaced very widely apart it will be impossible to furnish adequate illumination on the books midway between the sources on account of the glancing angle and the distance, unless a very high intensity be projected in such directions. In that case the angle at which high intensities are delivered is so close to the line of sight of an individual walking down the aisles that the fringe of the light beam will cause a very serious glare condition. If the light sources are spaced very closely all of the cost elements in the installation will be unduly high. It has been found that an average spacing of six feet is a good practical compromise between these limitations.

Fig. 1 is an elevation of my invention as viewed lengthwise of the aisle with one side shown in cross section;

Fig. 2 is a plan view showing the interior of the bowl in Fig. 1;

Fig. 3 is a diagrammatic plan view of a portion of a typical aisle with its adjacent book stacks;

Fig. 4 is a transverse vertical cross section of Fig. 2;

Fig. 5 is a diagonal vertical cross section of Fig. 2, and

Fig. 6 is a diagonal vertical cross section of Fig. 2 taken at a more acute angle with the center line of the aisle than Fig. 5.

In Fig. 1, 7 is a light source shown for convenience as a point at the optical centre of the light giving element in the lamp bulb 8. The source is surrounded by a compound enclosure 9 consisting of a top reflecting member 10 and a bottom transmitting and refracting bowl 11. The reflector 10 includes the upward light emitted by the source and is preferably of crystal glass and provided on its exterior surface with double reflecting prisms 12. The contour of reflector 10 is slightly ellipsoidal so that the reflected rays are returned to the bowl part 11 at slight angles with the downward light rays direct from the source. The effect of such reflected rays is to reinforce the downward intensity of the light and increase the diffusion of the light or blur the source without increasing the total angle of light delivered at any point on the bowl beyond the limits of efficient transmission. The outer surface of the bowl 11 is provided with prisms 13 which are concentric on the vertical axis of the unit 14—14. The major portion of these prisms are adapted to concentrate the light downward toward the axis of the bowl 14—14. Near the top edge of the bowl the inclination of the refracting faces is gradually reduced so that a small portion of the light rays will be emitted at high angles with the horizontal as the limit,

so that sufficient illumination may be delivered to the upper shelves.

In Figs. 1 and 2 the bowl 11 is provided with a plurality of refracting systems which are symmetrical in design and operation with reference to the transverse vertical plane 1—1 through the source and also the longitudinal vertical plane 15—15 through the source. The construction of any one quadrant is therefore typical of all four quadrants. The arrangements of these refracting systems is best explained by reference to the typical installation diagrams Figs. 3, 4, 5 and 6 in their relation to Fig. 2. Vertical plane 4—4 in Fig. 3 passes through the enclosure 9 and is normal to the book stacks. Cross section in this plane is shown in Fig. 4. Vertical plane 5—5 in Fig. 3 passes through the enclosure 9 and intercepts the book stack midway between the light sources. Cross section in this plane is shown in Fig. 5. Vertical plane 6—6 in Fig. 3 passes through the enclosure 9 and intercepts the book stacks opposite the next adjacent light source. Slanting plane 16—16, Figs. 3, 4, 5 and 6 passes through the enclosure 9 and the intercept of the floor with the book stack. In Fig. 2 the intercept of the slanting plane 16—16 lies within the refracting system 17 and the refracting system itself consists of a series of prisms parallel to this intercept. The prisms centre upon the plane 16—16 and are adapted to concentrate light in a wide wedge toward that plane while the outer prisms 13 opposed thereto act in combination with the inner prism to complete the concentration toward the plane 16—16 and reduce somewhat the lateral spread of the beam wedge. In Fig. 2 the intercept of the vertical diagonal plane 5—5 lies within the refracting system 18 and the refracting system itself consists of a series of prisms parallel to the plane 5—5. The prisms centre upon the plane 5—5 and are adapted to concentrate light in a wide wedge toward that plane while the outer prisms 9 opposed thereto act to redistribute the light downward along the long axis of the wedge so that the intensities are greatly built up as the intercept of the floor and book stack is approached. To simplify the theoretical design it would be desirable that system 18 Fig. 2 should cover all of the interior surface of the quadrant of bowl 11 which is not occupied by system 17. If that were done, however, an undue proportion of the refracting surfaces would have to be sacrificed in order that the plunger which forms the interior surface of the bowl might relieve from the glass at the end of the pressing operation. I have, therefore, introduced a third refracting system 19 adjacent to the transverse axis of the bowl 1—1 which consists of radial prisms adapted to refract light laterally away from plane 4—4 and toward plane 5—5. The outer prisms 13 opposed thereto act to redistribute the light in downward directions. The transverse or inward spill from the wedge beam centering on plane 5—5 laps the upward and outward spill from the wedge beam centering on slanting plane 16—16 and these are lapped by the longitudinal or outward spill from the corresponding wedge beam from the next adjacent unit centering on the plane corresponding to plane 5—5. These three components combine to give a substantially uniform illumination on the unit vertical surface of the book stack included between plane 4—4, plane 5—5, floor and ceiling.

In Fig. 4, 20 indicates the relative distribution of intensity in plane 4—4. In Fig. 5, 21 indicates the relative distribution of intensity in plane 5—5. In Fig. 6, 22 indicates the relative distribution of intensity in plane 6—6. The distribution in the vertical plane through the centre of the aisle 15—15 Fig. 3 is very similar to 22 in Fig. 6. The highest illumination on the vertical book stacks produced by these distributions is at the top shelf Fig. 4. The lowest illumination is at the intercept of the slanting plane 16—16, Fig. 4 and Fig. 5.

Owing to the general form of light distribution, a very good reading light is obtained at any point in the aisle. Owing to installation conditions glare is negligible when the user is looking at the book stacks. When one is passing along the aisle glare is reduced to a very low degree on account of the relatively concentrating form of distribution which gives very low intensities at high angles in the field of view.

While I have shown and described a device using a single transmitting bowl I do not conceive my invention to be limited to that form. It is evident that a double glass transmitting bowl can be used consisting of an inner bowl with smooth inner surface and provided with concentric prisms on the outer surface and an outer bowl with smooth outer surface and the arrangement of various refracting systems on its interior surface. The prismatic design of such a combination would be entirely similar in kind to that of the single bowl. The total output would be decreased on account of the two layers of transmitting glass but the limits of control would be increased because two additional surfaces are introduced.

It is evident also that the material used in making the upper reflecting part of the enclosure and the contour of the same may be changed materially without affecting the essential principles of my invention. The invention has been described with special reference to book stacks or library aisles but it is evident that it can be applied to any confined aisle spaces and illumination layouts involving similar conditions.

I claim:

1. A luminair for library stack room lighting, comprising a light source, a reflecting cover and a refracting bowl, the bowl having on one surface a series of annular refracting prisms concentric on the vertical axis of the luminair and adapted to redirect the light so that intensities toward the vertical are greatly increased and intensities toward the horizontal are greatly decreased and opposed thereto a series of cooperating refracting systems adapted to concentrate light toward certain definite planes.

2. A luminair for library stack room lighting, comprising a light source, a reflecting cover and a refracting bowl, the bowl having on one surface a series of annular refracting prisms concentric on the vertical axis of the luminair and adapted to redirect the light so that intensities toward the vertical are greatly increased and intensities toward the horizontal are greatly decreased and opposed thereto a series of cooperating refracting systems adapted to concentrate light toward the floor line of the stacks and toward vertical lines in the surface of the stacks widely spaced on each side of the luminair.

3. A luminair for library stack room lighting, comprising a light source, a reflecting cover and a refracting bowl, the bowl being divided into a plurality of refracting systems, the optical axes of which intersect the surface of the stacks respectively at the floor line and in vertical lines widely spaced on each side of the luminair.

4. A luminair for library stack room lighting, comprising a light source, a reflecting cover and a refracting bowl, the bowl having on one surface annular refracting prisms adapted to redirect the light in generally downward directions and opposed thereto a series of cooperating refracting systems adapted to concentrate the light toward the floor line of the stacks and toward vertical lines in the surface of the stacks widely spaced on each side of the luminair.

5. A luminair for library stack room lighting, comprising a light source, a reflecting cover and a refracting bowl, the bowl having on one surface annular refracting prisms adapted to redirect the light in generally downward directions and opposed thereto a series of cooperating refracting systems adapted to concentrate light toward the floor line of the stacks and toward vertical lines in the surface of the stacks widely spaced on each side of the luminair.

6. A luminair for library stack room lighting having a reflecting cover and a refracting bowl, the outer surface of which is provided with annular prisms, and the interior surface divided into a plurality of systems of parallel prisms, the optical axes of the different systems being at definite angles with each other.

7. A system of illumination for lighting library book stacks, comprising a plurality of luminaires stationed at convenient intervals in a line between adjacent stacks, each luminair consisting of a reflecting cover and a lower refracting bowl divided into a plurality of refracting systems, the optical axes of which intersect respectively the book stacks in vertical planes midway between the stations and the floor line of the book stacks.

Signed at Newark, in the county of Licking and State of Ohio, this 22nd day of June, 1928.

WILLIAM A. DOREY.