Sept. 5, 1967 K. FRANCK ETAL 3,340,393

UNDERPASS LUMINAIRE

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Fig. 1.

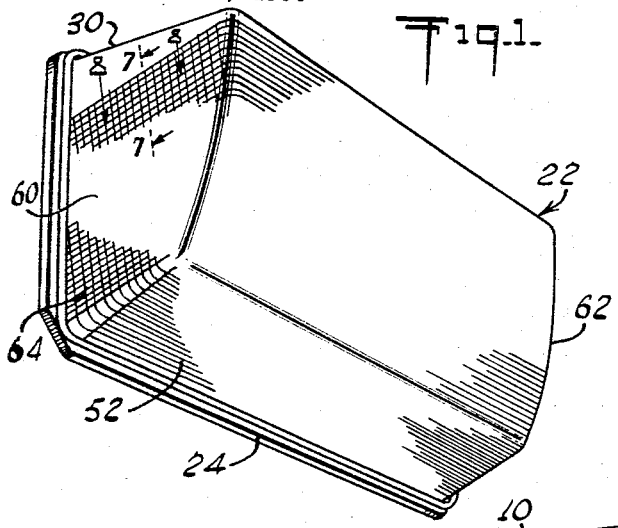

Fig. 2.

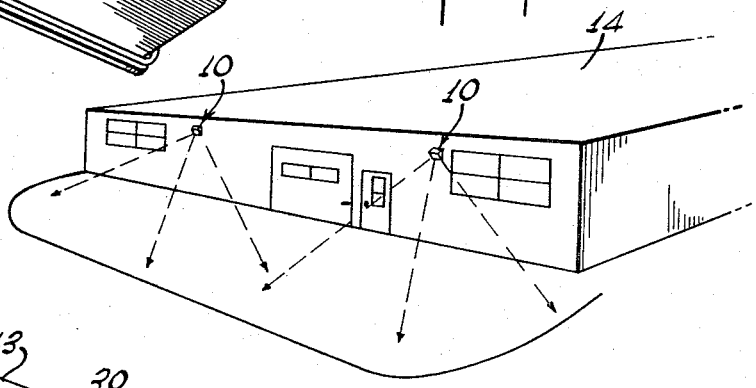

Fig. 3.

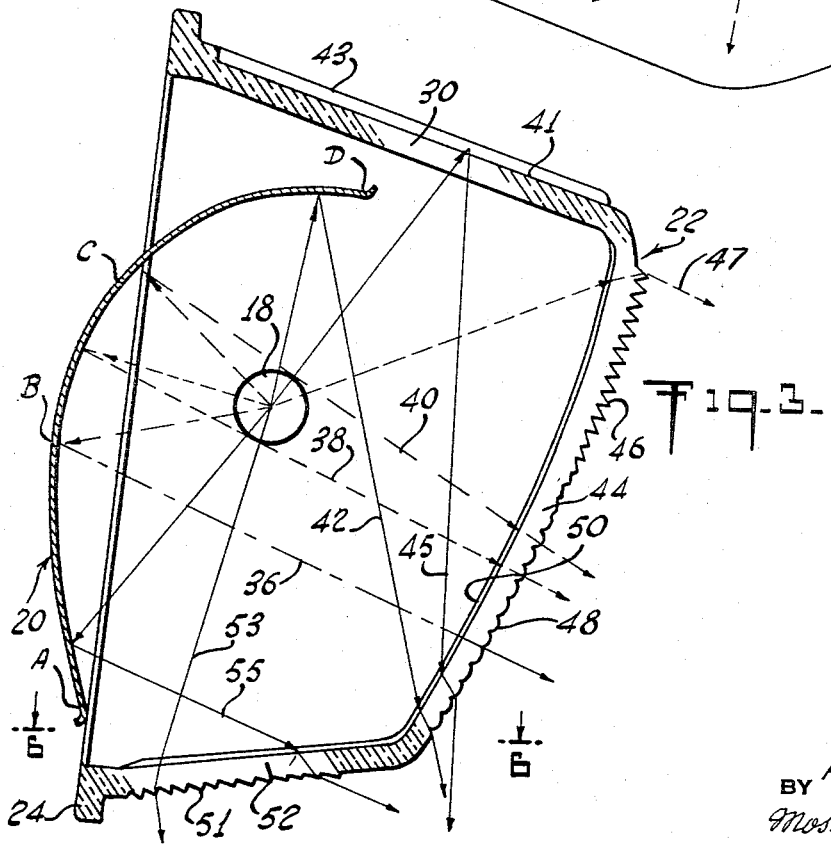

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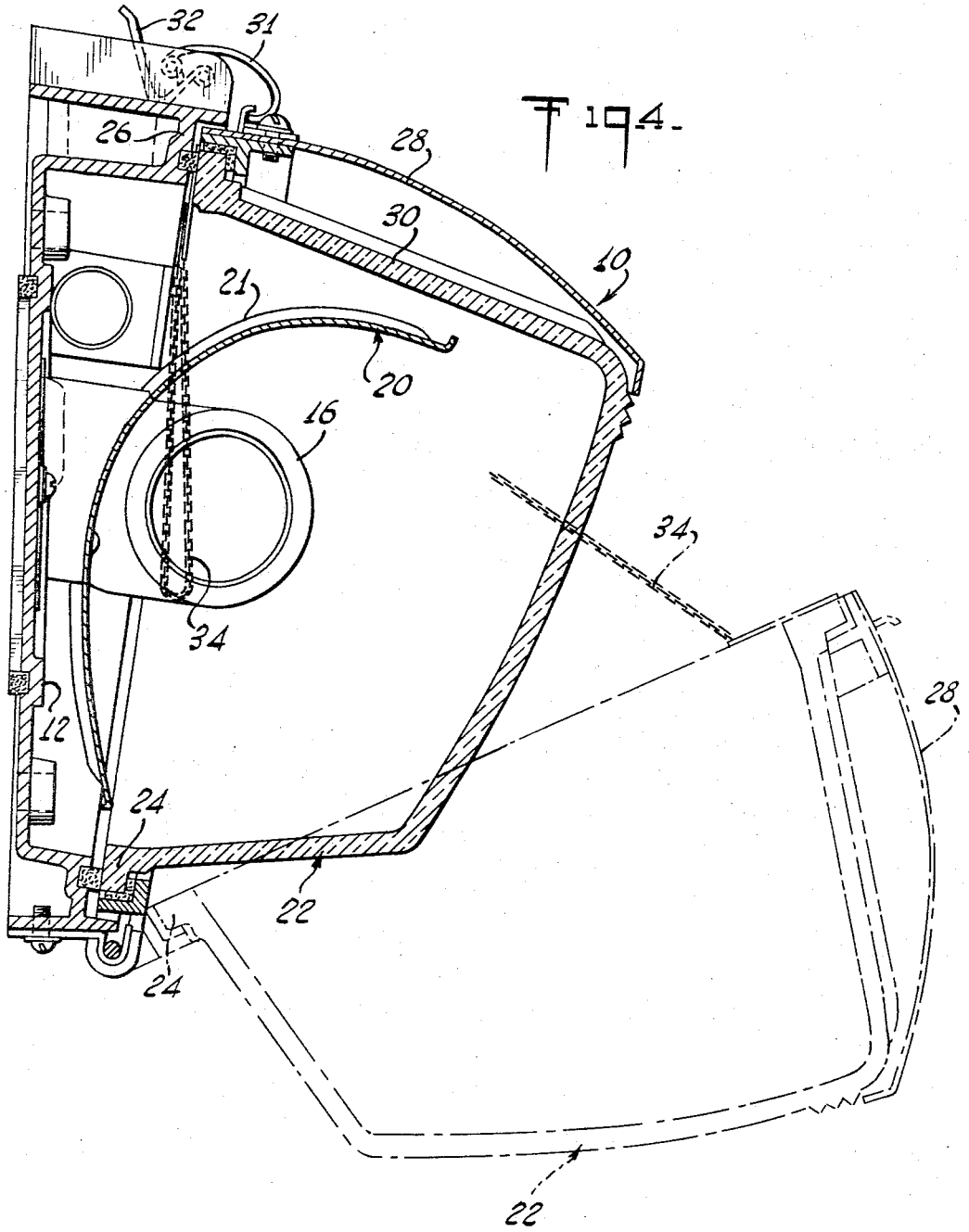
FIG. 4.



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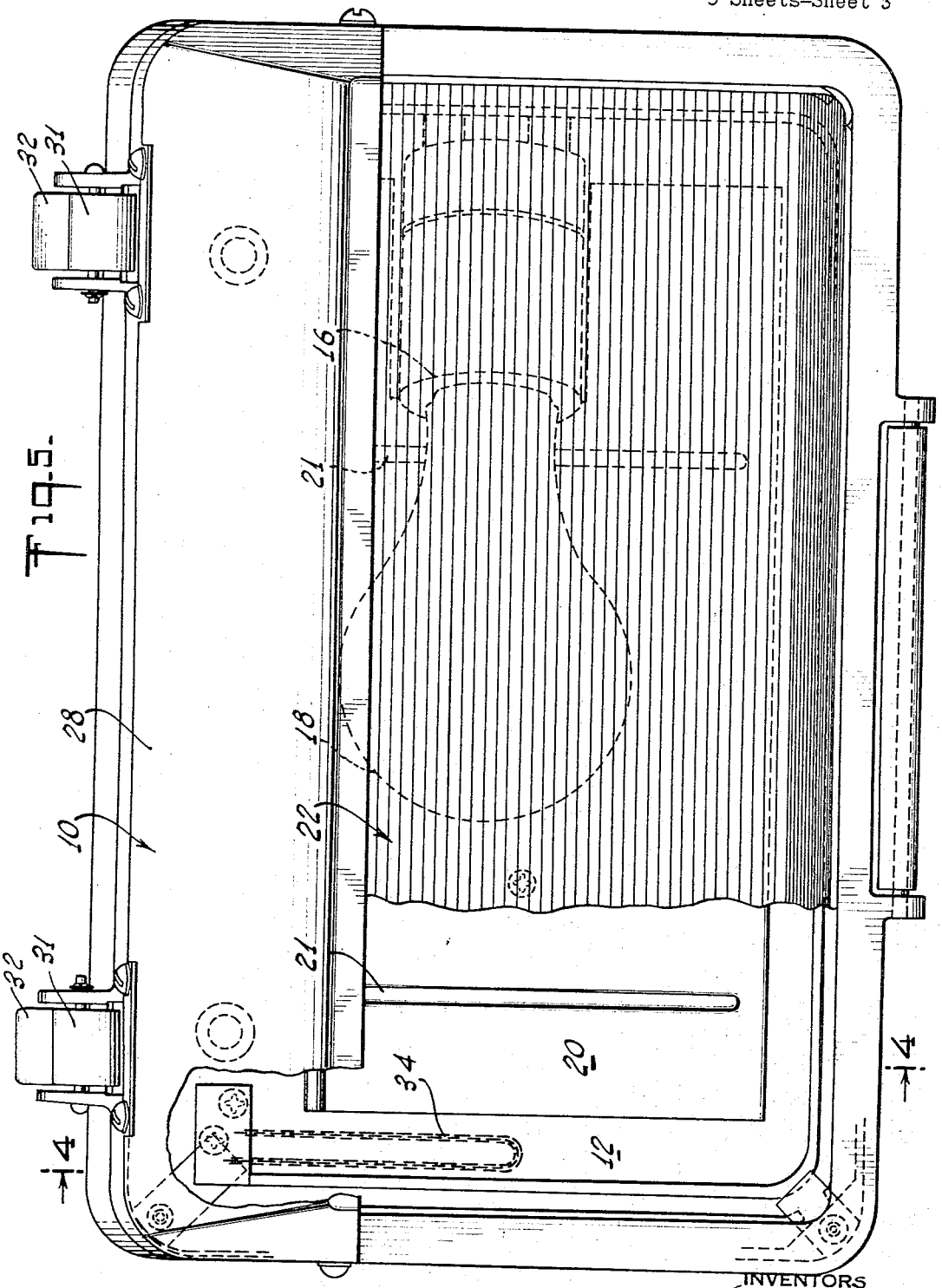

FIG. 5.

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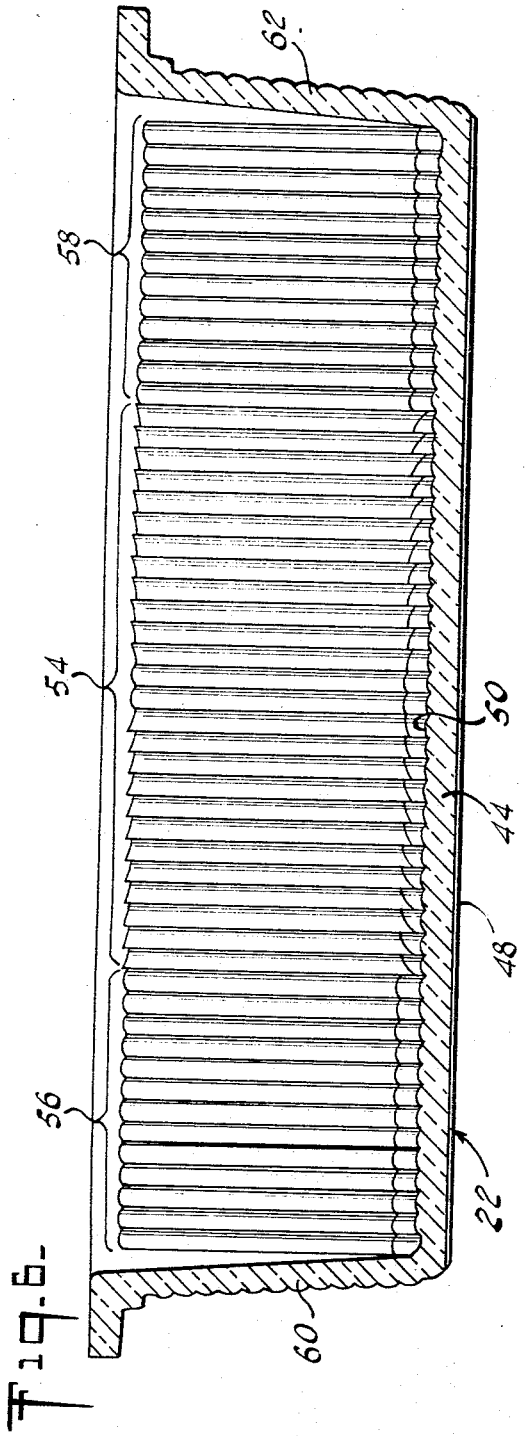

FIG. 6.

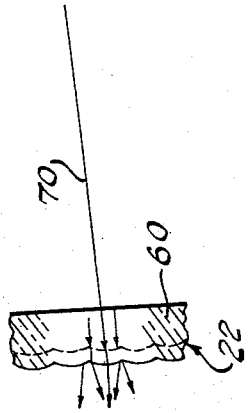

FIG. 8.

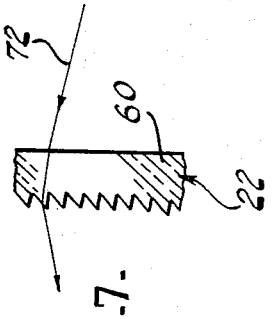

FIG. 7.

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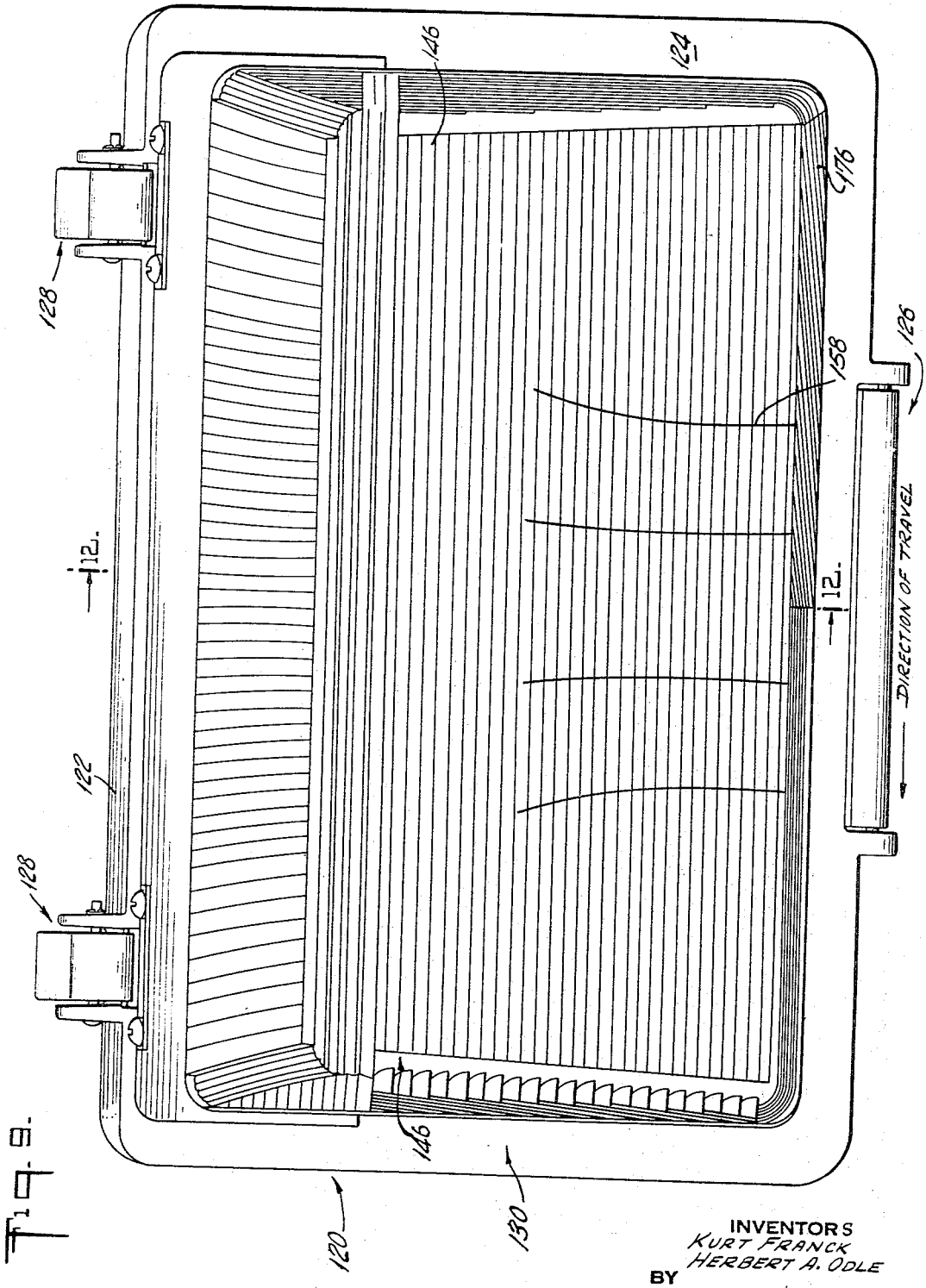

Fig. 9.

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Fig. 10.

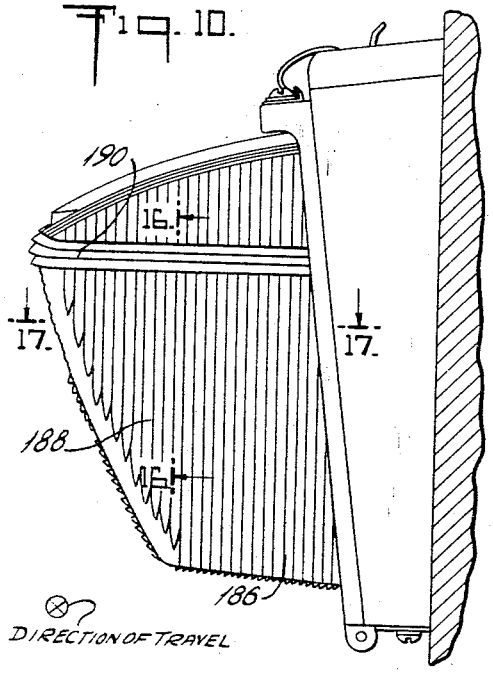

Fig. 11.

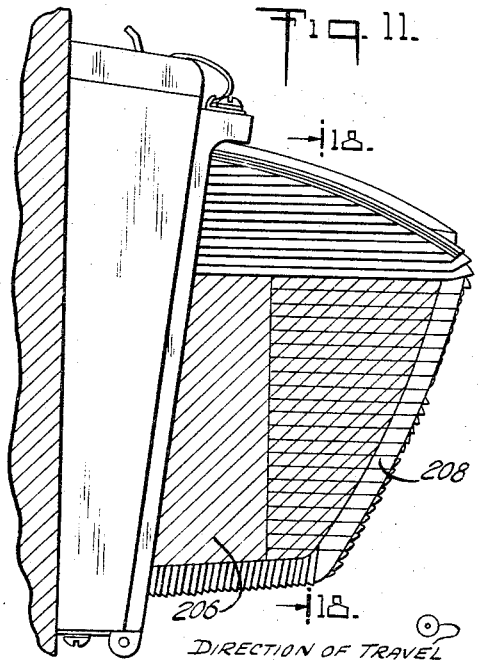

Fig. 16.

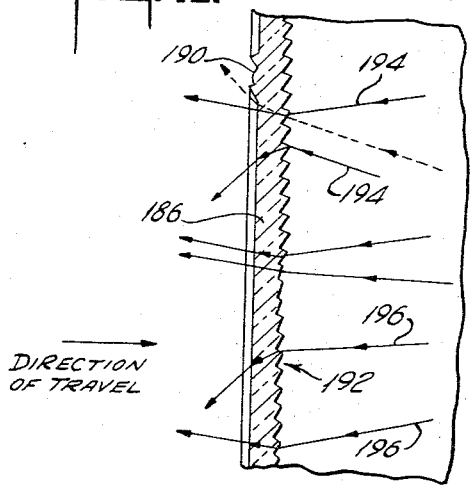

Fig. 17.

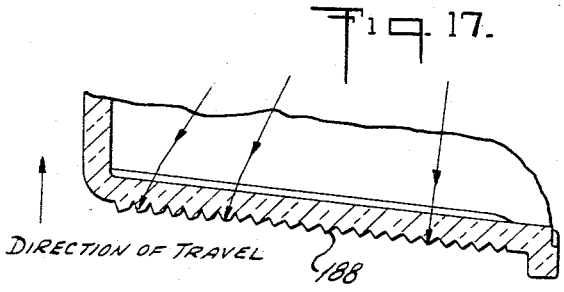

Fig. 18.

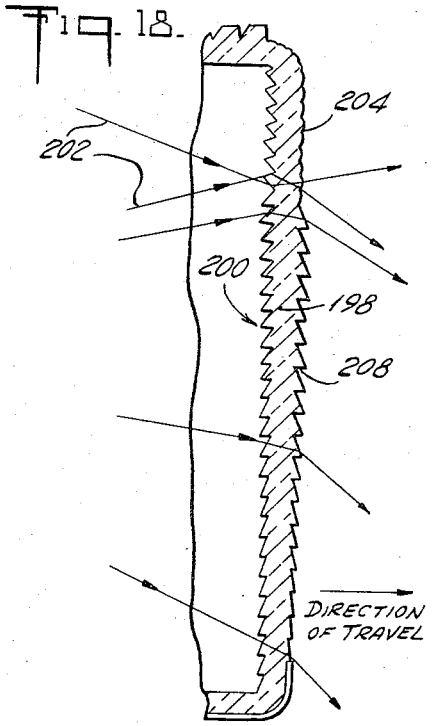

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FIG. 13.

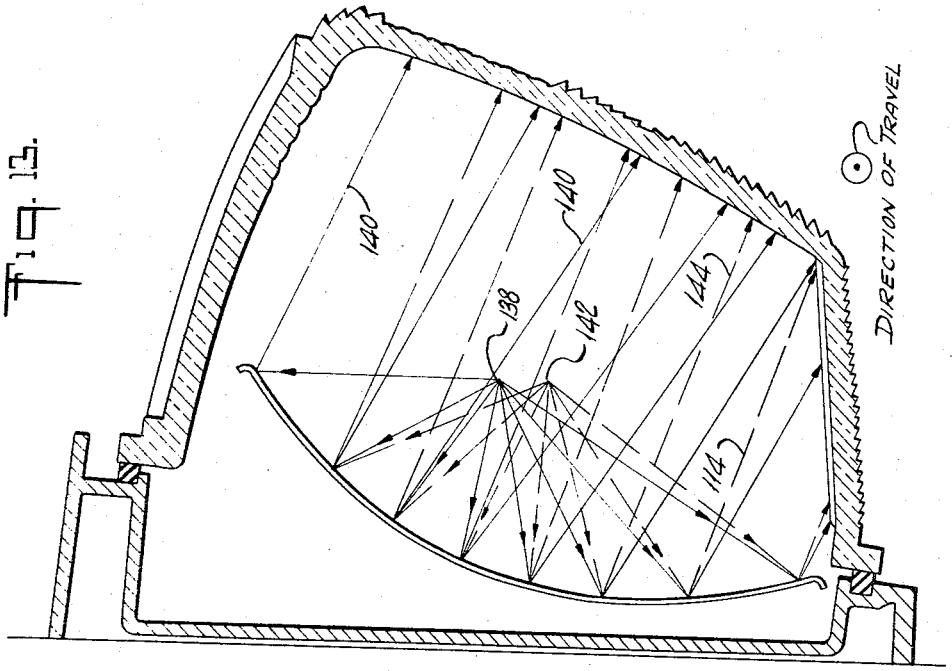

FIG. 12.

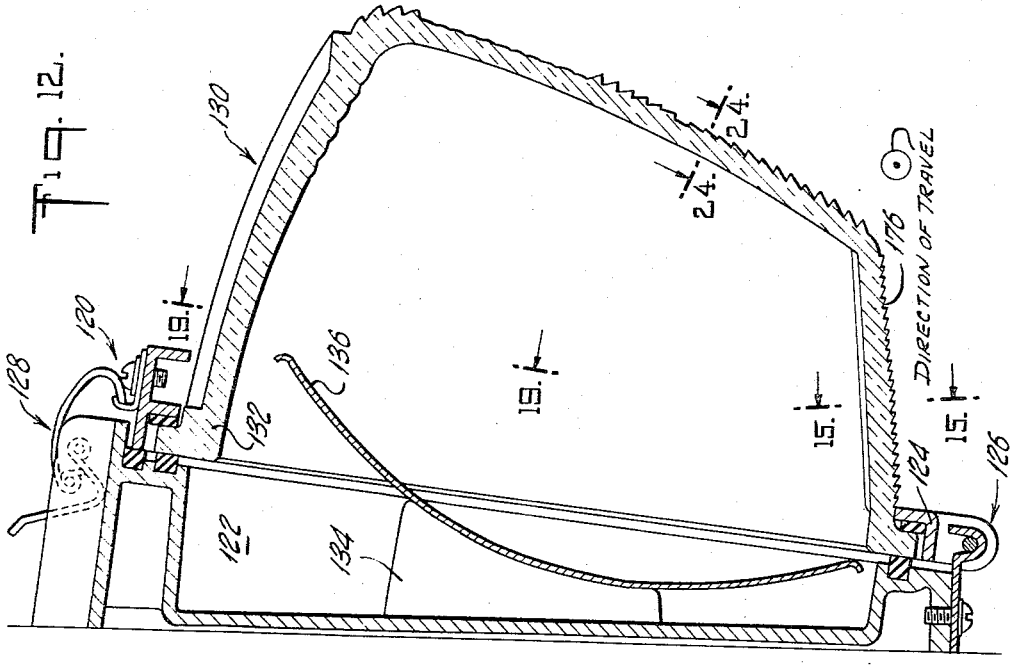

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Fig. 14.

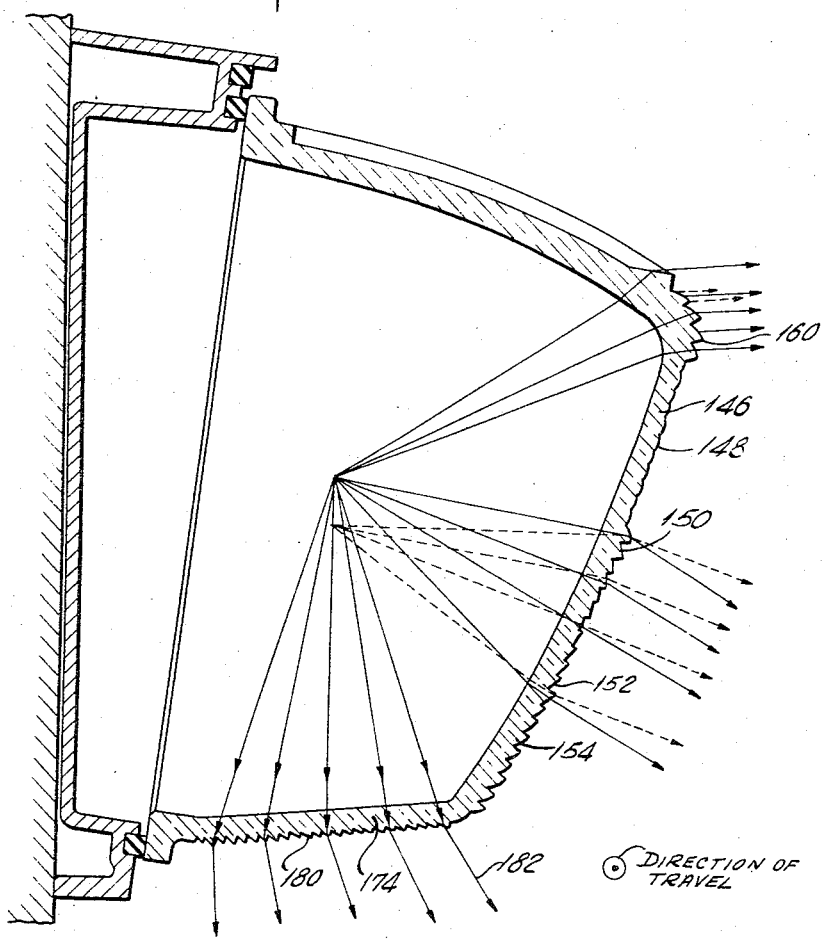
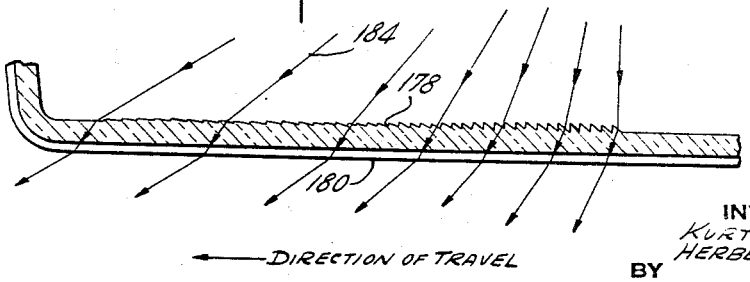


Fig. 15.



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Sept. 5, 1967 K. FRANCK ETAL 3,340,393

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Fig. 19.

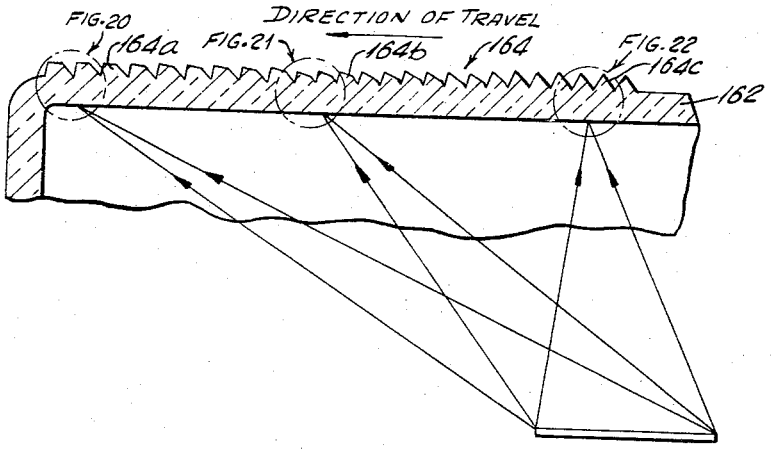


Fig. 20.

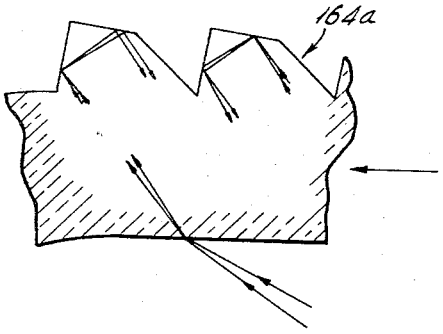


Fig. 21.

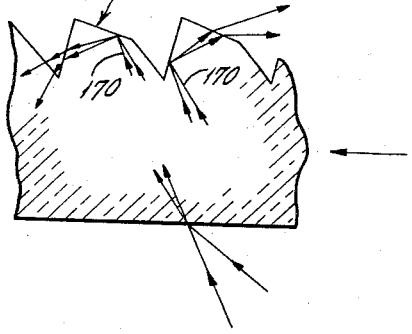


Fig. 22.

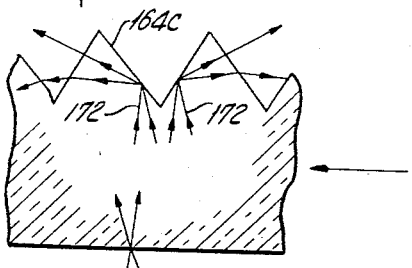


Fig. 23.

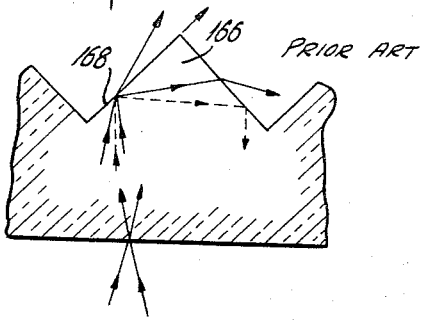
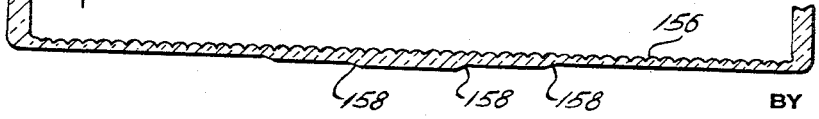


Fig. 24.



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United States Patent Office

3,340,393

Patented Sept. 5, 1967

3,340,393

UNDERPASS LUMINAIRE

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Filed Nov. 19, 1964, Ser. No. 412,513

31 Claims. (Cl. 240—93)

This is a continuation-in-part of applicant's co-pending patent application Ser. No. 3,561 filed Jan. 20, 1960, entitled, Rectangular Outdoor Unit.

This invention relates in general to luminaires, and in particular to a new and useful luminaire for mounting on a vertical wall and including means for directing light therefrom outwardly and downwardly in useful directions.

A luminaire constructed in accordance with the present invention is particularly useful for mounting on a vertical wall of a building for lighting, parking, or loading areas, play areas, platforms, etc. The invention includes means for reflecting light of an elongated light source, such as a mercury lamp, outwardly and downwardly from the building and angled to light complete areas alongside the building without causing high angular glaring light.

A feature of the invention is the provision of a reflector arranged within the luminaire for the purpose of intercepting substantially all the light that is not directed directly to a substantiallly trough-shaped refractor which substantially closes the unit. The reflector is provided to reflect light forwardly into useful directions and is specially shaped in order to insure that the light is not directed at high glare producing angles. The reflector also directs light around the mercury lamp in order to achieve better lighting efficiency. Since the mercury arc tube is substantially opaque to returning light, it is desirable that light is directed around the tube rather than back through it.

The luminaire includes a novel construction which permits hinging of a trough-shaped refractor at the bottom of a vertical wall portion of the unit and includes means for latching it against the top portion of the vertical wall. The refractor may be unlatched and swung downwardly for access to the interior of the luminaire. The refractor accepts as much of the light from the light source as is physically possible. It is advantageously mounted so that it has approximately a six and one half degree forward tilt. It includes a top portion to reflect downwardly all of the light which is directed toward the top portion into useful directions, and front, side and bottom portions for insuring that the light is directed downwardly and distributed uniformly beneath the luminaire.

The refractor is of special construction and includes a forward face which is divided into two optical sections; a top portion which includes prisms for depressing light down to a vertical angle of approximately sixty-five degrees from the horizontal, and a lower portion which is arranged to handle the reflected light from the reflector and the top of the refractor. Normally with the luminaire construction outlined, the top portion of the front panel only receives direct light from the light source and it is provided with prisms on its outside face to refract this direct light downwardly at approximately an angle of sixty five degrees. The lower optical portion of the front face accepts both direct light from the light source and light which is reflected by the reflector. The major portion of light which it receives, however, is reflected light, and its main function is to diffuse the light so that there will be no streaks or striations. This lower portion of the refractor is constructed so that it is capable of accepting both direct light and light from the reflector without changing the vertical angle of the light but diffusing it so that there will be no streaks or striations. In accordance with the invention this lower portion may also include prism portions for lifting or depressing the light into angular directions as desired. In the present arrangement the light is permitted to go through the lower portion of the front panel without any lifting or depressing of the direction of the light. The overall construction just described provides a refractor face with optical components, an upper one and a lower one, which combine to form one light beam which is directed downwardly from a luminaire to about sixty-five degrees vertical.

One feature of the invention is the provision of a top panel of the refractor which includes reflecting prisms on the outside face thereof arranged to reflect the light downwardly to one of the other panels of the refractor.

Another feature of the invention is the construction of the bottom portion of the trough-shaped refractor which is arranged so that it will be disposed at a substantially horizontal angle when the refractor is in an operating position. The bottom, nearly horizontal, panel of the refractor is provided primarily to intercept light directed backwardly and then to push this light out into useful directions. It was found, however, that when this light was pushed forward it still tended to bunch up under the luminaire and there was not a spreading of the light lengthwise of the luminaire. Therefore, in accordance with the invention approximately the center third of this bottom panel is provided with relatively deep inside prisms perpendicular to the wall to spread this light parallel with the wall in order to distribute the light uniformly over the area to be lighted.

In accordance with another feature of the invention the end panels of the trough-shaped refractor are designed to accept both direct light and reflected light and hence prismatic portions are provided to both refract and diffuse the light. In order to accomplish this the exterior face of the end panels are provided with scalloped prisms. It was found in the construction of such a refractor that it was not feasible to include diffusing flutes on the inside surface which would diffuse the light advantageously. Therefore, in accordance with the invention, diffusing flutes were combined with refracting prisms on the exterior surface of the panels and they effectively refract the light downward into a required direction and diffuse the light in plane approximately ninety degrees to the plane of refraction.

The present invention is novel particularly in the arrangement of reflector and refractor which permits the generation of a useful light beam below the luminaire which is formed partially by the light being concentrated by a specular reflector and partially by the light being concentrated by a prismatic configuration of the refractor. The refractor is specially designed with prisms on separate parts of its outer front face which effectively concentrate the direct light incident thereto into a beam and also accept the already concentrated light from the specular reflector. The end surfaces of the refractor are provided with scallop prism formations on the outer face thereof which are effective not only to refract light into useful directions but also diffuse it in a plane approximately 90° to the point of refraction.

The present invention also relates to luminaires of the type described which are particularly suited for use in underpasses through which vehicles travel, and the invention relates especially to luminaires adapted to be mounted on the side wall of such an underpass.

Considerable problems are involved with luminaires of this later type. On the one hand it is of course necessary to provide illuminate the road ahead of the approaching driver but at the same time it is also necessary to illuminate other parts of the underpass, and furthermore, it is, of course, highly undesirable to direct any light into the eyes of an approaching driver.

Accordingly, it is an object of this invention to provide an improved luminaire.

A further object of the invention is to provide a luminaire particularly adaptable for mounting on a vertical wall and including a reflector for reflecting light downwardly in useful directions, and a refractor lens which carries prisms to concentrate direct light incident thereon into useful directions below the luminaire and also accept the already concentrated light from the reflector.

A further object of the invention is to provide a wall mounted luminaire including a trough-shaped refractor having light directing prisms on each end effective to refract light into useful directions and diffuse it in planes approximately 90° to the plane of refraction.

It is also a primary object of the present invention to provide a luminaire which will substantially uniformly light the road ahead of an approaching driver in an underpass while at the same time shielding the eyes of the approaching driver from direct light.

Furthermore, it is an object of the present invention to provide a luminaire of this type which will at the same time direct light to the ceiling and walls of the underpass so as to reduce lighting contrasts within the underpass.

In addition it is an object of the present invention to provide a luminaire which will distribute light substantially evenly along the road at the sidewall of the underpass.

Also, it is an object of the invention to provide a refractor, for a luminaire of the above type, which has a prismatic construction capable of directing light in a manner achieving the above objects.

A primary feature of the present invention resides in the construction of the hollow refractor of the luminaire. This hollow refractor has top, bottom and front panels as well as front and rear end panels respectively directed toward and away from the approaching driver, the top panel of the refractor of the invention being provided with a system of outside shielding prisms which are a modified form of reflecting prisms, the front end panel forming a prismatic shiled for minimizing the luminaire brightness in the eyes of the approaching driver, while the bottom of the refractor provides an asymmetric distribution of light canted down the road away from the approaching driver also to shield direct light away from the eyes of the drives, while illuminating the near side of the street ahead of the approaching driver, and the rear end panel being provided with horizontal light-depressing prisms on its interior in combination with horizontal and diagonal depressing prisms at its exterior for forming a beam below 60° with respect to vertical along the near side of the road directed away from the approaching driver. The front panel of the refractor of the invention has a system of prisms which concentrate direct light into a parallel beam.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objectives obtained by its use, reference should be had to the accompanying drawings and descriptive matter in which there is illustarted and described the preferred embodiment of the invention.

In the drawings:

FIG. 1 is a perspective view of a refractor designed for use with a luminaire constructed in accordance with the invention;

FIG. 2 is a somewhat schematic perspective view of a pair of luminaires constructed in accordance with the invention in their arrangement on the side of a building;

FIG. 3 is a transverse somewhat schematic section of the reflector and refractor portions of the luminaire indicating various light ray paths;

FIG. 4 is a transverse section of a luminaire constructed in accordance with the invention taken along lines **4—4** of FIG. 5;

FIG. 5 is a front elevation partially broken away of a luminaire indicated in FIG. 4;

FIG. 6 is a fragmentary inside top elevation view of the refractor bottom panel taken along lines **6—6** of FIG. 3;

FIG. 7 is a fragmentary vertical section of one of the side panels taken along lines **7—7** of FIG. 1;

FIG. 8 is a fragmentary top plan view showing portions of the top and side panels taken along lines **8—8** of FIG. 1;

FIG. 9 is a front elevation of a luminaire including a modified embodiment of the invention and as it appears when looking toward the side wall of the underpass which carries the luminaire;

FIG. 10 is a view of the luminaire of FIG. 9 as seen from the right of FIG. 9, FIG. 10 illustrating in elevation the front end panel which faces the approaching driver;

FIG. 11 is a view of the luminaire of FIG. 9 as seen from the left of FIG. 9, FIG. 11 showing in elevation the rear end panel which is directed away from the approaching driver;

FIG. 12 is a transverse sectional elevation of the luminaire taken along the line **12—12** of FIG. 9 in the direction of the arrows;

FIG. 13 shows the refractor of FIG. 12 with a simplified mounting structure, FIG. 13 illustrating the manner in which light is reflected with high and low beam installation of a light source;

FIG. 14 is a section of the luminaire substantially identical with that of FIG. 12 but simplified to show the structure of the front and bottom panels for directing light in accordance with the present invention, the ray traces of the light being indicated in FIG. 14;

FIG. 15 is a sectional view of the bottom panel taken along line **15—15** of FIG. 12 in the direction of the arrows, FIG. 15 showing in particular that half of the bottom panel which directs light away from the approaching driver;

FIG. 16 is a vertical section of the front end panel, taken along line **16—16** of FIG. 10 in the direction of the arrows;

FIG. 17 is a horizontal sectional of the front end panel, taken along line **17—17** of FIG. 10 in the direction of the arrows;

FIG. 18 is a vertical section of the rear end panel, taken along line **18—18** of FIG. 11 in the direction of the arrows;

FIG. 19 is a fragmentary sectional view of the top panel, taken along line **19—19** of FIG. 12 in the direction of the arrows;

FIG. 20 shows on an enlarged scale and in detail the structure of the top panel at the region of its ends;

FIG. 21 shows the structure of the top of the refractor at a region between its ends and central portion;

FIG. 22 shows the structure of the top panel at its central portion;

FIG. 23 shows a prior art construction to afford a comparison with the structure of FIGS. 11–14; and

FIG. 24 is a longitudinal section of the front panel taken along line **24—24** of FIG. 12 in the direction of the arrows substantially along the entire length of the entire panel so as to illustrate the structure of the interior and exterior surfaces of the front panel.

Referring to the drawings and to FIGS. 1–8 in particular, the invention as embodied therein includes a luminaire generally designated **10** which comprises a back plate **12** for mounting against a vertical wall of a building, such as a school **14**. The back plate **12** contains the usual means for securing the plate to the vertical wall of the building **14** and an electrical socket **16** for housing a mercury arc lamp **18**. A substantially semi-annular specular reflector generally designated **20** is secured to the back plate **12** and extends in back of and above the lamp **18**. The lamp **18** and the reflector **20** are enclosed by a substantially trough-shaped refractor gen-

erally designated **22** which has a lower flange portion **24** which is hingedly connected to the bracket **12**.

In accordance with the invention, the back plate **12** is provided with a sealing or closing flange **26** which is arranged at an angle of approximately 6½° to the vertical in order to hold the refractor **22** at such an inclination when the refractor is in a closed position. The refractor **22** is provided with a curved cover plate member **28** which extends above a top inclined portion **30** of the refractor lens. A latching member **31** is bolted to the cover plate member **28** and includes a pivotal latching arm **32** which may be biased in back of a projecting portion of the back plate **12** to close the luminaire.

If desired, the trough-shaped refractor lens **22** may be swung downwardly to a pivotal location on the back plate **12** after the latch **31** is released. The refractor **22** is secured to the back plate at the upper end by a chain **34** which permits the refractor to be swung between the solid and dotted line positions indicated in FIG. 4.

The fixture of FIGS. 1–8 is primarily designed for use for illuminating the area adjacent a substantially vertical wall, such as the end of the building **14**. The luminaire may advantageously use a 300 watt incandescent or 175 watt mercury lamp, or, if desired, it could be made of sufficient length to use a linear source of light, such as a fluorescent lamp, or two or more mercury or incandescent lamps using the same, or approximately the same, optical principle.

Referring to FIG. 3, the reflector **20** is specially shaped to reflect all of the light which does not strike the refractor **22** directly. The reflector **20** is optically divided into three sections. A lower section extending approximately from the points indicated A and B on FIG. 3 is made substantially parabolic and is arranged to reflect a parallel beam of light toward the refractor at an angle of substantially 65° from the vertical as indicated by light ray **36**. The reflector includes a transition zone between the points B and C of FIG. 3. At B the light is just deflected to an angle of 65° from the vertical, but above B it is reflected progressively lower in order to miss the mercury arc lamp **18**. This is continued until at C there is an abrupt break in the contour. Numerals **38** and **40** indicate rays that are designed to miss the tube **18**. Above the point C to the point indicated D the reflector is sharply curved in order to direct light generally downwardly but to miss the tube **18** in all cases as indicated by ray **42**. The reason why the light is directed so that it will not hit the arc tube **18** is that this tube, in relation to the returning light rays, is quite opaque and, therefore, it is advantageous for the greatest efficiency to have all the reflected light miss the tube.

The reflector **20** is advantageously made so that all the longitudinal lines of the reflector are straight, or, in other words, the reflector is a flat sheet of metal bent in one direction but not having a compound curvature. This is also true of a cylinder, for example. Two vertical strengthening ribs **21** are provided for the reflector which give the reflector somewhat of a three dimensional character and these are provided for mechanical strengthening. The refractor **20** may also be advantageously curved in a longitudinal direction in order to give it a compound curvature.

The refractor **22** is substantially trough-shaped and is designed to accept as much of the light directly from the lamp **18** as is physically possible. It is mounted in the luminaire with a 6½° forward tilt. The top portion **30** is located approximately at an angle of 30° with respect to a horizontal plane and is at such a location that the light incident thereon could not normally be bent or refracted into useful directions. This is overcome by having a top panel **41** at the top outer surface covered with reflecting prisms **43** which are rows of prisms extending transversely along the longitudinal length of the refractor. The reflecting prisms **43** reflect the light back down to the front and bottoms of the refractor at rather low vertical angles, but in useful directions as shown by the ray trace **45** (FIG. 3). Each of the reflecting prisms **43** is arranged in a different manner and each is tilted to such an angle that the plane of its axis contains the light ray in the glass, this being a necessary condition for such a reflecting prism to function properly.

The refractor **22** includes a downwardly and inwardly extending front panel **44** which is divided into two optical sections, an upper one and a lower one. The top section contains the depressing prisms **46** on the outer face which are effective to bring light down to a vertical angle of substantially 65° such as indicated by direct light ray **47**. None of the reflected light from the reflector **20** falls on this portion of the refractor. The lower portion of the front panel **44** handles primarily the reflected light and its main function is not to move this parallel beam from the reflector but simply to diffuse it so that there are no streaks or striations. This is achieved by a set of horizontal flutes **48** on the outside surface in combination with vertical flutes **50** on the inside surface. Since some direct light also goes through this lower front section, it will obviously go in approximately the same direction as it would have gone without a refracting panel but will be smoothed out considerably.

The refractor **22** includes a bottom upwardly inclined panel or portion **52** having longitudinal rows of outside prisms **51** which intercept the backward light rays and redirect them outward into useful directions as indicated by light rays **53** and **55**. The bottom panel also contains a six inch long section of inside prisms near the center, as at **54**, to spread light lengthwise of the unit and to insure that there will not be an excess of light directly beneath the unit. The remainder of the inside surface of the bottom panel contains transversely running flutes for diffusion at areas indicated **56** and **58**.

The refractor **22** also includes end panels **60** and **62** which are located to accept both direct light and reflected light. Each of the panels is provided with a prismatic design capable of both refracting light and diffusing it sufficiently on the outside surface. This is achieved by placing horizontal prisms **64** on the outside surface, but rather than arrange each prism surface in a plane, the surfaces are scalloped to provide a certain amount of diffusion in a direction 90° to the direction of the prism refracting action. The scalloped prisms bring the direct light down to a vertical angle of about 65° and the scalloping portions, or flutes on the face of the prisms provide for lateral diffusion.

The end panels of the refractor are provided with scalloped prism formations which not only refract light into useful directions, but also diffuse it into a plane approximately 90° to the plane of refraction.

FIGS. 7 and 8 show enlarged detail portions of the independent action of the fluted areas and the prism areas occurring on the outside face on each of the side panels **60** and **62**. A light ray such as a light ray **70** which originates from the light source is diffused by the rays being bent inwardly so that they cross each other as indicated in FIG. 8. A light ray, such as light ray **72**, besides being diffused laterally, as indicated in FIG. 8, is also bent downwardly, as indicated in FIG. 7, into useful angular directions by the prism portion of the scallop prism formation on the exterior surface of the panels **60** and **62**.

Thus, the structure of FIGS. 1–8 provides a luminaire which includes a refractor which is effective to generate a beam of light partially by the light being concentrated by a reflector and partially by the light being concentrated by a prismatic structure of the refractor. The face of the refractor carries prisms to concentrate the direct light into a beam and also to accept the already concentrated light from the reflector and distribute it into useful areas.

Referring to FIGS. 9 and 12, it will be seen that the luminaire of this embodiment of the invention includes a

frame **120** which is adapted to be fixedly carried by a side wall of an underpass. This frame **120** includes a housing **122** fixedly mounted on the sidewall of the underpass in any suitable way and having a door **124** pivotedly attached to a lower portion of housing **122** by a suitable pivot assembly **126**. This door **124** is in the form of a rectangular frame and can be releasably held in the closed position shown in the drawings by cooperation of a pair of latches **128** of any suitable construction with the upper portion of the housing **122** which is provided with structure to cooperate with the latches **128** for releasably holding the door **124** in the closed position shown in FIGS. 9 and 12. The door **124** holds against housing **122** a refractor **130** of the present invention, this refractor **130** having a frame **132** surrounded by the rectangular door **124**, and, as is apparent from FIG. 12, a suitable gasket structure is provided for sealing the connection between the refractor **130** and the housing **122** so that the refractor **130** and the housing **122** form an interior space which is sealed off from the exterior of the luminaire. In its interior the housing **122** carries a support **134** for a reflector **136** which is adapted to be situated in the interior of the luminaire together with a suitable light source. This light source may, for example, be a mercury vapor lamp of from 175 watts to 250 watts, although it may also be a 300 watts incandescent lamp.

The luminaire is adapted to provide two lamp positions for a choice of high angle (70°) or low angle (60°) beams for wide and narrow underpasses, respectively. Referring to FIG. 13, when a lamp is situated in the low beam lamp position **138**, it will give a 60° beam shown by the solid line light ray traces **140** in FIG. 13, while if the lamp is situated at the high beam position **142**, it will provide a concentrated 70° beam, indicated by the broken line ray traces **144** in FIG. 13, these beam angles being measured with respect to nadir. The luminaire is provided with a pair of lamp holders providing the possibility of optionally placing the lamp either in the low beam position **138** or the high beam position **142**, and the reflector beams are deconcentrated by the refractor prisms described below. Nevertheless they still form broad vertical beams on which to build sharp maximum peaks with the direct light concentration from the center of the front refractor panel, as will be apparent from the description below. The manner in which the light is distributed by the reflector is of secondary importance in the luminaire of FIGS. 9–24, and of course the mechanical manner in which the light source of FIGS. 9–24 is mounted can take any conventional construction.

Referring to FIGS. 9, 14 and 24, it will be seen that the front panel **146** of the refractor is generally inclined inwardly toward the side wall of the underpass, from the top to the bottom edge of the front panel, so that the top edge of the front panel **146** is located at a greater distance from the side wall than the bottom edge of the front panel and thus the exterior surface of the front panel **146** is directed not only longitudinally along the underpass but also to some extent downwardly toward the bottom of the underpass. Along approximately its upper third portion, the exterior surface of the front panel **146** is formed with longitudinal flutes **148** providing a vertical light diffusion. The central horizontal third of the exterior front surface of the front panel **146** has in the illustrated example an upper group of five horizontal prisms **150** which have a light-depressing action, as is most clearly apparent from FIG. 14, and a bottom group of six prisms **152**, in the particular example illustrated, which have a light-elevating action, as is also apparent from FIG. 14 which shows ray traces for the low and high beam positions in solid and broken lines, respectively. In this way the central section of the front panel is provided with a system of horizontal prisms which concentrate direct light into a sharp parallel beam.

As is shown most clearly in FIG. 24, the interior of the front panel is provided with vertical flutes **156** for providing lateral diffusion and the depth of the outside prisms **150** and **152** of the central section, as well as of the outside prisms **154** of the bottom section referred to below, of the front panel, changes twice between the center line and each end of the front panel, as indicated by the designating lines **158** in FIG. 9 and as more clearly shown in FIG. 24, so that in this way the beam distribution will extend along the road substantially parallel to the curb lines.

As may be seen most clearly from FIG. 14, the lower section of the front panel, approximately the lower third thereof is provided with longitudinal horizontal prisms **154** which have a light-elevating action and which are provided with curved active surfaces for spreading the lifted direct light evenly from the beam provided by the central section of the prisms down to the light which issues from the bottom panel, and it will be noted that the prisms **154** also have depth variations, as shown at **158** in FIGS. 9 and 24.

The top edge of the front panel is provided with horizontal light-depressing prisms **160**, the active surfaces of which have a small amount of curvature to diffuse the direct light to between 92° with respect to vertical and 98° with respect to vertical with the lamp in the low beam 60° position, as shown in FIG. 14. The uppermost prism of the group of prisms **160** provides stock for terminating transverse reflecting prisms on the top panel of the refractor, as described below.

Referring to FIGS. 19–23, the top panel **162** of the refractor, which is inclined downwardly and slightly curved as shown most clearly in FIG. 12, is provided with a series of transverse outside prisms **164**. The spread of direct light from a long mercury arc is so large that a considerable amount of light would be refracted through the faces of known 90° mitre reflecting prisms **166** shown in FIG. 23. FIG. 23 illustrates a typical 90° mitre prism with ray traces as they would appear on the central line of the refractor. Approximately one third of this light is refracted through the first prism surface **168** and is directed to the ceiling above the luminaire with the result that an undesirably bright area is provided over the luminaire. If the mitre of the prisms **166** in FIG. 23 is reduced, more light is reflected from the first surface and less light is refracted above the luminaire.

The prisms of the top panel of the refractor of the invention are designed with progressively changing mitres as shown in FIG. 19 and as illustrated in particular in FIGS. 20–22. The direct light from the lamp has considerably more spread at the center than at the end. At each end of the top panel the spread in the glass will be on the order of only three degrees, and at this end region of the top panel **162** a series of prisms **164*a***, which are standard 90° mitre prisms, are provided since they can handle a spread of 5° or less. At the locations between the end regions and the central region of the top panel are provided a series of prisms **164*b***, which, as shown in FIG. 21, have their prism mitre reduced so that all light is reflected from the first surface it strikes, as shown by the ray traces **170** in FIG. 21, and this light is then reflected through the second surface and emerges at wide lateral angles where it is either intercepted by an adjacent prism or it reaches the ceiling at some distance from the refractor, as is clearly apparent from the ray traces of FIG. 21. At the central region a series of prisms **164*c*** are provided which as shown in FIG. 22 has a prism mitre which has been reduced to an even greater extent and here again, as is apparent from the ray traces **172** of FIG. 22, all direct light is reflected from the first surface of each prism and refracted through the second surface at wide lateral angles. As a result of this construction the top panel forms a prismatic shield avoiding a bright area over the luminaire. Some of the light is used to light the ceiling between successive luminaires, and the remaining light is returned into the refractor.

Referring to FIGS. 9, 12, 14 and 15, it will be seen that the bottom panel **174** is inclined upwardly away from the side wall of the underpass to a slight degree. At approximately the half of this front panel which is nearest to the approaching driver, the bottom panel **174** is provided with diagonal exterior prisms **176**, shown most clearly in FIG. 9, and these diagonal prisms refract their incident light outwardly from the wall of the underpass and spread it evenly from 45° with respect to vertical toward the approaching driver, to 25° with respect to vertical away from the approaching driver.

The half of the bottom panel which extends from the center line toward the end of the bottom panel which is directed away from the approaching driver is provided with transverse interior prisms **178**, shown most clearly in FIG. 15, and with longitudinal exterior prisms **180**, shown most clearly in FIGS. 14 and 15, and these inside and outside prisms respectively refract the incident light outwardly from the wall and spread it evenly from 25° to 60° with respect to vertical down along the road away from the approaching driver, as is apparent from the ray traces **182** and **184** shown in FIGS. 14 and 15, respectively. The ray traces **182** of the exterior prisms **180** in FIG. 14 illustrate the extent to which the light is directed downwardly away from the side wall of the underpass, and these prisms **180** vary in depth from the flange of the reflector **130** to the outer edge so as to form a somewhat concentrated distribution refracted outwardly from the wall of the underpass. FIG. 15 shows at the ray traces **184** how the light is refracted by the transverse inside prisms **178** which also vary in depth from the center line to the end of the panel so as to provide the distribution illustrated in FIG. 15 which varies in a direction downwardly toward the road and away from the driver from 25° adjacent to the center line to 60° with respect to the vertical at the end of the panel which is furthest from the approaching driver.

The prisms provided in the two halves of the bottom panel described above will give a smooth transition in distribution from one system to the other while shielding direct light from the eyes of the approaching driver and strengthening the distribution along the near side of the road in the opposite direction.

The front end panel **188** which is directed toward the approaching driver is shown most clearly in FIGS. 10, 16 and 17. This end panel **186** is provided at its exterior with vertical prisms **188** which have a 90° mitre reflecting construction, and, as may be seen from the horizontal section of FIG. 17, these reflecting prisms are oriented with their axis parallel to the light rays in the glass. The vertical prisms at the exterior of the front end panel **186** are interrupted in a horizontal direction and near their top end so as to form a groove **190** which is adapted to enable the optional aluminum cover to be installed. The inner surface of front panel **186** is provided with horizontal transverse prisms **192** shown most clearly in FIG. 16. These prisms refract direct and reflected light either above 100° with respect to vertical or below 45° with respect to vertical. Approximately the upper half of the horizontal prisms **192** receive light from the end of the reflector at angles considerably below the direct light. The lower surfaces of these later prisms are designed to refract the lowest reflector light to 10° above the horizontal, and all the direct light will be refracted at an angle higher than this angle. The upper surfaces of these very same prisms are set at an angle which will refract any incident light at 45° to vertical or lower and this action is shown by the ray traces **194** at the upper part of FIG. 16. The lower half of the interior prisms **192** are constructed to spread incident light to either 45° with respect to vertical, or lower, or 100° with respect to vertical, or higher, depending upon which prism surface receives the incident light, as shown by the ray traces **196** in FIG. 16. This combination of inside splitting prisms and outside reflecting prisms provided for the end of panel **186** gives a prismatic shield which virtually eliminates any light from being refracted through the end of the refractor into the eyes of the approaching driver.

Referring now to FIGS. 11 and 18, the rear end panel **198** which is directed away from the approaching driver has its inner surface provided with horizontal transverse prisms **200**. The prisms near the top of the inner surface are dual-acting inasmuch as they will refract all incident light on their lower surfaces to 100° with respect to vertical, or higher, and all light incident on their upper surfaces to 55° with respect to the vertical, or lower, as shown by the ray traces **202** in FIG. 18, while the remaining inside prisms will act in combination with the outside prisms to refract direct light down the road at from between 45° and 60° with respect to vertical. The upper group of prisms are those which would be located beneath the optional aluminum cover. At its exterior the upper portion of the rear end panel **198** is provided with horizontal flutes **204** which provide some vertical diffusion.

At its exterior surface below the flutes **204**, the end panel is provided with diagonal prisms **206** which refract the direct light away from the wall of the underpass and depress this light, while the front portion which has the diagonal prisms is provided with horizontal prisms **208** which intersect the diagonal prisms and which act as light-depressing prisms which cut through the diagonal prisms. This system of intersecting prisms provides lateral diffusion of the light through the rear end panel **198**.

It will thus be seen that with the prismatic configurations of the refractor **130** of the invention there will be light on the ceiling and walls of the underpass to reduce lighting contrast within the underpass, and at the same time a reasonably uniform lighting of the road will be provided and the eyes of the approaching driver will be shielded from direct light.

With the refractor of FIGS. 9–24, the light emerging from the front end panel directed toward the driver will be either directed above the horizontal to light the ceiling or below 45° with respect to the vertical where it is cut off from the driver by the top of the windshield, so that this front end of the refractor forms a prismatic shield minimizing the luminaire brightness in the driver's eyes and the bottom of the refractor provides an asymmetric distribution canted down the street away from the approaching driver so as to also shield direct light from the eyes of the driver while lighting the near side of the street ahead of him. The rear end of the refractor directed away from the approaching driver contains horizontal light-depressing prisms on the inside in combination with the horizontal and diagonal outside depressing prisms which provide a beam below 60° with respect to vertical along the near side of the road directed away from the approaching driver, and the front end panel of the refractor has the vertical inside flutes for later light diffusion and the outer three sections described above. The top panel of the refractor has the above-described system of outside shielding prisms which are modified forms of reflecting prisms.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the invention principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A luminaire comprising substantially vertical back plate means for attachment to a vertical wall, a light source, means for supporting the light source forwardly of said back plate, reflector means mounted on said back plate rearwardly of said light source and having a lower section extending below and entirely behind the light source and receiving downwardly and rearwardly emitted rays from the light source and reflecting the same downwardly and forwardly into a predetermined main beam

direction, an intermediate section behind the light source and extending above and below the same and receiving rearwardly emitted rays from the light source and reflecting the same at varying downward and forward angles between the predetermined main beam direction and lower vertical angles, an upper section behind the light source and extending forwardly at its upper portion in a curved path past a vertical plane passing through the light source and receiving rearwardly and upwardly emitted rays from the light source and directing the same downwardly in progressively lower varying angles below the predetermined beam direction, a trough-shaped refractor mounted on said back plate means and enclosing said light source and reflector, said refractor having a front panel extending in front of the light source in a plane above and below the light source and having an upper and a lower section, said upper section receiving only forwardly emitted direct rays from the light source and including prism means for directing the direct light into the predetermined main beam direction, said lower section receiving the reflected light from said reflector and direct light from the light source and including light diffusing means for smoothing the reflected light passing therethrough and for permitting the same to extend downwardly and forwardly at the angles between the predetermined main beam direction and the lower vertical angles.

2. The luminaire of claim 1 wherein said light source is an extended linear light source and said reflector extends in planes parallel to the long axis of said light source and reflects all light incident thereon, above and below the light source.

3. The luminaire of claim 1 wherein said front panel is tilted with respect to the vertical and lies in a plane with the upper and disposed forwardly and the lower and rearwardly, said refractor includes a top panel overlying said reflector and extending forwardly of a vertical plane through the forward edge of said upper section thereof, prismatic reflecting means are formed on said top panel and reflect upwardly and forwardly emitted rays from the light source into downward directions through said lower portion of said front panel.

4. The luminaire of claim 1 wherein said refractor includes a bottom panel extending beneath said light source and rearwardly thereof, and prism means are formed on said bottom panel for directing vertically and rearwardly emitted rays from the light source into forward directions.

5. A trough-shaped refractor having a front panel for substantially vertical orientation, a top panel extending rearwardly and upwardly from the upper edge of said front panel, a bottom panel extending rearwardly from the lower edge of said front panel in a substantially horizontal plane, and two side panels extending rearwardly from the sides of said front panel and vertically from said top and bottom panels, horizontally oriented light depressing prism means on the upper portion of said front panel, light diffusing means only on the lower portion of said front panel, light depressing prism means on said side panels, light reflecting means on said top panel and prism means on said bottom panel for directing light downwardly and forwardly.

6. Trough-shaped refractor means for disposition in front of a light source and comprising a front panel extending from its upper edge to its lower edge at an acute, rearward, vertical angle relative to the perpendicular, a top panel extending rearwardly from the upper edge of said front panel, a bottom panel extending rearwardly from the lower edge of said front panel, and two side panels extending rearwardly from the sides of said front panel and vertically from said top and bottom panels, horizontally oriented light-depressing prism means on the upper portion of said front panel, light-diffusing means only on the lower portion of said front panel, light-depressing prism means on said side panels, and prism means on said bottom panel for directing light downwardly and forwardly.

7. Trough-shaped refractor means for disposition in a luminaire in front of a light source and a reflector and wherein said reflector returns a large portion of the light from the light source in a predetermined downward and forward main beam direction, said refractor means comprising a front panel extending from its upper edge to the lower edge thereof in front of the light source at an acute, rearward, vertical angle relative to the perpendicular, a top panel extending rearwardly from the upper edge of said front panel, a bottom panel extending rearwardly from the lower edge of said front panel, and two side panels extending rearwardly from the sides of said front panel and vertically from said top and bottom panels, said front panel being divided into two distinct optical areas consisting of the upper portion of said front panel and the lower portion thereof, prism means on said upper portion for orientation relative to the light source and reflector for handling only direct light from the light source and for directing the same into the predetermined downward and forward main beam direction, light diffusion means only on said lower portion for orientation relative to said light source and said reflector for receiving substantially all the reflected light from the reflector travelling in the predetermined main beam direction and for smoothing the reflected light while permitting the same to pass therethrough in the predetermined main beam direction, light-depressing prism means on said side panels and prism means on said bottom panel for directing light downwardly and forwardly.

8. An underpass luminaire comprising a frame adapted to be mounted on a sidewall of an underpass and a hollow refractor carried by said frame and defining therewith a hollow interior space adapted to contain a reflector and a light source, said refractor having a front panel, top and bottom panels, and front and rear end panels respectively facing toward and away from a driver travelling through the underpass, and said refractor having surface areas carrying means for illuminating the ceiling and walls of the underpass to reduce lighting contrasts therein, for providing substantially uniform lighting on the road, and for shielding the eyes of the approaching driver from direct light, some of said surface areas including inner and outer surfaces of said front panel and said means carried by said inner and outer surfaces of said front panel including vertical interior flutes at said inner surface of said front panel for providing lateral light diffusion and horizontal flutes extending along an upper section of the outer surface of the front panel for vertical light diffusion, said outer surface of said front panel having beneath said upper section a substantially central section extending horizontally along the entire length of said front panel and said means carried by said central section including upper horizontal light-depressing prisms and lower light-elevating prisms cooperating to form a sharp parallel beam of concentrated direct light, and said outer surface of said front panel having a bottom section beneath said central section, and said means carried by said bottom section including light-elevating prisms having curved surfaces for spreading direct light evenly from the elevation of said sharp parallel beam down to light emerging from the bottom panel.

9. A luminaire as recited in claim 8 and wherein the prisms of said central and bottom sections change twice in their depth, between a substantially vertical center line of said front panel and each of the ends thereof, for providing a beam distribution extending along the road substantially parallel to the curb lines thereof.

10. An underpass luminaire comprising a frame adapted to be mounted on a sidewall of an underpass and a hollow refractor carried by said frame and defining therewith a hollow interior space adapted to contain a reflector and a light source, said refractor having a front

panel, top and bottom panels, and front and rear end panels respectively facing toward and away from a driver travelling through the underpass, and said refractor having surface areas carrying means for illuminating the ceiling and walls of the underpass to reduce lighting contrasts therein, for providing substantially uniform lighting on the road, and for shielding the eyes of the approaching driver from direct light, said top panel having an outer surface forming part of said surface areas of said refractor and said means carried by said outer surface of said top panel illuminating at least part of the ceiling of the underpass and including elongated prisms extending transversely across said top panel substantially perpendicularly to said front panel and parallel to said end panels, said transverse prisms having substantially 90° mitres at the regions of the ends of said top panel, mitres of less than 90° between a central region of said top panel and said end regions thereof, and at said central region of said top panel, mitre angles smaller than the mitre angles of the prisms between said central and end regions so that said top panel forms a prismatic shield avoiding a bright area over the luminaire, providing some light for illuminating the ceiling of the underpass, and returning the remaining light into the refractor.

11. An underpass luminaire comprising a frame adapted to be mounted on a sidewall of an underpass and a hollow refractor carrier by said frame and defining therewith a hollow interior space adapted to contain a reflector and a light source, said refractor having a front panel, top and bottom panels, and front and rear end panels respectively facing toward and away from a driver travelling through the underpass, and said refractor having surface areas carrying means for illuminating the ceiling and walls of the underpass to reduce lighting contrasts therein, for providing substantially uniform lighting on the road, and for shielding the eyes of the approaching driver from direct light, said surface areas including an outer bottom panel surface area extending along approximately that half of the bottom panel which is nearest to the approaching driver, said means carried by said outer bottom panel surface area illuminating the road substantially uniformly and including at the bottom surface of said bottom panel diagonal prisms for reflecting incident light outwardly away from the wall of the underpass and for spreading the light evenly from 45° with the respect to vertical toward the approaching driver 25° with respect to vertical away from the approaching driver.

12. An underpass luminaire comprising a frame adapted to be mounted on a sidewall of an underpass and a hollow refractor carried by said frame and defining therewith a hollow interior space adapted to contain a reflector and a light source, said refractor having a front panel, top and bottom panels, and front and rear end panels respectively facing toward and away from a driver travelling through the underpass, and said refractor having surface areas carrying means for illuminating the ceiling and walls of the underpass to reduce lighting contrasts therein for providing substantially uniform lighting on the road, and for shielding the eyes of the approaching driver from direct light, said surface areas including inner and outer surface areas of said bottom panel located approximately along that half of the bottom panel which is directed away from the approaching driver and the means carried by said inner and outer surfaces of said bottom panel for substantially uniformly illuminating the road including longitudinal prisms distributed along the outer surface of said bottom panel and varying in depth from an inner edge to an outer edge of said bottom panel for forming a substantially concentrated distribution refracted outwardly from the wall of the underpass, and said means at said inner surface of said bottom panel including transverse inner prisms receiving direct light from a light source in the luminaire and also varying in depth from approximately the center of said bottom panel to the end thereof which is most distant from the approaching driver for directing light in an inclined direction downwardly along the road away from the approaching driver.

13. An underpass luminaire comprising a frame adapted to be mounted on a sidewall of an underpass and a hollow refractor carried by said frame and defining therewith a hollow interior space adapted to contain a reflector and a light source, said refractor having a front panel, top and bottom panels, and front and rear end panels respectively facing toward and away from a driver travelling through the underpass, and said refractor having surface areas carrying means for illuminating the ceiling and walls of the underpass to reduce lighting contrasts therein, for providing substantially uniform lighting on the road, and for shielding the eyes of the approaching driver from direct light, said surface areas including inside and outside surfaces of said front end panel, the means carried by said latter surfaces for shielding the eyes of the approaching driver from direct light including interior substantially horizontal prisms extending across said front end panel at the interior thereof and exterior vertical prisms extending from the top of the bottom of said front end panel at the exterior thereof, said exterior substantially vertical prisms being 90° mitre reflecting prisms and said interior transverse substantially horizontal prisms including upper horizontal prisms distributed along approximately the upper half of the front end panel for refracting light either at an elevation higher than 100° with respect to vertical or lower than 45° with respect to vertical while lower prisms distributed along approximately the lower interior half of said front end panel split incident light to either 45° wtih respect to vertical or below or 100° with respect to vertical or above, so that between 45° and 100° with respect to vertical there is no light refracted through the front end panel, while the exterior prisms reflect light back into the refractor, whereby the front end panel forms a prismatic shield substantially eliminating any light from being refracted into the eyes of the approaching driver.

14. An underpass luminaire comprising a frame adapted to be mounted on a sidewall of an underpass and a hollow refractor carried by said frame and defining therewith a hollow interior space adapted to contain a reflector and a light source, said refractor having a front panel, top and bottom panels, and front and rear end panels respectively facing toward and way from a driver travelling through the underpass, and said refractor having surface areas carrying means for illuminating the ceiling and walls of the underpass to reduce lighting contrasts therein, for providing substantially uniform lighting on the road, and for shielding the eyes of the approaching driver from direct light, said surface areas including inner and outer surfaces of said rear end panel, and the means carried by said latter surfaces for illuminating the roadway including horizontal transverse prisms distributed along the inner surface of said rear end panel and including an interior upper group of prisms near the top of said rear end panel for refracting light either at an angle of 100° with respect to vertical or higher or at an angle of 55° with respect to vertical or lower, and the interior horizontal prisms below said upper group refracting direct light from the interior of the refractor down toward the road at angles of between 45° and 60° with respect to vertical, the means at the exterior surface of said rear end panel including at the upper portion of said rear end panel longitudinal flutes extending horizontally across said upper portion for providing vertical diffusion and below said flutes said means carried by said exterior surface of said rear end panel including diagonal exterior prisms for refracting the direct light away from the wall of the underpass and for directing the light down to the road, the front portion of the exterior surface of said rear end panel which is provided with said diagonal prisms also having horizontal prisms intersecting said diagonal prisms for providing lateral light diffusion.

15. For use in an underpass luminaire, a refractor hav-

ing an end panel directed toward the approaching driver and including exterior substantially vertical 90° mitre reflecting prisms and interior substantially horizontal prisms distributed from the top to the bottom of said end panel and aproximately the upper half of which refract light either above 100° with respect to vertical or below 45° with respect to the vertical, and approximately the lower half of said inside prisms spreading incident light also either above 100° or below 45° with respect to vertical, whereby the combination of inside splitting and refracting prisms and outside reflecting prisms forms a prismatic shield preventing light from being refracted into the eyes of an approaching driver.

16. For use in an underpass luminatire, a refractor having a front panel formed with interior vertical flutes for providing lateral diffusion and carrying at its exterior longitudinal horizontal flutes along approximately the upper third of said front panel for providing vertical diffusion, said front panel having a central section provided with an upper group of horizontal prisms for directing light downwardly and a lower group of horizontal prisms for elevating light, and said exterior surface of said front panel having a lower section beneath said central section and provided with longitudinal horizontal light-elevating prisms having curved surfaces for spreading light evenly beneath the beam provided by said central section of prisms downwardly toward the road.

17. For use in an underpass luminaire, a refractor having a bottom panel provided along the exterior surface of that half of the bottom panel which is directed toward the approaching driver with exterior diagonal prisms and along that half of the exterior surface of the bottom panel which is directed away from the approaching driver with longitudinal prisms of varying depth for directing light away from a side wall of an underpass down to the road, said half of said panel which is directed away from the approaching driver carrying at its inner surface transverse prisms which also vary in depth from the center of said bottom panel towards the end thereof most distant from the approaching driver and which refract light down toward the road in a direction extending from between 25° and 60° away from the approaching driver.

18. For use in an underpass luminaire, a refractor having an end panel directed away from the approaching driver and carrying at its inner surface transverse horizontal prisms distributed from the top to the bottom of said inner surface, and diagonal prisms at its exterior surface, said inner horizontal prisms refracting light to angles of 100° with respect to vertical or higher or to angles of 55° with respect to vertical or lower at the upper portion of said panel, and said prisms along the lower portion of the interior of the panel cooperting with said diagonal prisms at the exterior of the panel for directing light down the road at an angle of from 45° to 60° with respect to vertical, the exterior surface of said panel being provided along the front portion thereof with horizontal prisms intersecting said diagonal prisms for providing lateral diffusion of light.

19. For use in an underpass luminaire, a refractor having an upper panel carrying mitred reflecting prisms for reflecting a substantial portion of the light which is received by said upper panel back into the refractor and for transmitting some of the light through said upper panel for illuminating a ceiling, said refractor having a front end panel to be directed toward and approaching driver and formed with exterior prisms for reflecting light back into the refractor and with interior prisms for directing light above and below an angular range which would direct light into the eyes of the approaching driver, said refractor having a bottom panel provided with prisms for directing light away from the sidewall of an underpass and downwardly along the road at a direction inclined away from the approaching driver, said refractor having a front panel provided with horizontal exterior prisms which concentrate direct light into a sharp parallel beam, said refractor having a rear end panel directed away from the approaching driver and provided with means for directing light downwardly onto the road and in a direction inclined way from the side wall of the underpass.

20. An underpass luminaire comprising a frame adapted to be mounted on a sidewall of an underpass and a hollow refractor carried by said frame and defining therewith a hollow interior space adapted to contain a reflector and a light source, said refractor having a front panel, top and bottom panels, and front and rear end panels respectively facing toward and away from a driver travelling through the underpass, and said refractor having surface areas carrying means for illuminating the ceiling and walls of the underpass to reduce lighting contrasts therein, for providing substantially uniform lighting on the road, and for shielding the eyes of the approaching driver from direct light, said refractor being formed with an exterior grooved portion adjacent to the top of the refractor for attaching to the refractor an aluminum cover which may optionally be used over the top of the refractor.

21. A luminaire as recited in claim **18** wherein the upper panel of the refractor is wider than its bottom panel, the front panel being inclined inwardly toward the side wall of the underpass from its upper to its lower edge between the top and bottom panels, and said end panels being substantially vertical.

22. For use in an underpass luminaire, a refractor having a top panel carrying prisms for reflecting light back into the refractor and for directing some light upwardly towards the ceiling of the underpass, said refractor having a front end panel facing the approaching driver and forming a prismatic shield which minimizes the brightness of the luminaire in the eyes of the approaching driver, said end panel directing light which emerges therefrom either above horizontal to illuminate the ceiling of the underpass or below 45° where it is cut off from the approaching driver by the top of the windshield, said refractor having a bottom panel providing an asymmetric light distribution canted down the road away from the approaching driver, also to shield direct light from the eyes of the driver while lighting the near side of the road ahead of the approaching driver, and a rear end panel, at the end of the refractor which is directed away from the approaching driver, having at its interior horizontal light-depressing prisms and at its exterior diagonal light-depressing prisms forming a beam below 60° with respect to vertical along the near side of the road directed away from the approaching driver, and said refractor having a front panel the upper portion of which carries horizontal exterior flutes providing vertical diffusion and the central exterior portion of which has a system of horizontal prisms concentrating direct light into a parallel beam, the exterior portion of said front panel beneath said central portion thereof having horizontal light-elevating prisms with curved faces which fill evenly beneath said latter beam.

23. For use in a luminaire, a trough-shaped refractor comprising a front panel extending from its upper to its lower edge at an acute, rearward, vertical angle relative to the perpendicular, a top panel extending rearwardly from said upper edge, a bottom panel extending rearwardly from said lower edge, and two end panels, said front panel forming at different elevations a plurality of different optical means for directing light in predetermined directions with predetermined diffusion and concentration, said different optical means including one area formed with horizontal flute means only for diffusing the light passing therethrough and another area formed with horizontal prism means only for vertically redirecting the light passing therethrough.

24. The trough-shaped refractor of claim **23** wherein said different optical means include a third area formed with horizontal light elevating prisms and said front panel is adapted to be disposed in front of a light source with said one area above a plane perpendicular to said front panel and passing through said source, with the

other said area below said plane, and the third area below said other area.

25. The trough-shaped refractor of claim **24** wherein said front panel optical means and said panel are constructed and arranged to accept light from the light source in a first position and in a second position, said first and second positions being vertically spaced relative to one another whereby light beams of varying vertical angles are transmitted.

26. A refractor according to claim **23**, wherein one of said end panels includes means for redirecting light at vertical angles above and below predetermined glare angles.

27. An underpass luminaire comprising a frame adapted to be mounted on a sidewall of an underpass and a hollow refractor carried by said frame and defining therewith a hollow interior space adapted to contain a reflector and a light source, said refractor having a front panel, top and bottom panels, and front and rear end panels respectively facing toward and away from a driver traveling through the underpass, said front panel extending from its upper to its lower edge at an acute, rearward vertical angle relative to the perpendicular, said refractor having surface areas on said panels carrying light directing means including means for illuminating the ceiling and sidewall of the underpass to reduce lighting contrasts therein, also including a plurality of different optical means on said front panel at different elevations for providing a substantially uniform lighting on the road underneath the underpass, and also including refracting and splitting prism means on the inside of said front end panel and reflecting prism means on the outside of said front end panel, said splitting refracting and reflecting prism means forming a prismatic shield substantially eliminating any light from being emitted into the eyes of an approaching driver.

28. A luminaire to be mounted on an underpass wall above a roadway and having a light source, which comprises: a refractor and a reflector, said refractor having a light transmissive front panel and forward and rearward end panels for receiving light from the source and from the reflector, said front panel extending from its upper to its lower edge at an acute, rearward, vertical angle relative to the perpendicular, a top panel extending rearwardly from said upper edge, a bottom panel extending rearwardly from said lower edge, said front panel forming at different elevations a plurality of different optical means for directing light in predetermined directions with predetermined diffusion and concentration, said different optical means including one area formed with horizontal flute means only for diffusing the light passing therethrough and another area formed with horizontal prism means only for vertically redirecting the light passing therethrough, said forward end panel constituting means for receiving light and transmitting the same toward oncoming traffic along the roadway and for redirecting the same, said light receiving front end panel being formed on the internal, light incident surface thereof with prism means for redirecting the light into upper and lower angles above and below predetermined angles in which the eyes of an oncoming driver would otherwise be aligned with direct light from said forward end panel, said forward end panel being formed externally with prism means for laterally redirecting the refracted light from said first mentioned prism means.

29. The luminaire according to claim **28**, wherein said second mentioned prism means comprise surface means for laterally reflecting light internally of said forward end panel and which has been refracted by said first mentioned prism means.

30. The luminaire according to claim **29**, wherein said second mentioned prism means comprise vertically oriented prism in side-by-side relationship and having their axes parallel to the path of refracted light.

31. For use in a luminaire, a trough shaped refractor comprising a forward and rearward end panel, a front panel extending from its upper to its lower edge at an acute, rearward, vertical angle relative to the perpendicular, said front panel forming at different elevations a plurality of different optical means for directing light in predetermined directions with predetermined diffusion and concentration, said different optical means including one area formed with horizontal flute means only for diffusing the light passing therethrough and another area formed with horizontal prism means only for vertically redirecting the light passing therethrough, said forward end panel including means for redirecting light at vertical angles above and below predetermined glare angles.

References Cited

UNITED STATES PATENTS

2,474,341	6/1949	Wince	240—93
2,887,568	5/1959	Franck	240—106 X
2,898,449	8/1959	Vreugdenhil	240—73 X

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