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(71) Applicant: **DIACON S.r.l.**
Via Piave 33
I-17047 Vado Ligure(IT)

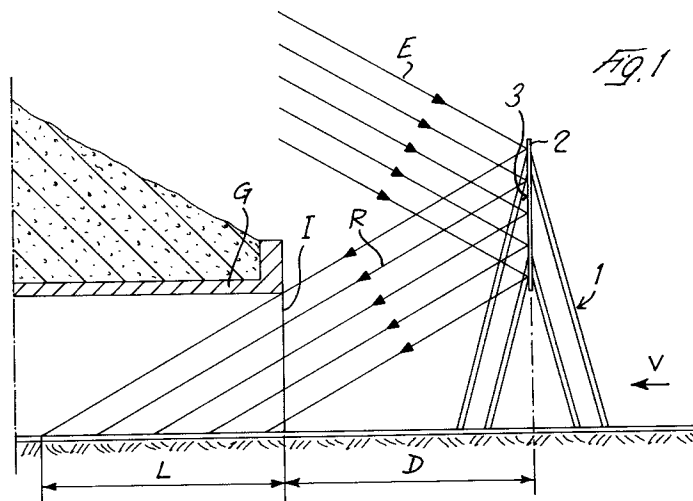
(72) Inventor: **Barlocco, Emilio**
Loc. Contrada 33
I-17040 Stella(IT)

(74) Representative: **Porsia, Bruno et al**
c/o Succ. Ing. Fischetti & Weber
Via Caffaro 3/2
I-16124 Genova (IT)

(54) **Method and device for illuminating the entrance portions of tunnels, particularly of tunnels in highways and motorways.**

(57) The object of the invention is a method of illuminating the entrance portions of tunnels, particularly of tunnels in highways and motorways. According to this method, the portion at the entrance (I) of tunnel (G) is illuminated over a length (L) which is sufficient for a driver's eyes to become accommodated to the conditions of a lesser degree of light in a tunnel at a predetermined, maximum running speed of vehicles,

by having the light outside tunnel (G) suitably reflected toward the entrance (I) and into the interior of tunnel (G). The invention also provides a device for carrying out the said method, comprising a reflecting element (2) which is arranged at a distance from, and upstream of the entrance (I) of tunnel (G), relative to the vehicles running direction (V), and has its reflecting surface (3) turned toward the entrance (I).



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This invention concerns a method and a device for illuminating the entrance portions of tunnels, particularly of tunnels in highways and motorways.

In order to abate the "dark orifice" effect caused by the strong and sudden difference in light between the exterior and the interior of tunnels, especially during day-time, the tunnel lighting systems are intensified at the tunnel entrance portions.

The object of the invention is to provide a method of illuminating the entrance portions of tunnels, especially during day-time, which will allow to considerably reduce the presently required, important consumption of electric energy.

The invention further aims to provide a device for carrying out the said method, which should be rather inexpensive, easily assembled, and safely operated.

According to the invention, the method of illuminating the entrance portions of tunnels, particularly of tunnels in highways and motorways, provides for the tunnel entrance portions to be illuminated over a length that is sufficient for a driver's eyes to become accommodated to the conditions of a lesser degree of light in a tunnel at a predetermined, maximum running speed of vehicles, by having the light outside a tunnel, or external light, suitably reflected toward the tunnel entrance and into the tunnel interior.

Simultaneously with such an external light reflection, the external light may be concentrated into a beam having a higher light density.

As external light it turns to advantage to use the natural ambient light from the sun.

The device according to the invention contemplates a reflecting element which is arranged at a distance from, and upstream of the entrance of a tunnel, relative to the running direction of vehicles, and has its reflecting surface turned toward the tunnel entrance.

Apart from an important saving of electric energy, the fact that the device of the invention is independent from any source of energy renders it possible to have this device easily installed. The reflected light which is turned in the sense of the vehicles transit, and is directed to the inward portion of the tunnel entrance and on the roadway at this inward portion, strikes upon the vehicles from behind so that any risk of the drivers' eyes to be dazzled, is avoided. The size of a reflecting element can be suitably determined so as to provide such an illumination in a tunnel that is sufficient for eliminating the sudden falling of light in the tunnel entrance and for preventing the vehicles transiting through the tunnel in the contrary direction, from being frontally illuminated, which would dazzle the drivers' eyes.

Other features further improving the above-disclosed method and device also form the object of

the invention, and are the subject of the dependant claims.

The particular features of the invention, and the advantages arising therefrom, will appear more in detail from the specification of one preferred embodiment thereof, which is shown by way of a non-limiting example in the accompanying drawings, in which:

Figure 1 is a side view showing the device according to the invention arranged in front of, and at a distance from the entrance of a tunnel.

Figure 2 is a top plan view of the device according to Figure 1.

Referring to the Figures, a device according to the invention for illuminating, particularly during day-time, the entrance portions of tunnels comprises a bridge framework 1 of any suitable type, which at its top portion carries a reflecting element 2 in form of a panel that is placed at such a sufficiently high level as to allow the transit of vehicles thereunder. The reflecting element 2 has its reflecting surface 3 turned toward the entrance I of tunnel G, and this reflecting surface is so turned that the incident external light E falling thereupon, is reflected as shown by reference letter R, into the interior of the tunnel entrance I, and on the roadway at the tunnel entrance inward portion.

The reflecting panel 2 is so arranged and orientated that the reflected light R is set at an angle that allows the reflected light to penetrate for a length L through and into the tunnel entrance. The longitudinal extent of this length is such that at a predetermined maximum speed of vehicles transiting through a tunnel, it is sufficient for assuring a gradual accommodation of the drivers' eyes to the conditions of a lesser degree of light in the tunnel, so that the "dark orifice" effect is eliminated.

The framework 1 may be of a trellis or tubular construction, and on its front side which is turned toward the incoming vehicles, as indicated by arrow V, it may also carry signaling elements, such as a signaling panel. The reflecting element 2 or its reflecting surface 3 may be formed by the rear side of the not shown signaling panel, which is opposite to the tunnel entrance, or the same may be supported on the said rear side of this panel.

The reflecting element 2 is arranged at a distance D upstream of the entrance I of tunnel G.

The reflecting surface 3 may be of any suitable type, and it may consist of mirror elements that can be differently composed, or of metal panels having a high coefficient of reflection.

The reflecting panel 2 may be carried in a shiftable and orientatable manner owing to the provision of actuating means for causing it to swing in the horizontal and vertical direction, and of actuating means for causing it to slide in the transversal or vertical direction (both not shown). The actuating

means can be automatically controlled by means of a control unit, such as a training unit, according to brightness sensors, and these means permit to still have optimum features of illumination even with the external light being set at a different angle, and having a different intensity, such as according to the varying position of the sun

The reflecting surface 3 is so orientated and arranged that no reflection of light is produced in the contrary direction to the vehicles running direction V, so that any risk of the drivers' eyes to be dazzled, is efficaciously avoided.

Moreover, the reflecting surface 3 may be made in form of a flat, entirely or locally curved, for example concave, surface. This surface may also consist of a plurality of individually curved modules. It is also possible to make the reflecting surface 3 with an angle of curvature which may be varied in one or in two dimensions.

In order to efficaciously eliminate any loss in the reflection efficiency, resulting from the reflecting surface 3 being soiled, this surface may be treated with a matter that prevents the adhesion of dirt thereto. It is also possible to have cleaning means of the manually operated, or servo-control operated, or automatic type, associated with the reflecting panel 2 for cleaning its reflecting surface.

Claims

1. A method of illuminating the entrance portions of tunnels, particularly of tunnels in highways and motorways, characterized in that the portion at the entrance (I) of tunnel (G) is illuminated over a length (L) that is sufficient for a driver's eyes to become accommodated to the conditions of a lesser degree of light in a tunnel at a predetermined, maximum running speed of vehicles, by having the light outside a tunnel (G), or external light, suitably reflected toward the entrance (I) and into the interior of tunnel (G).
2. The method according to claim 2, characterized in that the external light is reflected toward the entrance (I) and into the interior of tunnel (G) in the same sense as the transit (V) of the vehicles entering the tunnel (G), and from above it is downwardly directed to the roadway at the internal length (L) which is consecutive to the entrance (I) of tunnel (G).
3. The method according to claim 1 or 2, characterized in that simultaneously with such an external light reflection, the external light may be condensed into a beam of a higher light density.
4. The method according to any of the preceding claims, characterized in that as external light the natural ambient light from the sun is used.
5. The method according to any of the preceding claims, characterized in that the reflected light is so directed that any dazzlement is avoided of vehicles transiting in a direction which is concordant with, or is contrary to the direction of reflection.
6. A device for carrying out the method according to any of claims 1 to 5, characterized in that it comprises a reflecting element (2) which is arranged at a distance (D) from, and upstream of the entrance (I) of tunnel (G), relative to the vehicles running direction (V), and has its reflecting surface (3) turned toward the entrance (I).
7. The device according to claim 6, characterized in that the reflecting element (2) may be a single panel or a compound panel, and this reflecting element is supported at a sufficiently high level over the roadway by a bridge framework (1), or it may be suspended from any existing frame.
8. The device according to claim 6 or 7, characterized in that the reflecting surface (3) may be formed by mirror elements or by metal panels having a high coefficient of reflection.
9. The device according to any of the preceding claims, characterized in that the reflecting surface (3) is either entirely or locally a flat or curved, for example concave, surface.
10. The device according to claim 9, characterized in that the curvature of the reflecting surface (3) is adjustable.
11. The device according to any of the preceding claims, characterized in that the reflecting element (2) or its reflecting surface (3) are supported so as to be swingable around at least one vertical axis and at least one horizontal axis, and/or so as to be horizontally and vertically shiftable, thanks to the provision of hand-operated, or servo-control operated, or preferably automatic, actuating means for the reflecting element or surface to be swung or shifted.
12. The device according to any of the preceding claims, characterized in that the reflecting element (2) forms, or is supported on, the rear side of a signaling element having its front side turned toward the incoming vehicles.

13. The device according to any of the preceding claims, characterized in that hand-operated or automatic cleaning means are associated with the reflecting surface (3) for cleaning the same.

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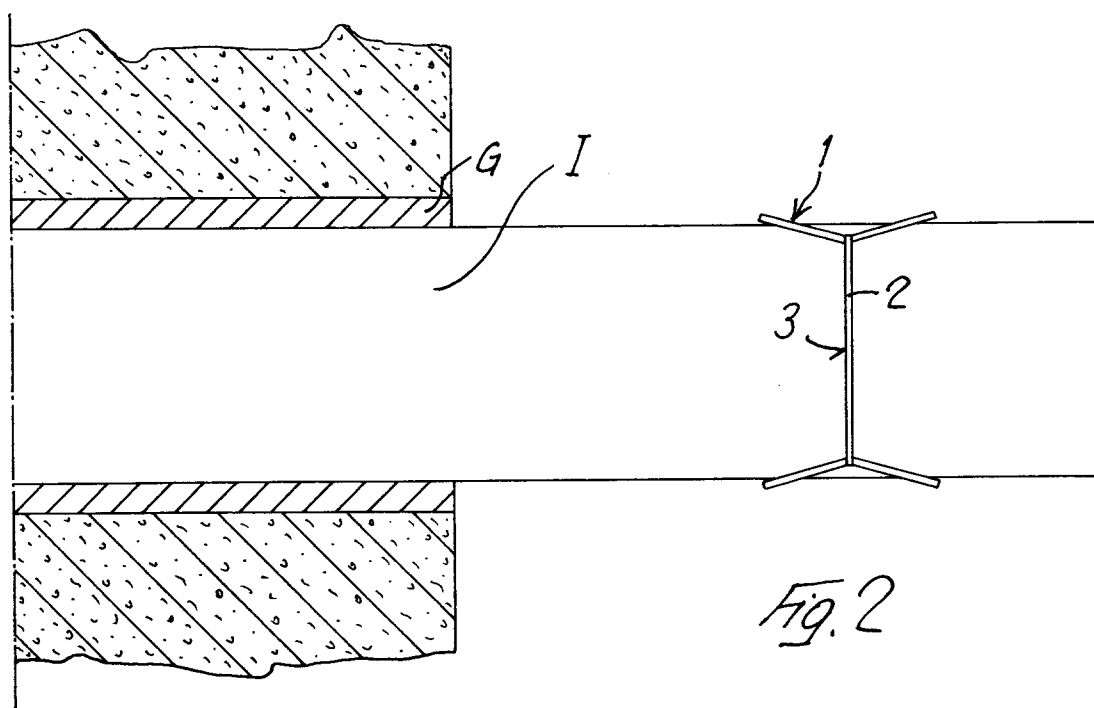
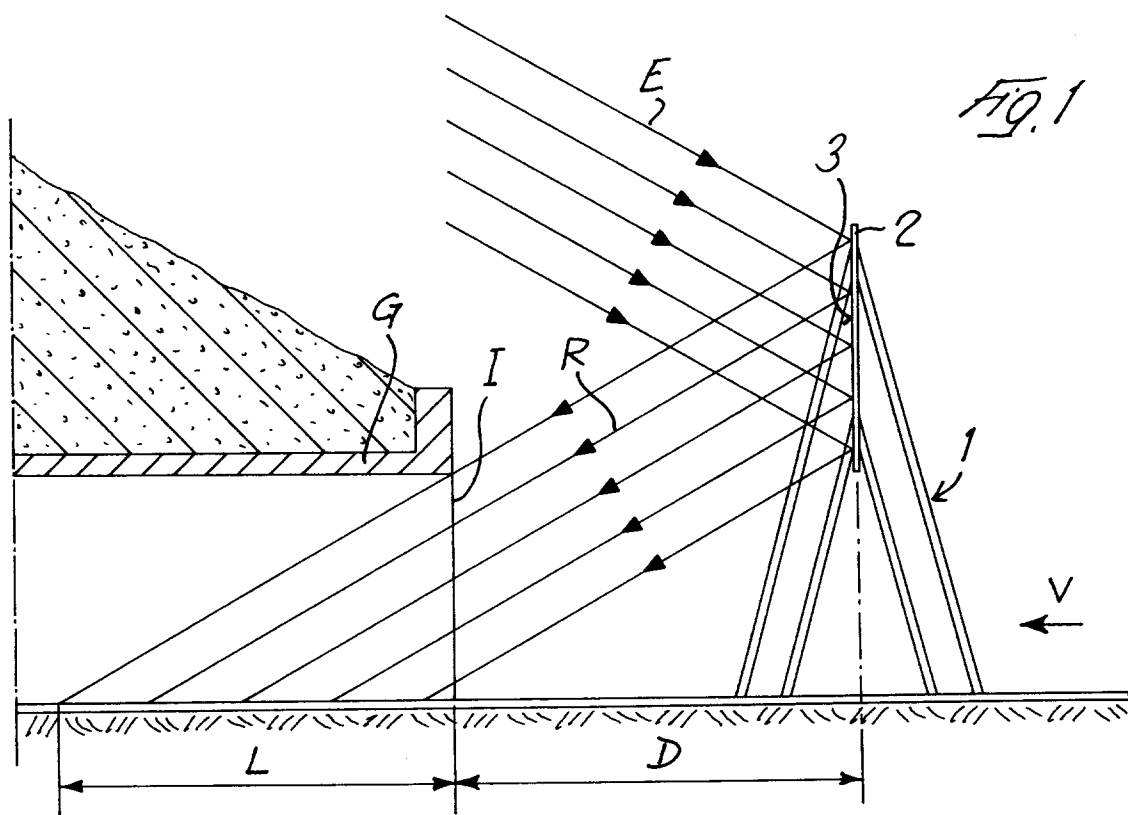
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EUROPEAN SEARCH REPORT

Application Number
EP 93 11 5144

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	DATABASE WPI Section PQ, Week 9325, Derwent Publications Ltd., London, GB; Class Q71, AN 93-203549 & RO-A-103 556 (INST POLITEHNIC IASI) 25 March 1992 * abstract *	1,4,6,9, 11	F21S11/00 F21V7/00
A	DE-A-34 08 649 (ED. ZÜBLIN AG) * page 3, line 3 - line 12 * * page 5, line 26 - page 6, line 12; figures 1,2 *	1,4,6	
A	DE-A-23 34 951 (SIEBENBROCK) * claim 1; figure 1 *	1,4	
A	PATENT ABSTRACTS OF JAPAN vol. 010, no. 180 (P-471)(2236) 24 June 1986 & JP-A-61 027 517 (P S KANKYO GIKEN K.K.) 7 February 1986 * abstract *	1,4	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			F21S F21V E21D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 7 February 1994	Examiner Martin, C
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	