United States Patent [19]

Hedgewick

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[54] **ROADWAY MARKER**

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[*] Notice: The portion of the term of this patent subsequent to Dec. 14, 1988, has been disclaimed.

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[52] **U.S. Cl.** **350/103,** 404/12, 350/109

[51] **Int. Cl.** **G02b 5/12**

[58] **Field of Search** 350/97–109; 94/1.5; 404/9–16

[56] **References Cited**

UNITED STATES PATENTS

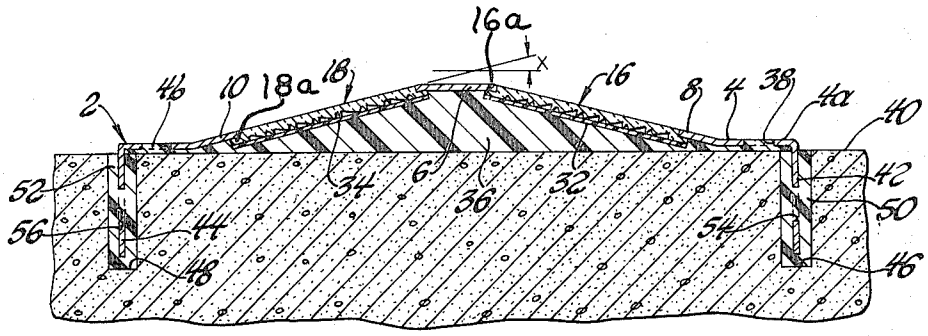
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3,106,878	10/1963	Nagin et al.	94/1.5
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Assistant Examiner—Michael J. Tokar
Attorney—Gerald E. McGlynn, Jr. et al.

[57] **ABSTRACT**

A roadway marker comprising a metal housing having a base and a plurality of walls projecting from the base including a reflector supporting wall extending from the plane of the base at an angle less than fifteen degrees. An opening is formed in the reflector supporting wall, and a reflective insert of light transmitting synthetic resin is mounted in the housing with an outer surface extending across the opening and an inner surface formed with a plurality of cube corner reflex reflector elements. In order to increase the optical efficiency of the reflective insert, a sheet of flexible plastic material covers the inner surface of the reflective insert to protect the reflector elements from moisture and chemical attack and eliminate the necessity to metalize the reflector elements. The housing is filled with a mass of resin which contacts the plastic sheet on the side thereof opposite the reflector elements, the plastic sheet protecting the reflector elements from the resin filler to isolate the reflector elements from the resin to increase the optical efficiency.

30 Claims, 4 Drawing Figures



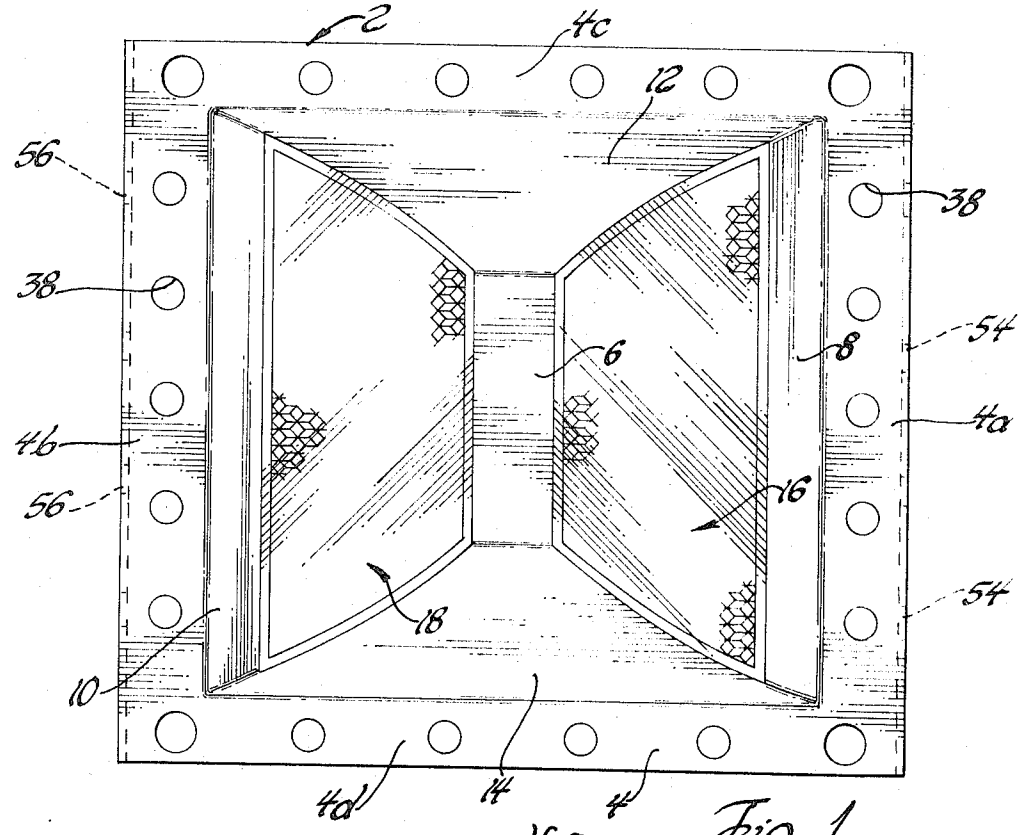


Fig. 1

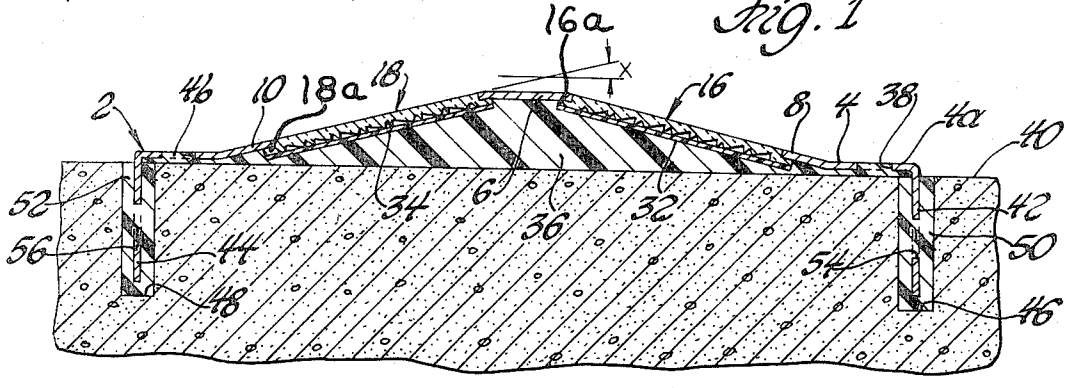


Fig. 2

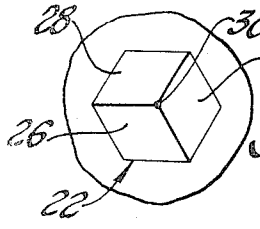


Fig. 3a

Fig. 3

ROADWAY MARKER

This invention relates generally to pavement or roadway markers, and is particularly concerned with a roadway marker employing cube corner reflex reflectors, and one that is highly resistant to damage from snowplows and similar equipment, and one which reduces the traffic hazard caused by presently available roadway markers which project above the surface of the road.

Roadway markers using angled reflex cube corner reflex reflectors have come into widespread use to delineate traffic lanes and the edges of roadways. Such roadway markers are superior to painted strips on the roadways since under poor weather conditions, the painted strips on the roadways are not visible. Roadway markers using reflex reflectors project somewhat above the surface of the roadway and reflect light from the headlights of a car back to the eyes of the driver. However, several problems have arisen due to the use of such roadway markers, namely, the roadway markers are highly subject to damage from snowplows and other road machinery, and the traffic hazard increases as the angle of the roadway marker with respect to the road surface increases.

U.S. Pat. No. 1,906,655 broadly discloses cube corner reflex reflectors of the type that have been used extensively in automobile tail lights and in upright highway delineators placed on poles along roadways. However, the only cube corner reflex reflectors commercially available until recent years were of the "square reflex" variety wherein the reflector must be positioned normal to the incident beam of light. Consequently, this latter type of cube corner reflex reflector was not suitable for use in a roadway marker mounted on the surface of the road since it is required to be disposed vertically or perpendicularly with respect to the roadway surface and would accordingly be easily damaged by snowplows and the like, and furthermore would soon become useless as it would become covered with dirt, grease and grime which would be difficult, if not impossible, to clean from the vertical reflector surface.

British Pat. No. 441,319 discloses the theory of "angled reflex," that is, the theory that cube corner reflex reflectors can be effective when the incident light is not normal (square) to the reflector. The theory of angled reflex is that the cube corner portions at the rear of the reflector can be tilted so that their axes are aligned with the light ray in the reflector material after the light ray has been refracted at the surface of the reflector material. Consequently, with the introduction of angled reflex manufacturing technology in the early 1960's, it became possible to use cube corner reflex reflectors in roadway markers since the reflector element was no longer required to project vertically from the surface but could instead be inclined relative to the roadway surface. Examples of roadway markers using angled reflex cube corner reflex reflectors are disclosed in U.S. Pat. Nos. 3,332,327; 3,392,639; 3,409,344 and 3,485,148.

In the prior art roadway markers using angled reflex cube corner reflex reflectors, the reflector elements have been required to be disposed at an angle of at least 15° with respect to the roadway surface in order to place the reflector near enough to the vertical to be optically effective. As the angle of the reflector with respect to the roadway surface decreases, the optical efficiency also decreases. Thus, even though the use of angled cube corner reflex reflectors in the roadway markers has been possible, the prior art angled cube corner reflex reflector roadway markers project from the surface at an angle such that the roadway marker is still highly susceptible to damage, particularly by snowplows and similar equipment, and still present an undesirable traffic hazard. One reason for the loss of optical efficiency is that in order to protect the cube corner reflex reflector elements from moisture and chemical attack, the surface of the reflector on which the cube corner reflector elements are formed has been metalized (see for example U.S. Pat. No. 3,332,327). While the metalized layer performs the function of protecting the reflector elements, it also causes a loss of optical efficiency, and this loss can be as high as 50 percent. Maximum optical efficiency is obtained when there is no metalizing or coating on the surface of the reflector elements. This loss of optical efficiency contributed to the requirement that the reflector elements be positioned at an angle of at least 15° with respect to the roadway surface.

Another problem with presently available roadway markers using cube corner reflex reflector systems is that the markers have generally been secured to the road surface in such a manner as to be easily displaced by snowplows and similar road equipment. Generally, the markers are fixed in place upon the road surface by an adhesive such as an epoxy resin. However, because of the abrupt angle of the marker with respect to the roadway surface (of at least 15°), the markers have been highly susceptible to damage and displacement by road equipment.

It is therefore an object of this invention to provide a roadway marker using cube corner reflex reflector elements wherein the reflector elements can be disposed at an angle of less than 15° with respect to the surface of the roadway to reduce the traffic hazard caused by the roadway markers, and to increase the resistance of the roadway marker to being damaged by snowplows and similar equipment.

Still another object is to provide a roadway marker having a housing or frame that can be secured to the roadway surface in such a manner as to provide a high degree of resistance to being removed by snowplows and the like.

A still further object is to provide a roadway marker including a reflective insert with cube corner reflex reflector elements formed thereon that will be optically efficient when the reflective insert is disposed at an angle of less than fifteen degrees with respect to the roadway surface.

In carrying out the foregoing, and other objects, a roadway marker according to the present invention includes a housing of metal or similar rugged material having a base with a plurality of walls projecting from the base and including at least one reflector supporting wall. The reflector supporting wall extends from the plane of the base at an angle of less than 15° and is preferably disposed at an angle with respect to the plane of the base of from 3½ to 14°. A reflective insert is mounted in the housing and has an outer surface which extends across an opening formed in the reflector supporting wall, and an inner surface which is formed with a plurality of cube corner reflex reflector elements. A sheet of flexible plastic material underlies and covers the inner surface of the reflective element to protect

the prisms from moisture and chemical attack to thereby increase the optical efficiency of the reflective element. A mass of resin fills the housing and contacts the flexible sheet on the side thereof opposite the reflector elements.

The base includes a pair of planar end portions each of which projects from the lower edge of one of the reflector supporting walls, and a skirt depends from the edge of each of the end portions of the base. Slots are formed in the roadway surface, the roadway surface defining a support for the roadway marker, and the skirts are inserted into the slots. The skirts are formed with openings, and the slots are filled with epoxy resin or the like, the holes providing a mechanical interlock between the skirts and the resin.

Other objects, advantages and features of the invention will become apparent from the following description taken in connection with the accompanying drawings in which:

FIG. **1** is a plan view of a roadway marker embodying the present invention;

FIG. **2** is a cross-sectional view of the roadway marker of FIG. **1** with the marker illustrated mounted on the surface of a roadway;

FIG. **3** is an enlarged fragmentary sectional view of a portion of a roadway marker; and

FIG. **3***a* is a fragmentary view of the reverse face of one of the reflective inserts illustrating one of the cube corner reflex reflector elements.

Reference numeral **2** collectively designates a metal housing having a planar base **4**, a top wall **6** spaced from the plane of the base **4**, a pair of reflector supporting walls **8** and **10** extending in opposite directions from the top wall **6** to the base **4**, and a pair of spaced side walls **12** and **14** extending from opposite ends of the top wall **6** to the base **4**. Each of the side walls **12** and **14** has an edge which is common to one edge of each of the reflector supporting walls **8** and **10**.

An opening is formed in each of the reflector supporting walls **8** and **10**, and a pair of reflective inserts **16** and **18** are mounted on the reflector supporting walls **8** and **10**, respectively, such that the outer surfaces of the reflective inserts extend across the opening of the respective reflector supporting walls **8** and **10**. The reflective inserts **16** and **18** are of identical construction, and are formed of light transmitting synthetic resin material. As shown in FIG. **3**, the outer surface **20** of the reflective insert **18** is smooth, and the inner surface is formed with a plurality of cube corner reflex reflector elements **22**. The inserts **16** and **18** are formed with peripheral flanges **16***a* and **18***a*, respectively, which project beneath the respective reflector supporting walls **8** and **10** at the edges of the openings.

With reference to FIG. **3***a*, each reflector element **22** has three substantially square planar surfaces **24**, **26** and **28** arranged mutually at right angles and meeting at a common point **30** remote from the outer or obverse face **20** of the reflective insert. Each of the reflector elements thus forms a cube corner, and the diagonal of the cube corner passing through the point **30** defines the axis of the cube corner.

Reference numerals **32** and **34** designate thin sheets of flexible plastic material underlying and covering the inner surfaces of the reflective inserts **16** and **18**, respectively, to protect the reflector elements **22** from moisture and chemical attack. The edges of the sheets **32** and **34** are secured by heat sealing to the edges of the inner surfaces of the respective reflective inserts.

After the reflective elements **16** and **18** are inserted into the openings of their respective reflector supporting walls **8** and **10**, with the plastic sheets **32** and **34** applied thereto, the housing **2** is filled with resin material as indicated by reference numeral **36** in FIG. **1**, the material preferably being epoxy resin. The epoxy resin **36** fills the housing, but the plastic sheets **32** and **34** isolate the surfaces of the reflector elements **22** from the resin fill **36** to thereby prevent optical deterioration caused by moisture or chemical attack on the surfaces of the reflector elements **22**.

The base portion **4** of the housing **2** is formed with end portions **4***a* and **4***b* projecting from the lower edges of the reflector supporting walls **8** and **10**, respectively, and a pair of side portions **4***c* and **4***d* projecting from the lower edges of the side walls **12** and **14**, respectively. Holes **38** are formed in the side and end portions of the base which are filled with the epoxy resin **36** to provide a mechanical interlock between the housing and the resin.

Depending skirts **42** and **44** are formed on the outer edges of the end portions **4***a* and **4***b*, respectively. When the roadway marker is to be secured to the surface **40** of a roadway, the surface **40** defining the support for the roadway marker, slots **46** and **48** are formed in the roadway, and the skirt **42** and skirt **44** are respectively inserted into the slots **46** and **48**. Openings **54** and **56** are formed in the skirts **42** and **44**, respectively. After the skirts **42** and **44** are received in the respective slots **46** and **48**, the slots are filled with epoxy resin or similar material as indicated by reference numerals **50** and **52**, respectively, the holes **54** and **56** providing a mechanical interlock between the resin filler and the skirts.

The reflector supporting walls **8** and **10** extend at an angle *x* with respect to the plane of the base **4** which is less than 15°, and is preferably in the range of 8 to 12° to provide the greatest amount of optical efficiency but which at the same time is not abrupt and thus provides good resistance to snow plow damage. The skirts **42** and **44**, and their associated slots **46** and **48** extend transversely to the direction of traffic on the roadway surface **40**. Consequently, there are no free edges of the roadway marker that can be engaged by snow plows or similar equipment to tear the roadway marker from the surface **40**. As alluded to previously, the low angle *x* of less than 15° also provides low resistance to snow plows and similar equipment, permitting the snow plow to pass over the roadway marker without an abrupt build-up of forces sufficient to damage or displace the marker. The mechanical interlock between the resin **50, 52** and the skirts **42** and **44** also provides resistance against vertical movement of the housing **2** with respect to the roadway surface **40**.

The resin filler **36** provides bearing strength for the reflector inserts **16** and **18**, and the metal housing **2** prevents the reflective inserts from being damaged by the weight of vehicles passing over the roadway marker. The low angle *x*, of the roadway marker with respect to the surface, substantially reduces the traffic hazard provided by presently available roadway markers of this type. The elimination of the necessity for metallizing the surfaces of the reflector elements **22** substantially increases the optical efficiency of the roadway marker and permits the axes of the reflector

elements 22 through the cube corner 30 to be on the order of 3½ to 14° without optical failure.

The plastic sheets 32 and 34 also provide a cushion for the inserts 16 and 18. The cube corners 30 rest on the plastic sheets 32 and 34, and, when a vehicle passes over the inserts, the plastic sheets cushion the forces. The large number of cube corners in contact with the plastic sheet distributes the weight acting on the outer surfaces of the inserts, the cube corners tending to dig into the respective flexible sheets. The sheets also maintain the necessary space behind the cubes so that light can pass through the inserts to be reflected by the cubes.

While specific embodiments of the invention have been disclosed in the accompanying drawings and described in the foregoing specification, it should be understood that the invention is not limited to the exact construction shown. Alterations in the construction and arrangement of parts, all falling within the scope and spirit of the invention, will be apparent to those skilled in the art.

I claim:

1. A roadway marker comprising: a housing having a base and a plurality of walls projecting from said base including at least one reflector supporting wall extending from the plane of said base at an angle of less than 15°; an opening in said reflector supporting wall; a reflective insert mounted in said housing, said reflective insert having an outer surface extending across said opening and an inner surface formed with a plurality of cube corner reflex reflector elements; and a sheet of flexible plastic material covering said inner surface of said reflective insert to protect said reflector elements from moisture and chemical attack.

2. A roadway marker as claimed in claim 1 further including a mass of resin filling said housing and contacting said sheet on the side thereof opposite said reflector elements.

3. A roadway marker as claimed in claim 1 wherein said base includes a planar end portion projecting from the edge of said reflector supporting wall, and a skirt depending from the edge of said end portion opposite said reflector supporting wall.

4. A roadway marker as claimed in claim 3 further including means defining a support, a slot formed in said support, said housing being seated on said support with said skirt received in said slot.

5. A roadway marker as claimed in claim 4 wherein said slot is filled with resin and said skirt is embedded in said resin.

6. A roadway marker as claimed in claim 5 further including a mass of resin filling said housing and contacting said sheet on the side thereof opposite said reflector elements.

7. A roadway marker as claimed in claim 6 further including a plurality of holes formed in said skirt, the resin in said slot filling said holes to mechanically interlock said skirt with said resin.

8. A roadway marker as claimed in claim 1 wherein said plurality of walls includes a top wall spaced from the plane of said base, said reflector supporting wall extending from one edge of said top wall to said base.

9. A roadway marker as claimed in claim 8 wherein said plurality of walls includes a pair of spaced side walls extending between the opposite ends of said top wall and said base, said side walls each having an edge common to one edge of said reflector supporting wall.

10. A roadway marker as claimed in claim 9 wherein said base includes a planar end portion projecting from the lower edge of said reflector supporting wall, and a pair of spaced, planar side portions each projecting from the lower edge of one of said side walls.

11. A roadway marker as claimed in claim 10 including a skirt depending from the edge of said end portion opposite said reflector supporting wall.

12. A roadway marker as claimed in claim 11 further including means defining a support, a slot formed in said support, said housing being seated on said support with said skirt received in said slot.

13. A roadway marker as claimed in claim 12 wherein said slot is filled with resin and said skirt is embedded in said resin.

14. A roadway marker as claimed in claim 13 further including a mass of resin filling said housing and contacting said sheet on the side thereof opposite said reflector elements.

15. A roadway marker as claimed in claim 1 wherein said plurality of walls includes a top wall spaced from the plane of said base, said one reflector supporting wall extending between said top wall and said base, and further including a second reflector supporting wall extending between said top wall and said base in the opposite direction from said one reflector supporting wall.

16. A roadway marker as claimed in claim 15 including an opening in said second reflector supporting wall, a second reflective insert mounted in said housing, said second reflective insert having an outer surface extending across said second opening and an inner surface formed with a plurality of cube corner reflex reflector elements; and a second sheet of flexible plastic material covering said inner surface of said second reflective insert to protect said reflector elements from moisture and chemical attack.

17. A roadway marker as claimed in claim 16 wherein said plurality of walls further includes a pair of spaced side walls extending between the opposite ends of said top wall and said base, said side walls each having an edge common to one edge of each of said reflector supporting walls.

18. A roadway marker as claimed in claim 17 wherein said base includes a pair of planar end portions each projecting from the lower edge of one of said reflector supporting walls, and further including a skirt depending from each of said end portions, each said skirt depending from the edge of its respective end portion opposite the respective reflector supporting wall.

19. A roadway marker as claimed in claim 18 further including means defining a support, a pair of spaced slots formed in said support, said housing being seated on said support with each of said skirts received in one of said slots.

20. A roadway marker as claimed in claim 19 wherein each of said slot is filled with resin, and said skirts are embedded in the resin.

21. A roadway marker as claimed in claim 20 further including a plurality of holes formed in each of said skirts to mechanically interlock said skirts with the resin in said slots.

22. A roadway marker as claimed in claim 21 further including a mass of resin filling said housing and contacting said sheets of flexible plastic material on the sides thereof opposite said reflector elements.

23. A roadway marker comprising: a metal housing having a base, a top wall spaced from the plane of said base, a pair of reflector supporting walls extending in opposite directions from said top wall to said base at an angle of less than 15° with respect to the plane of said base; and a pair of spaced side walls extending from opposite ends of said top wall to said base, each of said side walls having an edge common to one edge of each of said reflector supporting walls; an opening formed in each of said reflector supporting walls; and a pair of reflective inserts of light transmitting synthetic resin material each of which is mounted in said housing on one of said reflector supporting walls, each of said reflective inserts having an outer surface extending across the opening of its respective reflector supporting walls and an inner surface formed with a plurality of cube corner reflex reflector elements.

24. A roadway marker as claimed in claim 23 wherein said base includes a pair of planar end portions each of which projects from the lower edge of a respective one of said reflector supporting walls, each of said end portions having a skirt depending from the outer edge thereof.

25. A roadway marker as claimed in claim 24 further including means defining a support, a pair of spaced slots formed in said support, said housing being seated on said support with each of said skirts received in one of said slots.

26. A roadway marker as claimed in claim 25 wherein each of said slots is filled with resin, and said skirts are embedded in the resin.

27. A roadway marker as claimed in claim 26 further including a plurality of holes formed in each of said skirts to mechanically interlock said skirts with the resin in said slots.

28. A roadway marker as claimed in claim 27 further including a sheet of flexible plastic material covering the inner surface of each of said reflective elements to protect said reflector elements against moisture and chemical attack.

29. A roadway marker as claimed in claim 28 further including a mass of resin filling said housing and contacting said flexible plastic material.

30. A roadway marker comprising: a metal housing having a planar base, a top wall spaced from the plane of said base, a pair of reflector supporting walls extending in opposite directions from said top wall to said base at an angle of less than 15° with respect to the plane of said base, and a pair of side walls extending from the opposite ends of said top wall to said base, each of said side walls having an edge common to one edge of each of said reflector supporting walls; an opening formed in each of said reflector supporting walls; a pair of reflective inserts of light transmitting synthetic resin material each of which is mounted in said housing on one of said reflector supporting walls, each of said reflective inserts having an outer surface extending across the opening of its respective reflector supporting wall and an inner surface formed with a plurality of cube corner reflex reflector elements; a sheet of flexible plastic material covering the inner surfaces of said reflective inserts to protect said reflector elements from moisture and chemical attack, a mass of resin filling said housing and contacting said flexible material on the side thereof opposite said reflector elements, said base having a pair of end portions each projecting from the lower ends of respective ones of said reflector supporting wall, and a skirt depending from each of said end portions.

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