

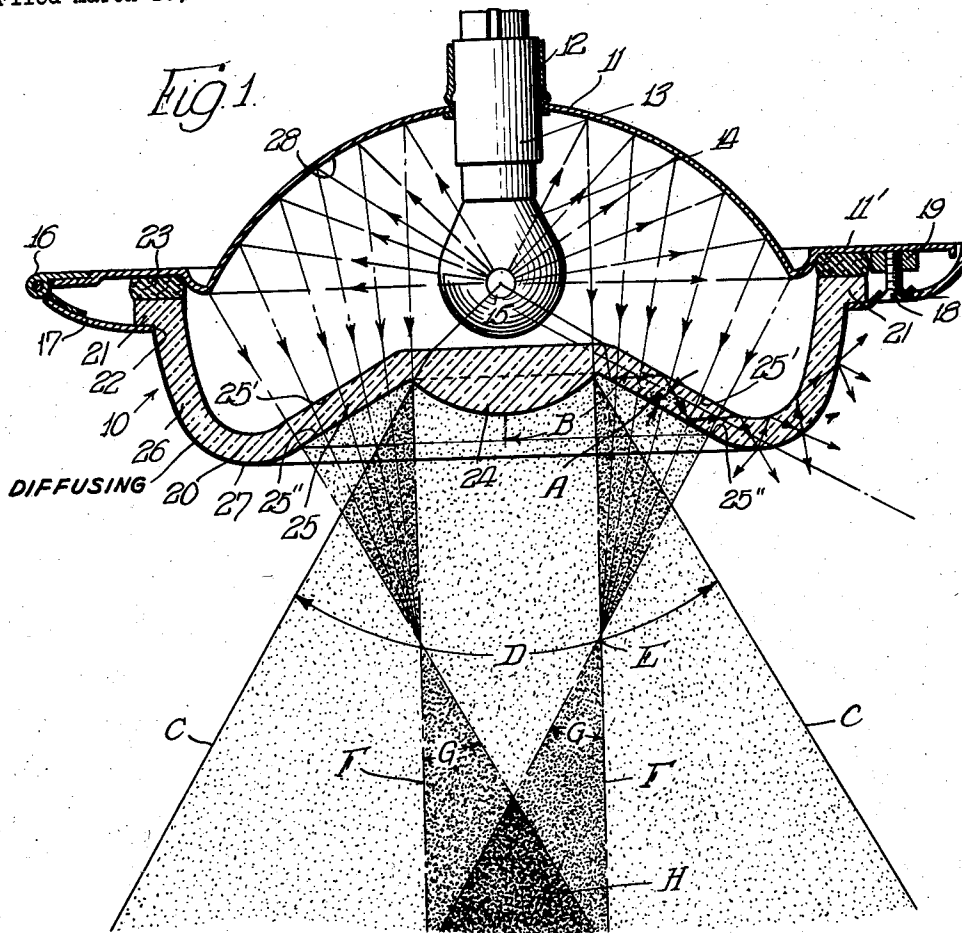
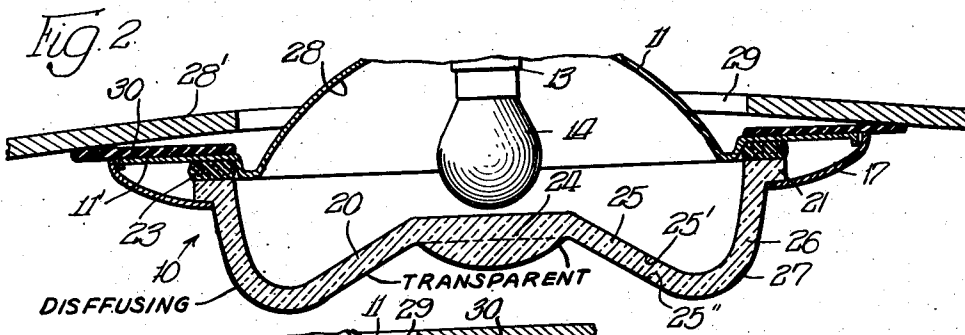
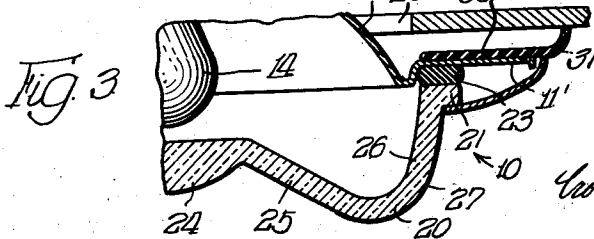
July 1, 1952

R. G. NORDQUIST
DOME LIGHTING FIXTURE

2,602,135

Filed March 13, 1948

2 SHEETS—SHEET 1



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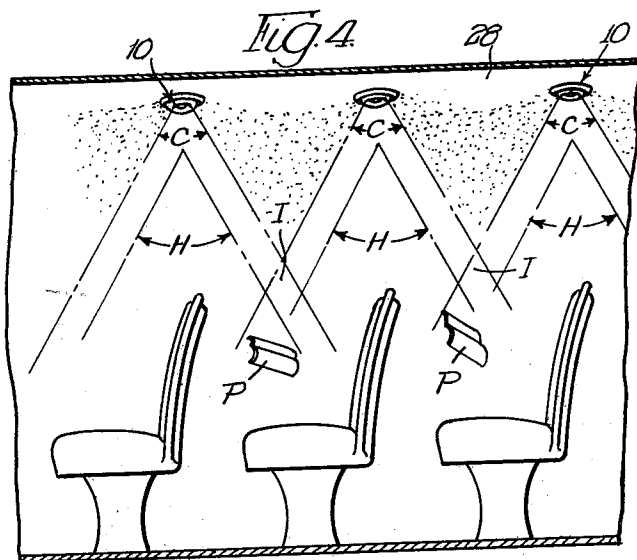
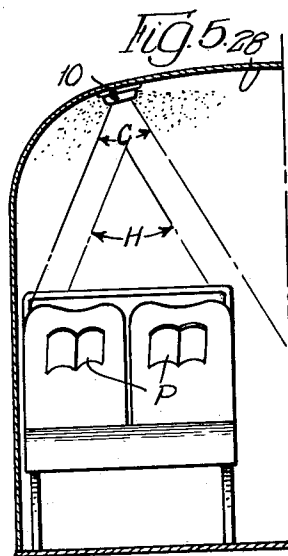
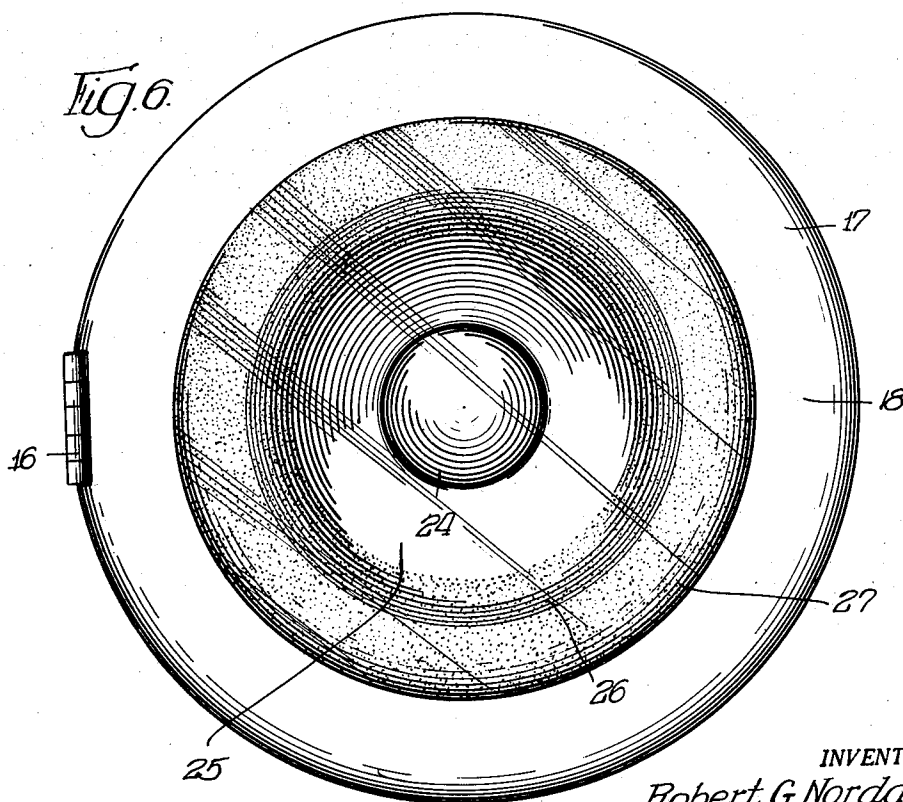
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2 SHEETS—SHEET 2



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UNITED STATES PATENT OFFICE

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DOME LIGHTING FIXTURE

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This invention deals generally with improvements in a lensed lighting fixture adapted to project a directed, strongly intensified beam of light onto a predetermined reading or equivalent area or zone and, more particularly, to a fixture of this type which is also adapted to disseminate a diffused, flood-light illumination laterally of the intensified beam.

Previous lighting fixtures designed to emit through a lens a relatively intense beam directly illuminating a given area, such, for example, as a reading plane beneath the fixture, have, in most cases the disadvantage that the surrounding areas or zones are subjected to undesirable lateral glare, occasioned by direct viewability of the filament or other light source of the fixture from such areas. In the event light controlling means such as louvers, special lensing, or reflectors and the like are employed to limit the direct rays emanating from the source, then the total light available from and the efficiency of the fixture are substantially cut down. Moreover, the adaptability and utility of a given fixture, as for installation in more than one surrounding, are severely restricted; and these various expedients still do not offer a desirable ease of control.

The above objection as to side glare is particularly marked when the installation of the fixtures is intended for a public, multi-passenger vehicle, in which it is desirable to illuminate surrounding zones other than the beam-illuminated area, for example, an aisle zone or certain car-card areas, with a softer, more diffused type of illumination. Passengers in the aisle or occupying seats adjoining the beam-lighted area, though they are not impinged directly by the main beam through the fixture lens, are still invariably annoyed by being exposed to a direct view of the beam source.

Other practical objections to existing fixtures of this general class arise from the bulk or complexity, the expensiveness and the lack of adaptability of the various louver, bracket, connector and other constituent elements which must be employed in association with the lens and light source thereof if an attempt is to be made to achieve any degree of non-glare illumination. A simple, inexpensive fixture which dispenses with the aforesaid auxiliary components and affords the desired sort of illumination has yet to be offered the trade.

It is therefore a general object of the invention to provide a fixture, primarily composed of a one-piece light-transmissive panel including a clear portion or a lens and having a light source and

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reflector within said panel, in which said lens or clear portion is so related to the remainder of said panel and to said reflector as to direct onto a predetermined area a beam of light constituted by a component direct from said source and a component reflected by said reflector; and, furthermore, in which it is impossible to obtain a direct view of said light source from any point outside said predetermined, beam-lighted area.

It is a more specific object to provide a lighting fixture made up of a light-transmissive panel and an internal light source and reflector, wherein said panel includes a clear or condensing lens portion and an adjacent clear, transparent portion so related to the first named portion and reflector that the light source is subject to direct view only through the first named clear or lens portion, notwithstanding the fact that said adjacent clear portion is fully exposed to the source and, in transmitting reflected light, contributes materially to the intensity of the beam projected by the fixture.

A still further object is to provide a fixture of the type described, including a source of illumination, a reflector and a one-piece light-transmissive panel enclosing said source and reflector, wherein said panel includes a central, preferably plano-convex, clear beam emitting element and a further clear portion adjoining and preferably surrounding, said element in a novel angular relation thereto, thereby serving to prevent direct viewing of said source through said further clear portion and, in turn, from any portion of the total zone illuminated by said fixture, other than that which is beam-illuminated through said element.

Yet another object is to provide a fixture of the foregoing character in which the beam emitted through the central clear element of the panel is intensified by rays of light reflected from the reflector and in which said reflected rays are restricted, in traversing the panel for this purpose, to said clear portion adjoining the beam-emitting element, thereby resulting in vastly improved light control.

Another specific object of the invention is to provide a novel light-transmissive panel for a lighting fixture of the type described, including a clear, direct beam emitting portion and a further clear portion integral with and adjoining said beam emitting portion in a particular and novel inclined or conical relation thereto, which last named portion is effective to prevent exit therefrom of direct rays from said source internally traversing the same, together with a dif-

fusing portion adjoining said inclined clear portion to which said rays, in internally traversing the latter, are directed for emission in diffused form.

In another aspect, it is an object to provide a fixture of the above type and a novel means to mount the same on surfaces of various shapes.

A further general object is to provide a fixture including a light transmissive panel, light source and reflector having the foregoing characteristics and relationships, in which the panel is a simple, one-piece member which is free from bulky, complicated and dust catching auxiliary light control means, which is extremely versatile in its adaptability to various installations and which achieves a maximum of lighting efficiency in operation.

Other objects of the invention will be apparent to those skilled in the art upon a consideration of the following specification and by reference to the accompanying drawings, in which:

Fig. 1 is a view in transverse vertical section through a fixture in accordance with the present invention, illustrating structural details of the light-transmissive panel thereof and its relation to a source of illumination and reflector with which it coacts;

Figs. 2 and 3 are fragmentary views in transverse vertical section taken respectively at right angles to one another showing the method of mounting the fixture of the invention in sealed relationship to a curved vehicle deck or other supporting surface with which it is associated;

Figs. 4 and 5 are, respectively, fragmentary schematic views in longitudinal side elevation and front elevation illustrating a proposed installation of a system of the fixtures according to the invention in a conventional type of elongated public vehicle such as a railway or trolley car, bus, airplane or the like, and showing the improved illumination of the interior of such vehicle made possible by the system; and

Fig. 6 is a bottom plan view of the fixture of the invention, in accordance with a preferred embodiment thereof.

The lighting fixture of the present invention, although particularly intended for installation in vehicle lighting systems, i. e., in buses, railway and trolley cars, airplanes, etc., is also well adapted for more general application in lighting systems of other types in which, as stated above, it is desired to obtain an intensified and well-controlled beam of light from an internal light source or filament, accompanied by a lateral diffused illumination of the space surrounding said beam.

While I have chosen to illustrate the fixture (as in Fig. 6) in a circular external outline, characterized by concentric, circular, clear lens and adjoining zones and a surrounding peripheral diffusing zone, it is to be understood that the specific external shape of the fixture in this regard is not of controlling importance, and that the principles of the invention are equally adaptable to structures having other external outlines.

The advantages afforded by the present structure are primarily traceable to the novel lighting panel thereof and its relationship to an internal reflector and light source. The panel itself involves a novel relationship of a central, preferably plano-convex clear lens element a surrounding, clear, inclined area and an external diffusing area, the inclination of said first named area relative to said lens element being such that direct light rays from said source which impinge

said clear area, externally of the lens, do so in an endwise direction, almost parallel to its length, and are transmitted therethrough without exiting from said clear area, for final emission through said diffusing area. This result is due to the fact that said rays can only impinge the opposed inner surfaces of the clear area at an angle less than that minimum angle which will permit exit through said area. Consequently, it is absolutely impossible for one located outside of the zone of direct beam-illumination by the fixture's lens element to view the light source directly. As a further consequence of this, intense side glare such as is frequently a source of annoyance to surrounding vehicle passengers is completely eliminated; yet at the same time, the clear area surrounding the lens is available for the transmission, and merge with the lens beam, of rays reflected from a reflector behind the light source, thereby greatly augmenting and intensifying the final reading beam at the desired zone to be direct-illuminated.

Referring to Fig. 1 of the drawings, wherein the basic structural aspects of the fixture are most clearly illustrated, particularly the cross-sectional outline of the light transmissive component thereof and its novel relation to a light source and reflector, the reference numeral 10 designates the fixture generally. The latter includes a specular reflector 11 having a socket tube 12 swaged therein centrally thereof. This tube is adapted to fixedly receive a conventional bayonet-type socket 13 in which the lighting element 14, illustrated as a conventional incandescent filament bulb, is received. It will be understood from the description to follow that the invention is not necessarily limited to such filament-type element or to a point light source, and that other types of lighting means, such as a gaseous discharge or arc type are contemplated. I have therefore employed the reference numeral 15 to designate broadly the filament of the bulb 14 as a light source, on the understanding that said source will find its equivalent in the light emissive gas, the electrode or other conventional light emissive element of whatever other type of illumination is applied to the fixture.

The reflector 11 is provided with an integral surrounding annular rim or flange 11' which may have a hinge 16 secured marginally thereto for pivotally supporting an annular ornamental bezel or like panel carrying frame 17. The latter may be secured to the reflector flange 11' by means of a screw 18 threaded into a tapping pad 19 affixed to said flange.

The reference numeral 20 denotes the circular light transmissive panel of the fixture, the peripheral flange 21 of which is supported by frame 17, in the opening 22 of the latter. The cross-sectional outline of this panel is of material importance in the invention and will hereinafter be discussed in detail. An annular sponge rubber or felt cushion 23, preferably cemented to the reflector flange 11' concentrically of the reflector, is adapted to be compressed between said flange and the upper surface of the panel flange 21 so as to dust-seal the interior of the fixture in a very effective manner.

The light transmissive panel 20 comprises a central, plano-convex, clear lens portion 24, a surrounding, inclined or conical portion 25 which is also clear or transparent, and an external peripheral portion 26 which is cupped upwardly and outwardly to its juncture with the flange 21. This peripheral portion is appropriately treated

by firing white enamel thereon, as indicated at 27, by etching or otherwise, to render the same light-diffusing in character. Its inner peripheral, cupped extremity merges directly into the outer extremity of the inclined or tapered, clear portion 25. In the form illustrated the various portions 24, 25, 26 are circular in shape, arranged in a concentric bull's eye pattern. See Fig. 6. However, as pointed out above, the principle of the invention is also well adapted to other shapes of panel, such as an elongated outline for fluorescent lighting, etc.

Lens 24 is disposed immediately adjacent the bulb 14 and its action in combination with the surrounding clear, tapered portion 25 and diffusing portion 26, as well as the internal reflecting surface of reflector 11, designated 28, is well illustrated in Fig. 1.

The angle of inclination of the clear portion 25, relative to a vertical line or plane through the axis of the light source 15, the lens 24 and the fixture itself, is of primary importance in the invention. It is selected so that the angle A of internal reflection of said portion 25, i. e., the angle of reflection of light from the source 15 in opposite directions from the internal surfaces 25', 25'' of said portion 25, is below a value which will permit exiting of the direct rays. Hence they travel longitudinally through said portion, being internally reflected in so doing. A value of about 42° for the angle A between said rays and said internal surfaces 25', 25'' of portion 25 gives rise to this condition and should not be materially exceeded.

Accordingly, the angle B between the conical portion 25 and the axis or plane through the light source will be governed by the relative position of said portion and light source 15 so as to produce the proper angle A of internal reflection. If the distance between the lens 24 and said light source is increased, the angularity B of portion 25 must be decreased, otherwise the value of angle A will surpass the permissible maximum of about 42° and direct light emission from portion 25 will occur. This will enable a direct viewing of the source 15 through said portion, a condition which the present invention is intended to prevent.

The theory and operation of the fixture in controlling light emission are illustrated clearly in Fig. 1, wherein it has been attempted to illustrate the relative intensity of various components of the beam emitted by the fixture by a corresponding intensity of shading. Rays emanating from filament 15 pass downwardly and enter the plano-convex lens 24 by which they are condensed to emerge in the form of a conical beam C whose arcuate spread is indicated by the reference character D. Other rays from the filament emitted in such directions that they impinge reflector surface 28 are reflected thereby downwardly through the clear portion 25 of the panel 20 to a focus at E and diverge in the form of the secondary annular, reflected beam F, whose angularity is indicated at G. Beam F is superimposed on the primary beam C referred to above, and results in a highly intensified, composite beam H within the overall envelope of the condensed, lens-transmitted beam C.

The fixture 10 is positioned on its support in such manner that this highly intensified beam H is directed in the zone including the reading plane P of a passenger therebeneath, in spotlight fashion as illustrated in Figs. 4 and 5. The concentric conical beam C of slightly less intensity

floods the remainder of the area directly beneath the fixture with ample illumination for reading.

The functioning of the conical portion 25 in preventing direct viewing of the filament 15 from the zone outside the confines of the primary beam C is also illustrated in Fig. 1, and its effect is apparent in Figs. 4 and 5. It will be noted that a ray impinging said portion, for example at its junction with the lens 24, is reflected, as shown by the internal arrows in Fig. 1, from the opposite internal surfaces 25', 25'' of said conical portion without escaping therefrom, due to the fact that the angle A is less than the necessary exiting angle of 42°. Angle A does not increase to a value sufficient to permit exit until the ray has traversed the length of portion 25, at which time it is diffused upon emission, due to the diffusing character of the outer portion 26 of the panel. This diffused nature of the aforesaid exiting direct rays, as well as other rays which impinge portion 26 directly from the filament 15, has been indicated by the external divergent arrows in Fig. 1. The effect is to softly floodlight the space in the vehicle interior laterally of the fixture and externally of the direct beam C. Notwithstanding the fact that there is a substantial area of clear glass exposed around the lens 24, it transmits only reflected light and the lens transmits only direct rays from the filament. Objectionable glare arising from the direct viewing of said filament through the clear area 25 is thus impossible, due to the internal reflecting characteristic of said portion.

Referring to Figs. 4 and 5, it will be noted that the intersection at I of beams C from successive fixtures affords illumination in this space, of an intensity equalling that of the composite beam H, which space includes the reading plane P of a passenger. In short, that portion of the volume of the interior in which the passengers are seated is uniformly flooded by an intensified, shadow-free, beam illumination. Again by reference to Figs. 4 and 5, it will be noted that the zones externally of those served by the beam illumination, are lighted solely by the diffused light emanating from the portion 26 of the respective fixtures and it is impossible to view the light source directly from these zones. Eyestrain and annoyance are thus eliminated.

In mounting the above fixture, it is desirable to employ means which will adapt the circular flat reflector flange 11 thereof to conform to the slight curvature which is normally found in the deck 23 of a passenger vehicle such as is represented in those figures, through an aperture 29 in which deck the reflector 11 projects. To this end I contemplate the provision of a relatively flexible, annular, upwardly dished gasket or adapter 30 (shown in Figs. 2 and 3) of rubber or other readily conformable material. This accommodates itself to the contour of the deck when applied upwardly thereagainst and secured by any suitable means. It will be noted that said adapter flattens out (Fig. 2) in engaging the deck across its curved dimension, while maintaining sealing engagement across the dimension normal thereto (Fig. 3) by means of its dished lip 31.

The foregoing construction eliminates the possibility of reflected light passing through the lens portion 24 of the panel. This is ordinarily hard to control and imposes a limitation on the selection of a suitable reflector. A further notable feature of advantage lies in the fact that the panel 20 is an integral, one-piece construction

and is well adapted to be molded with requisite accuracy by mass production methods. It involves no complicated louvers, special lensing, connectors, brackets, etc.

Reference has been made to the special adaptability of the fixture for use in bus, railroad, airplane or like lighting systems. It will be apparent to those skilled in the art that the basic principle thereof is also applicable quite generally in the field of space lighting, for example, in headlights, searchlights, etc., and, in fact, in practically any beam-lighting installation in which it is desired to control side glare and still maintain full lighting efficiency.

I claim:

1. A fixture of the type described, comprising a hollow, dished, light transmissive panel and a shaped reflector fixedly associated with said panel whereby to provide a space for the reception of a light source therebetween, means to mount a light source in said space, said panel defining the forward extremity of said fixture and including a clear, beam-emitting element located forwardly of and in axial alignment with said source and a further annular tapered, clear section integral with and laterally merging with said element, said clear section being defined by tapered external surfaces of smooth, uninterrupted character diverging outwardly from said beam emitting element and forwardly away from said space at an angle relative to the axis of the fixture through said reflector, light source and beam-emitting element such that direct rays from said source laterally entering said clear section impinge the internal surfaces thereof at a reflective angle smaller than the angle of exit, said clear section being transparent throughout so as to pass rays reflected from said reflector and impinging the external surface of the section nearest said reflector.

2. A fixture of the type described, comprising a hollow, dished, light transmissive panel and a shaped reflector fixedly associated with said panel whereby to provide a space for the reception of a light source therebetween, means to mount a light source in said space, said panel defining the forward extremity of said fixture and including a clear, beam-emitting element located forwardly of and in axial alignment with said source and a further clear section integral with and laterally merging with said element, said clear section being defined by tapered external surfaces of smooth, uninterrupted character diverging outwardly from said beam emitting element and forwardly away from said space at an angle relative to the axis of the fixture through said reflector, light source and beam-emitting element such that direct rays from said source laterally entering said clear section impinge the internal surfaces thereof at a reflective angle smaller than the angle of exit, said clear section being transparent throughout so as to pass rays reflected from said reflector and impinging the external surface of the section nearest said reflector, said reflector being so disposed relative to said source and panel as to reflect rays from said source to the clear section only of said panel.

3. A fixture of the type described, comprising a hollow, dished, light transmissive panel and a shaped reflector fixedly associated with said panel whereby to provide a space for the reception of a light source therebetween, means to mount a light source in said space, said panel defining the forward extremity of said fixture and including a clear, beam-emitting element located

forwardly of and in axial alignment with said source and a further clear section integral with and laterally adjoining said element, and a diffusing section integral with and merging with said clear section, said clear section being defined by tapered external surfaces of smooth, uninterrupted character diverging outwardly from said beam emitting element and forwardly away from said space at an angle relative to the axis of the fixture through said reflector, light source and beam-emitting element such that direct rays from said source entering said clear section from a lateral direction impinge the internal surfaces thereof at an angle smaller than the angle of exit, said clear section being transparent throughout so as to pass rays reflected from said reflector and impinging the external surface of the section nearest said reflector, said reflector being so disposed relative to said source and panel as to reflect rays from said source to the clear section only of said panel, said diffusing section being located relative to said clear section to emit in diffused form said rays internally traversing said clear section and reflected from said internal surfaces thereof.

4. A lighting fixture comprising a reflector and a hollow, drum-like, light transmissive panel fixedly connected to said reflector, means to mount a light source in the space between said reflector and panel, said panel defining the forward extremity of said fixture and including a central, clear beam-emitting portion located forwardly of the light source and an annular clear section surrounding and merging directly with the periphery of said beam-emitting portion, the forward and rear surfaces of said clear section being disposed about said beam emitting portion in a generally conical shape diverging radially upwardly of said beam-emitting portion and in an axial direction away from said light source, said clear section being defined by smooth, uninterrupted surfaces and being transparent to rays externally impinging the same, the inclination of said clear section relative to said beam-emitting portion being such that the angle of impingement of its internal surfaces by direct light rays from said source laterally entering and longitudinally traversing the same is not substantially in excess of the exit angle, whereby said rays are reflected internally in said clear section in longitudinally traversing the same, said clear section being positioned relative to said reflector for transmission of reflected rays from said source in convergent relation to a beam traversing said lens portion.

5. A lighting fixture comprising a reflector and a hollow, drum-like, light transmissive panel fixedly connected to said reflector, means to mount a light source in the space between said reflector and panel, said panel defining the forward extremity of said fixture and including a central, plano-convex, clear, beam emitting lens portion located forwardly of the light source, an annular clear section merging directly with the periphery of said lens portion, the forward and rear surfaces of said clear section being disposed about said beam emitting lens portion in a generally conical shape diverging radially outwardly of said beam-emitting portion and in an axial direction away from said light source, said clear section being transparent to rays externally impinging the same, and an external annular light diffusing section merging directly with said last named section, the inclination of said clear section relative to said lens portion being such that

the angle of impingement of its internal surfaces by direct light rays from said source laterally entering and longitudinally traversing the same is not substantially in excess of 42°, whereby said rays are reflected internally of said clear section in longitudinally traversing the same, said clear section being positioned relative to said reflector for transmission therethrough, to the exclusion of said lens portion, of reflected rays from said source directing said reflected rays in convergent relation to a beam emitted by said lens portion, said diffusing section being located, relative to said clear section to emit in diffused form said internally reflected direct rays.

6. A lighting unit comprising a shaped reflector, a light transmissive panel in fixed relation to said reflector and means to mount a light source between said reflector and panel, said panel defining the forward extremity of said unit and having a clear beam-emitting section located immediately forwardly of and in axial alignment with said source and a clear, annular, rearwardly and inwardly inclined section surrounding and merging with the external periphery of said beam-emitting section and fully transparent to rays externally impinging the same, the angle of inclination of said annular section relative to the axis of said light source and first named section being in inverse ratio to the distance of said light source from said beam-emitting section and being of a value such that direct rays from said source entering and internally traversing said inclined section impinge the internal surfaces of the latter at angles less than the angle of exit, said clear, inclined section being defined by opposed smooth, uninterrupted surfaces.

7. A lighting unit comprising a shaped reflector, a light transmissive panel in fixed relation to said reflector and means to mount a light

source between said reflector and panel, said panel defining the forward extremity of said unit and having a clear beam-emitting section located immediately forwardly of and in axial alignment with said source and a clear, annular, rearwardly and inwardly inclined section surrounding and merging with the external periphery of said beam-emitting section and fully transparent to rays externally impinging the same, the angle of inclination of said annular section relative to the axis of said light source and first named section being in inverse ratio to the distance of said light source from said beam-emitting section and being of a value such that direct rays from said source entering and internally traversing said inclined section impinge the internal surfaces of the latter at less than a 42° angle, said beam-emitting and inclined sections being disposed relative to said reflector whereby rays reflected from the latter pass only through said inclined section.

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