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OVAL BEAM LENS

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This invention relates to lenses, and more particularly to an illuminating spotlight lens comprising a novel combination of prisms for producing a light beam of oval cross-section having a substantially uniform light intensity throughout.

Effective illumination of theatrical stages presents many special problems. Generally the area of the stage to be illuminated is wider than it is high and the complete and uniform illumination of such a stage has heretofore required the use of several carefully adjusted spotlights of the round beam type. The only practical alternative means for producing a substantially oval or rectangular beam having uniform intensity has been to use a single round beam spotlight of exceptional size in conjunction with special shutters or "barn doors" which are adapted to intercept substantial segments of the round beam. Either technique, of course, is an inefficient means of utilizing the lighting equipment itself and the illumination it produces.

I have invented a compound lens to be employed in combination with a conventional circular spotlight housing to produce an oval or elliptical beam of light of uniform intensity. For a design of given focal length, my new oval beam lens will produce a beam of light having a cross-section which has a substantially constant ratio of width to height. This constant ratio is maintained whatever the position of the lens with respect to the light source from the spot position all the way to the flood position. Moreover, the beam produced by my new lens has a substantially uniform distribution of light intensity throughout its entire cross-section. Ordinarily, no special shutters need be used with my new lens. This results in the most efficient use of the available light from a spotlight of a given size.

The advantages of the illumination obtainable with my new lens are immediately apparent. For example, in lighting the stage front of a theatre from a balcony or other elevated location an oblong light pattern is required. This pattern must usually be slightly higher than a person on stage and, at the same time, of substantially greater width, inasmuch as the person generally moves to the right and left of a given location. Formerly, several round spotlights were necessary to effect such a light pattern. Now a single spotlight using my new lens will produce the same effect. Moreover, the greater width of the beam from a single source produces a more uniform spread of light to right and left and the resultant shadows are less noticeable. A more pleasing quality of illumination of the stage may be obtained with several units overlapping the various areas of the stage.

My new lens is also particularly useful for so-called back lighting of an entertainer. This is a technique that has come into wide use with the advent of television. The head and body of the entertainer are illuminated from a position above and slightly to the rear. Because the light pattern should not cover much more than the actor's height and the beam is inclined downwardly at a rather sharp angle, a lens must produce a rather small

beam angle in one direction. Here again, the actor may move generally to right and left of the center of the beam and the extra width obtainable with my new lens means that the light covers a wider area permitting a freedom of movement for the actor which could otherwise only be had where several pieces of conventional round beam lighting equipment were used.

A still further example of stage illumination to which my new lens is particularly suited is that of side lighting where the lights are placed in the wings or side entrances of the stage and slightly above the entertainers. These side entrances are normally quite narrow. When conventional round beam lenses are used in the spotlights considerable illumination is lost due to the masking effect of the curtains around the entrance. When applied in this case, a lens according to my invention is oriented so that the smaller dimension of the oval beam is horizontal and the greater dimension of the beam is vertical. This obviously results in illuminating a much greater area across the stage with a spotlight of a given size. Moreover, the effect of side lighting from a single source is markedly different from that obtained from a plurality of sources.

According to my invention, then, I provide a spotlight lens, cast in one piece of glass, and having on its opposite faces cooperating lens elements which produce an oval shaped beam of uniform intensity and variable dimensions, but having within small limits, a constant ratio of height to width. In other words, my lens produces a beam having a greater divergence in two opposite directions parallel to a first diameter of the lens than the divergence in two opposite directions parallel to a second diameter perpendicular to the first diameter.

My new lens has on its light-incident, or rear face a plurality of arcuate ridges situated on each side of the second diameter referred to above. These arcuate ridges are disposed on the face of the lens so that they are concave with respect to the second diameter and each of them slopes outwardly and rearwardly of the lens. In effect, each ridge is a portion of a lens of negative or divergent refracting power. Generally, the refracting power of each ridge is different from that of adjacent ridges and the refracting power of each ridge may vary from the center to its outer edge.

On the light-emergent or front face of the lens, I provide a plurality of concentric annular ridges of positive or convergent refracting power. The relative dimensions of the ridges on the light-incident and light-emergent faces of the lens and their respective refracting powers are initially established according to well-known optical laws to produce an oval beam having any desired fixed ratio of height to width. Moreover, the dimensions of the lens elements may be designed to provide any desired focal length for the entire combination.

A feature of my new lens is that an object to be illuminated which is wider than it is high can be illuminated with greater intensity and uniformity throughout the lighted area than is possible with a conventional round beam spotlight of the same size and focal length. An additional feature is that the ratio of the width to the height of the beam is substantially constant over the entire range of positions of the lens with respect to the light source between the extremes of flood and spot positions. My invention may be embodied in lenses of all sizes and focal lengths and such lenses may be shuttered or "barn doored" with practically no loss of light intensity in the remaining beam.

A detailed description of a preferred embodiment of my invention is given in the following specification in which reference is made to the accompanying drawings.

In these drawings: