United States Patent [19]

Reusser

[11] **3,762,825**

[45] **Oct. 2, 1973**

[54] **TRAFFIC LANE MARKER AND REFLECTOR**

[75] Inventor: **Hans E. Reusser**, Cleveland, Ohio

[73] Assignee: **Republic Steel Corporation**, Cleveland, Ohio

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[21] Appl. No.: **147,525**

[52] **U.S. Cl.** **404/16**

[51] **Int. Cl.** **E01f 11/00**

[58] **Field of Search** ..... 94/1.5; 40/125 N

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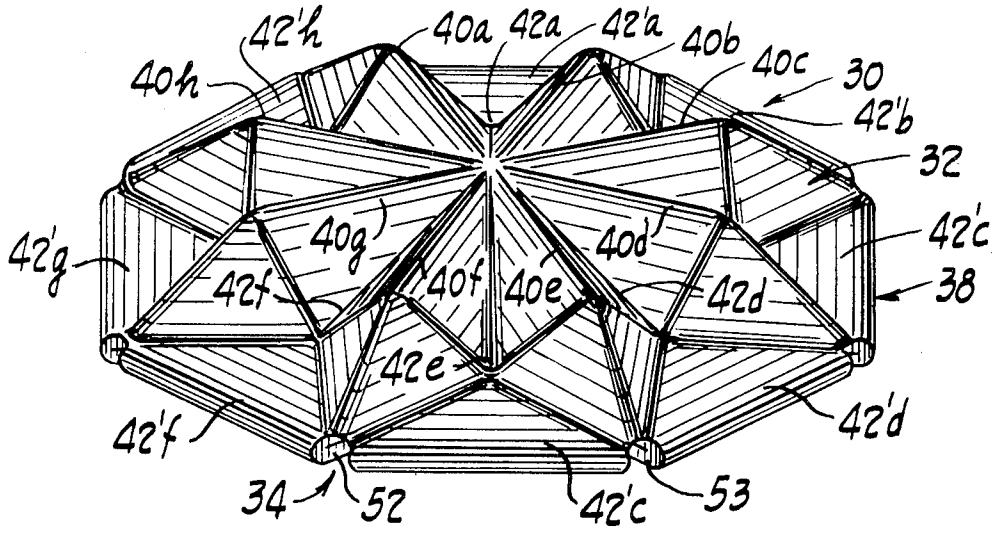
Primary Examiner—Nile C. Byers, Jr.

Attorney—Robert P. Wright and Joseph W. Malleck

[57] **ABSTRACT**

A marker for indicating traffic lanes on a roadway, in the form of a vault-like metal stamping with a generally flat base comprised of peripherally spaced, inwardly bent, tabs that underlie only a portion of an upper surface of the marker. The upper surface is continuous, with alternate, generally radially extending, ridges and depressions. A preferred configuration of the upper surface has flat horizontal portions at base level, spaced between the ridges at the periphery of the marker, forming a part of the depressions. The ridges incline steeply upward and inward from the periphery and extend generally parallel to the base at the central part of the marker. In one embodiment, an opening is provided in an inclined face of the upper surface for a reflector having a flat face inclined at approximately the same angle as the surface in which the opening is formed. The reflector is of the cube-corner type in which a plane common to the cube corners is perpendicular to the cube-corner axes and angularly related to the front face of the reflector. The plane of the cube corners is located substantially behind the front face, recessed from the opening, and a major portion of the cube-corner pattern extends the full width of the opening in the upper surface of the marker.

17 Claims, 20 Drawing Figures



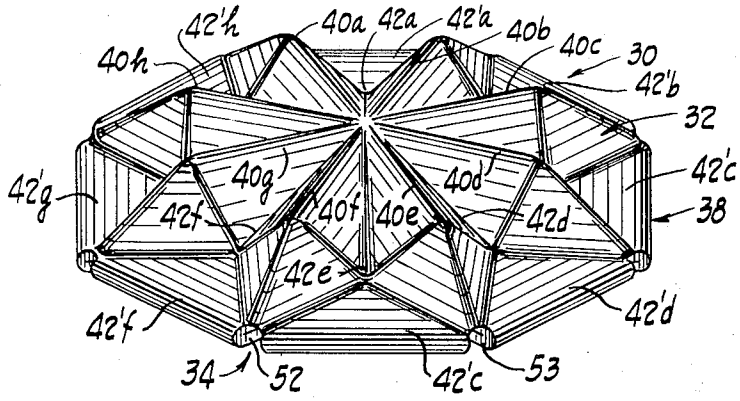


Fig. 1

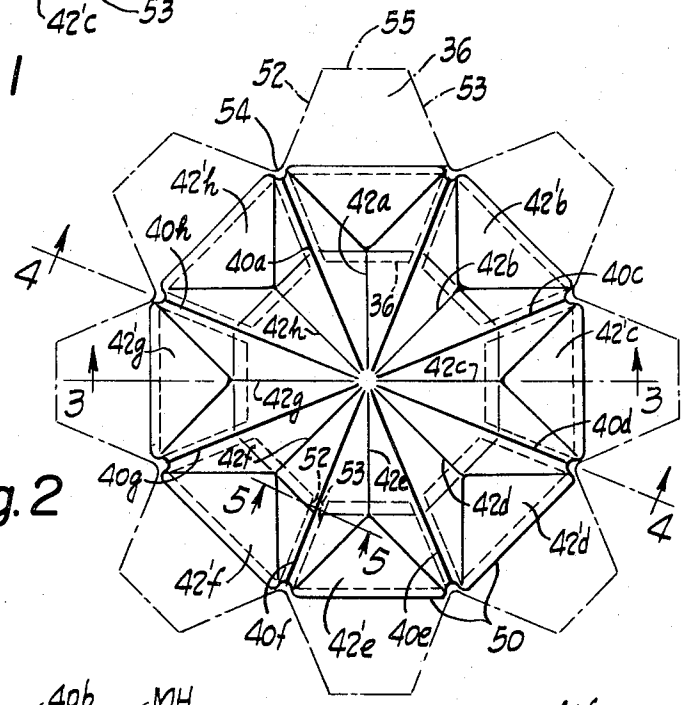


Fig. 2

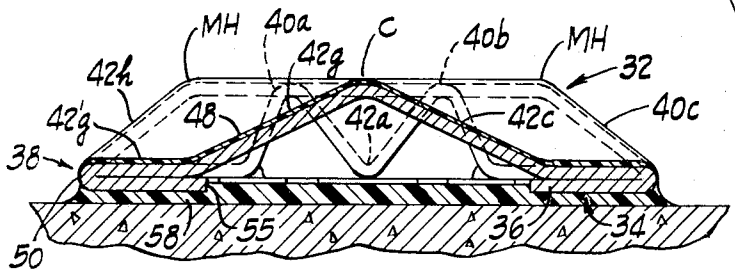


Fig. 3

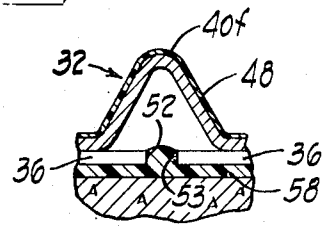


Fig. 5

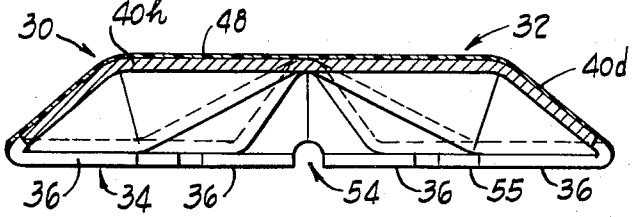


Fig. 4

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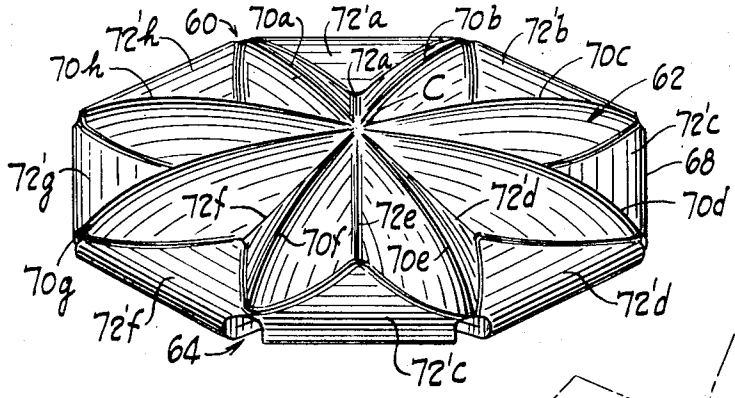
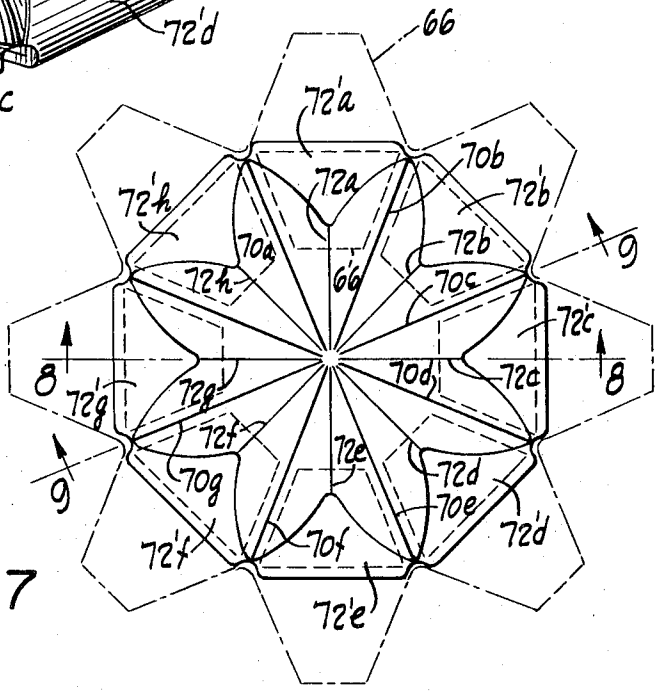


Fig. 6



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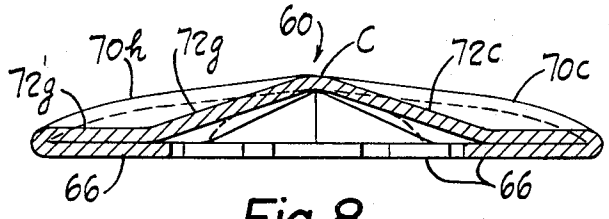

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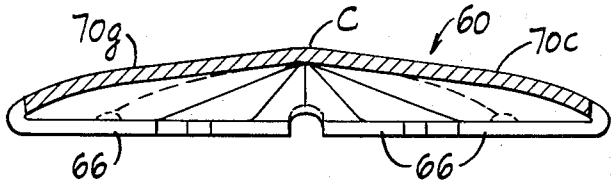

Fig. 9

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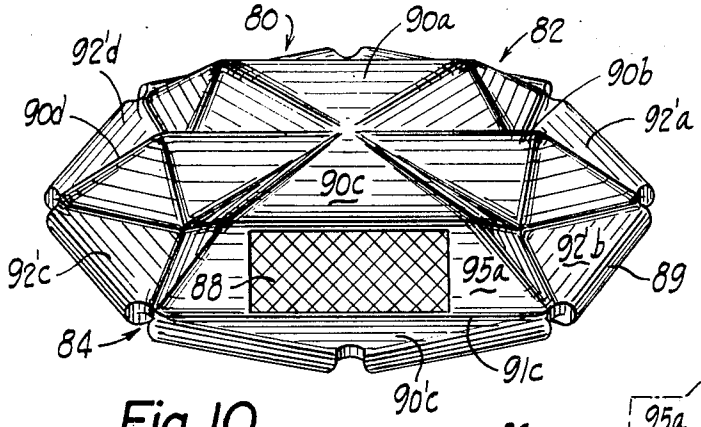
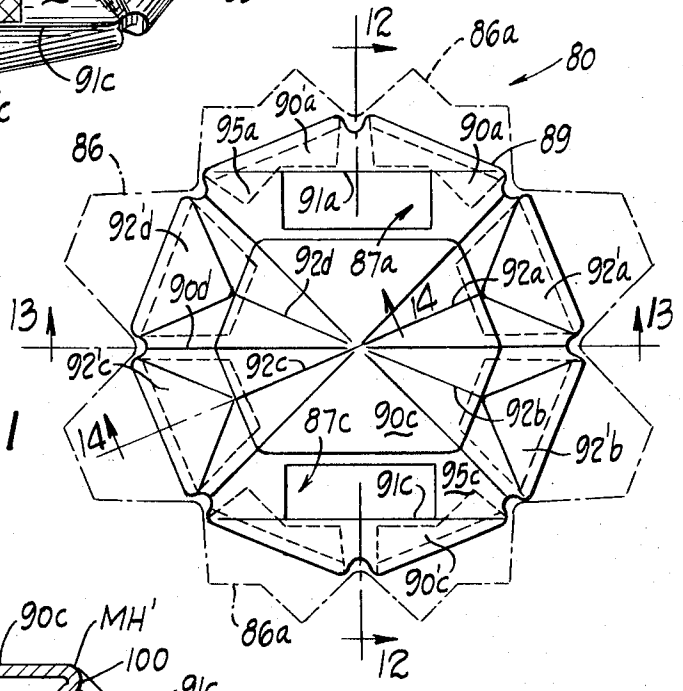


Fig. 10



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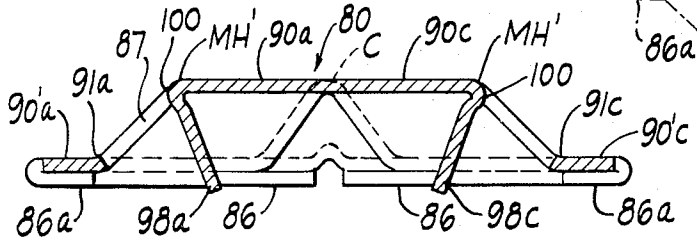

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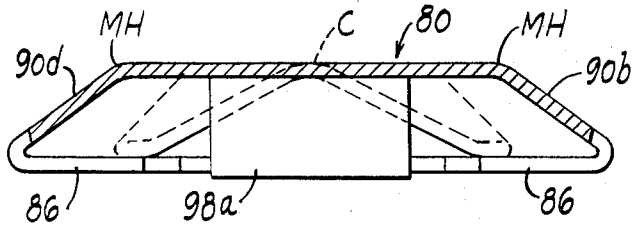

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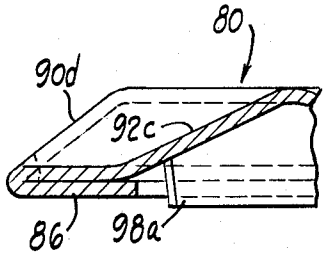

Fig. 14

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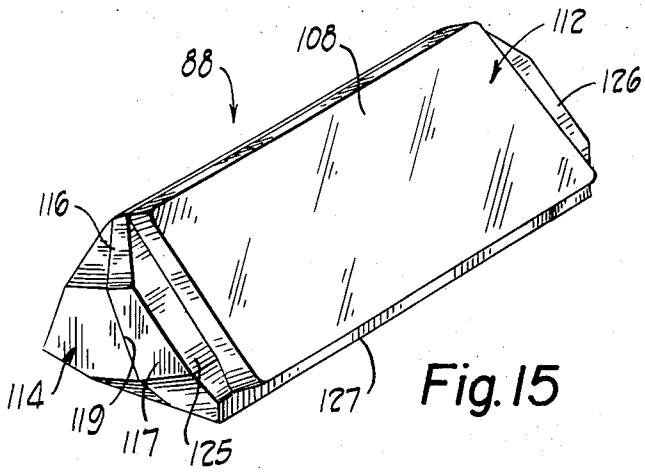
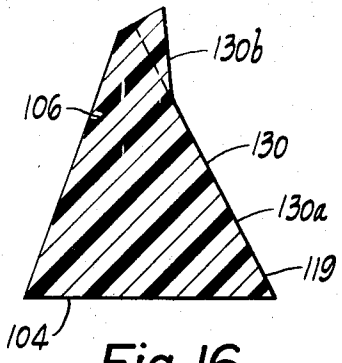


Fig. 15



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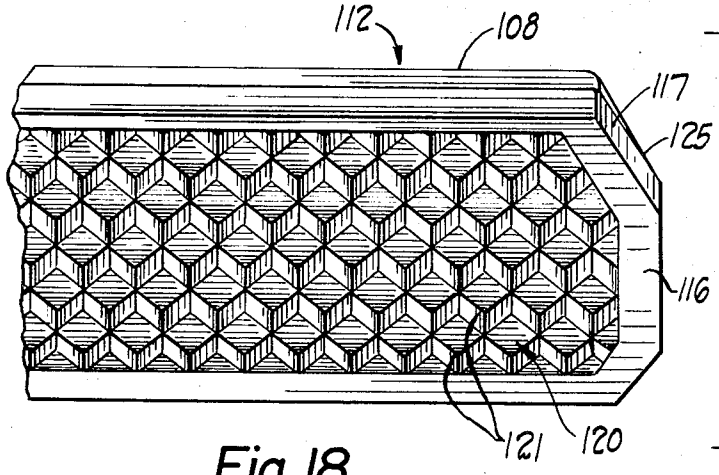

Fig. 18

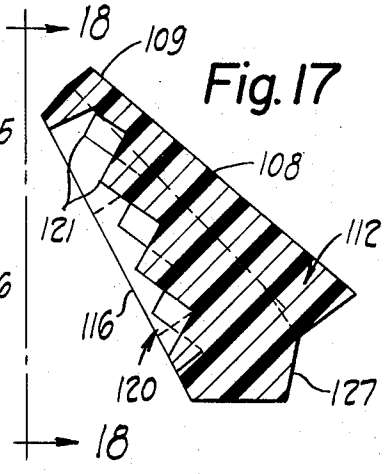

Fig. 17

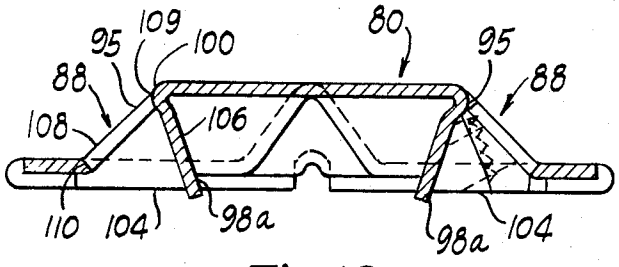

Fig. 19

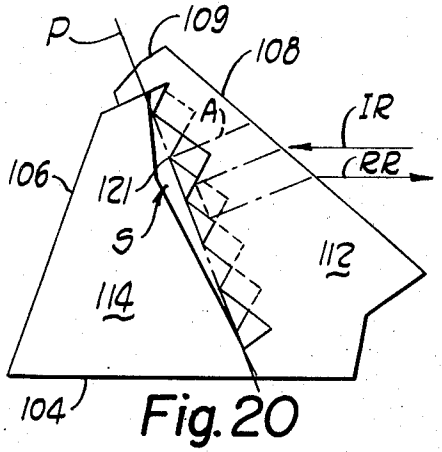

Fig. 20

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TRAFFIC LANE MARKER AND REFLECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to traffic guides and street markers.

2. Prior Art

A variety of different constructions of traffic lane markers are known, which are adapted to be adhered to the pavement and which are raised above the level of the pavement to provide a visual indication of traffic lanes and to transmit warning vibrations when a vehicle wheel passes over the markers. Such markers may or may not include reflectors to increase night visibility and many, depending upon their construction and material, require fillers for reinforcement. Markers are typically made of ceramic or plastic bodies molded to shape, or may be in the form of a metal dome. For example, certain known markers are disc-like in shape, made of ceramic or plastic material, with an overall smoothly molded or glazed upper domed surface. The outside diameter is approximately equal to the width of a painted center line, i.e., about 4 inches, and the greatest thickness is at the center, typically about one-half inch. This type of construction offers poor headlight reflection at normal low approach angles and the brittleness of ceramic requires a totally rigid support, as by a cement bond between the under surface and the pavement. Any attempt to provide significant identations or the like that would produce a supplementary reflecting surface pattern reduces section thickness and adds to the fragility of the marker. Further, the entire surface is subjected to scuffing or marring and wear from the tire abrasion which is particularly damaging to reflective beading on a plastic marker.

Metal markers, for example, markers of the type shown in the U. S. Letters Patent Nos. 1,746,312 and 2,242,619 overcome certain disadvantages of ceramic markers, but known constructions have their own shortcomings and have failed to provide an optimum construction from the standpoint of securing the marker to the pavement, providing good reflectance, minimizing abrasion and wear, and promoting self-cleaning. Such known constructions, for example, do not provide facets or large areas that are oriented to reflect light yet protected from abrasion and wear to a satisfactory extent, do not provide a relatively steep angle of inclination upward from the periphery of the marker to assure efficient reflectance of light approaching at a low angle of incidence, and typically require either metal studs or fasteners to secure them to the roadway, or must be recesses in the roadway, or filled with a reinforcing and adhering material, such as cement or the like.

Pavement markers with integral light reflectors and relatively steeply inclined side surfaces are known, for example, as shown in U. S. Letters Patent No. 3,332,327, but such markers lack brightness in day light, are relatively expensive, and require a solid core that sacrifices some reflector efficiency in order to reinforce fragile plastic shell construction against damage by traffic.

SUMMARY OF THE INVENTION

In accordance with the present invention, metal markers, preferably steel, are provided and are of a construction that permits economy of fabrication, high strength and durability, and have surface contours that provide a large reflective area to effectively gather and reflect light approaching at all angles of incidence so as to be highly visible both day and night. To this end, the markers are stamped from steel sheet or plate, with a generally vaulted form upper surface and base tabs about the periphery of the upper surface, bent inwardly beneath the upper surface, adapting the marker to be surface mounted on the pavement with a suitable mastic or adhesive. The base forming tabs provide both a firm support, substantial surface area for adhesion, and a keying effect due to vertical surfaces provided between adjacent tabs, to effectively secure the marker to the pavement and to resist lateral movement of the marker in any direction.

The upper surface is contoured with a plurality of ridges and depressions that increase the rigidity and strength of the marker against compressive forces that would tend to flatten the marker in use, and further, provide supplementary reflecting surfaces and protect these surfaces from abrasion. Provision is made for receiving reflector inserts to further increase the visibility of the markers at night. More specifically, the metal marker of the present invention is of hollow or shell-like construction, comprised of a rigid vault forming an upper surface and a partial flat base beneath the vault, extending inwardly from the perimeter of the vault. The vault is a continuous surface, shaped with ridges and depressions that provide reflective faces at different aspects or angles. Much of the reflective surface is protected from abrasion by the ridges of the vault surface. The vault surface includes portions about the periphery that are inclined upwardly and inwardly toward the center thereof at different angles from the vertical so that, at a given radial distance from the center, portions of the vault about the periphery are at different heights from the base.

A particularly advantageous construction has upper surface portions adjacent the perimeter of the base that rise steeply from the base to the maximum height of the vault. These portions are separated at the perimeter by flat horizontal portions of the upper surface and are separated inwardly of the perimeter by vault portions that incline more gradually upward and inward from the flat horizontal portions. One preferred embodiment incorporating such construction includes at least one relatively large face adjacent the perimeter and inclined relatively steeply upward and inward to the maximum height of the vault. An opening is formed in the face by a flap that is bent inward along an upper edge. This opening receives a reflector and the flap extends to a location below the plane of the base to reinforce the vault against deformation from compressive loads.

The upper surface of the marker is covered with a protective coating that is highly visible and durable, such as porcelain enamel or a bright organic coating.

The inturned tabs forming the base of the marker extend only part way toward the center of the marker and are spaced apart peripherally to provide vertical surfaces between the tabs, that extend in a generally radial direction. The flat lower surface of the tabs provides a supporting surface with substantial area for adherence, while the vertical edges of the tabs provide a large perimeter, with portions extending in a great many radial directions. When the marker is adhered to a highway surface with a mastic or other thick adhesive, a portion of the adhesive extrudes upward between the flaps

when the marker is pressed into place to cooperate with the vertical edge surfaces thereof and provide a keying effect that resists any tendency of the marker to move in the plane of the base under pressures applied to side surfaces during use.

Each of the preferred embodiments has an octagonal perimeter that facilitates bending the base-forming tabs inward, yet still approaches a circular shape that is not limited to a particular orientation in use, except with a reflector insert. Further, each of the inwardly extending tabs is prevented from being bent upward from the intended base plane by flat peripheral marker portions that directly overlie the tabs. This prevents distortion of the tabs under load or impact, which would result in a tilting of the marker and could weaken or destroy the adhesive bond between the tabs and the pavement.

In one preferred embodiment of this invention, a reflector of improved construction is located within the marker, with a face surface received in an opening in an inclined face or wall portion of the marker. The improved reflector provides high strength, maximum reflective area, and efficient light return, and is oriented at an angle that promotes automatic cleaning or wiping of the reflector face during use. It is more intense, directional and less affected by a water film, than a beaded surface coating. The preferred reflector construction utilizes the so-called multiple cube-corner type of reflective surface, with a sealed air space adjacent the inner reflective surface of a lens element. The cube-corner pattern is arranged to provide the greatest light return in a path perpendicular to a plane common to the cube points, i.e., at a zero degree angle of incidence. The cube-corner pattern forms an inside surface of a portion of the reflector, which is in the general form of a wedge prism and is one of two pieces that form the reflector. A base portion forms the other reflector piece and the two are adhered together about border portions. The two piece construction facilitates molding the reflector with a cavity behind the cube-corner pattern.

Both the external flat surface of the lens portion and the cube-corner pattern plane are inclined in an upward and rearward direction relative to the marker body, the angle of the pattern plane with respect to the vertical being less than that of the front face. The angle between the front face or surface of the wedge-shaped lens portion and the plane of the cube corners, coupled with the index of refraction of the material forming the lens element, causes incident light received at a low angle from headlights to be directed perpendicularly to the pattern plane when the prism is positioned in the marker.

The wedge-shaped lens portion of the reflector is oriented with the thickest portion downward and with the cube-corner pattern behind the wall opening of the marker. By locating the pattern plane behind the metal that forms the opening, the reflective pattern can extend the full width of the opening and the edge structure required as a mounting boundary and juncture between the two pieces forming the reflector, and which is non-functioning from a reflective standpoint, can be located behind and to the sides of the border of the opening. The thicker lower part of the lens portion is at the most exposed part of the reflector and the strength provided by the thickness eliminates the need for metalizing the reflective surface and filling the reflector behind the reflective surface, which is normally required for thin reflective elements that are subjected to impact or stress and reduces reflective efficiency. The face surface of the reflector is inclined at a slightly greater angle from the vertical than that of the vault face in which it is located, so that the top and thinnest portion of the reflector lens portion is recessed relative to the plane of the face and thereby protected from direct impact during use.

From the above, it will be apparent that a basic object of this invention is to provide a marker for highway traffic that can be readily and economically fabricated, that is of high strength and is durable, that can be readily and securely adhered to a roadway without fasteners, that effectively reflects light from oncoming headlights, and that retains both its light reflective qualities and day visibility after substantial use.

A more particular object of this invention is to provide a marker of the above character that can be economically fabricated in the form of a metal stamping and that, with minor modifications, can receive and retain a light reflector insert.

A further object of this invention is to provide an improved reflector insert for a traffic marker of the type referred to above.

The above and other objects, features and advantages of this invention will become more apparent from the detailed description that follows, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of one embodiment of a metal traffic lane marker embodying the present invention;

FIG. 2 is a top plan view of the marker of FIG. 1, illustrating in phantom the configuration of the marker as originally stamped from a metal sheet;

FIG. 3 is a sectional view of the marker of FIG. 2, taken along the line 3—3 and showing portions of a supporting roadway and adhesive material adhering the marker to the roadway;

FIG. 4 is a sectional view taken along the line 4—4 of FIG. 2;

FIG. 5 is a partial sectional view taken along the line 5—5 of FIG. 2;

FIG. 6 is a perspective view of another embodiment of a metal marker embodying the present invention;

FIG. 7 is a top plan view of the marker of FIG. 6, showing in phantom the configuration of the marker as originally stamped from a metal sheet;

FIG. 8 is a sectional view taken along the line 8—8 of FIG. 7;

FIG. 9 is a sectional view taken along the line 9—9 of FIG. 7;

FIG. 10 is a perspective view of another embodiment of a metal traffic lane marker embodying the present invention, which includes a reflector insert;

FIG. 11 is a top plan view of the marker of FIG. 10, with an initial stamped configuration shown in phantom;

FIG. 12 is a sectional view taken along the line 12—12 of FIG. 11;

FIG. 13 is a sectional view taken along the line 13—13 of FIG. 11;

FIG. 14 is a sectional view taken along the line 14—14 of FIG. 11;

FIG. 15 is a perspective view of reflector insert adapted to be received in an opening of the marker shown in FIGS. 10 to 14;

FIG. 16 is a transverse sectional view of a base part of the reflector of FIG. 15;

FIG. 17 is a transverse sectional view of a lens element part of the reflector element of FIG. 15, taken in the same transverse plane as FIG. 16;

FIG. 18 is a rear elevational view of the lens element part of the reflector insert shown in FIG. 17, viewed from approximately the plane 18—18;

FIG. 19 is a view partially in section and partially in elevation illustrating the manner in which the reflector insert of FIG. 15 is located within a marker of the construction shown in FIG. 10;

FIG. 20 is a diagrammatic sectional view on an enlarged scale, of the reflector insert of FIGS. 15 to 19, illustrating the manner in which incident light is refracted and reflected.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

With reference to FIGS. 1 to 5, one embodiment of a traffic marker constructed in accordance with the present invention is indicated generally by the reference numeral 30. The marker is comprised of a vaulted portion or upper surface 32 and a base 34. The marker is constructed of sheet metal, initially stamped to the shape shown in FIG. 2, with base-forming tabs 36 extended outwardly, as indicated in phantom. Subsequent to stamping, the tabs 36 are bent inward into the dotted line position shown, beneath the vaulted portion 32. The preferred embodiment is constructed of 13 gage (0.090 inch thick) steel, which has been found suitable for the intended purpose, and is approximately 4 inches wide and three-fourths inch high, with the tabs bent under.

The vaulted portion 32 has a continuous, solid, surface with a generally octagonal perimeter 38 about the base. The octagonal perimeter is advantageous because it allows for a multiplicity of facets for reflective purposes, and at the same time assures that the facets are sufficiently small that there is no need for establishing a particular orientation of the marker when it is applied to the pavement. The vault is formed with eight generally radiating ridges 40*a–h*, separated by eight radially extending and peripherally spaced depressions 42*a–h*. The ridges 40 originate at the level of the base of the marker, at the perimeter, at corners of the octagonal shape. From the perimeter, they incline upward and inwardly of the marker, to the maximum height of the marker at a point indicated at MH in FIG. 3, a radial distance less than half the total radial distance to the center C of the marker. The ridges are substantially flat along a major portion of their length, from the location of maximum height MH, inward to the center C. The depressions 42 include a flat triangular shaped part 42'*a–h* at the perimeter of the vault, and in part forming the sides of the octagonal perimeter. The portions 42*a–h* of the vault that form the depressions slope upward and inward from the apex of each triangular part to the center of the vault at a more gradual angle than the inclined portions of the ridges 40*a–h* and are substantially longer in length, as can best be appreciated from FIG. 3 by comparing the length of the depression point 42*g* to the ridge portion 40*h* from the perimeter 38 to the point MH. This provides a contour to the ridges that forms faces or facets at different angular relationships from the highest point MH of the ridge to the lowest part of the depression that act as supplementary reflecting surfaces for light from oncoming headlights or day lighting, for maximum visibility. By comparison, existing forms of low and smooth domed marker profile offer the absolute minimum in usefully visible surface area. The difference becomes more evident when night visibility of the marker is enhanced by a light reflective beaded coating 48 on the top surface. The light return is less and deterioration is greater on the smooth domed profile of existing forms than on the ridge-protected facets of the present construction, with the beads retained in epoxy. The entire beaded area of a low profile, smooth dome, marker is subject to rapid wear and normally loses reflectivity under a water film. Facet areas of the present marker, in addition to confining wear to ridges, are steep enough to shed water. Unbeaded finishes may also consist of epoxy material or nylon, which can be applied in powder form by spraying electrostatically, or in a fluidized bed to a heated stamping and then cured to a hard, durable, coating. A nylon powder requires a primer to promote adhesion, and a total coating of 6 mils thickness or more, up to perhaps 15 mils, has been found to be satisfactory. A white porcelain coating can also be used, is highly light reflective and wear resistant, but is more readily chipped through stone impact than is an epoxy or nylon.

The base forming tabs 36 that initially extend outward when the marker form is stamped, are bent inward, into contact with the form beneath the triangular parts 42'*a–h*. Each tab is a continuation of the triangular part, and when bent underneath it, forms along a respective fold line 50, the straight sides of the octagonal perimeter 38. Side edges 52, 53 of each tab 36 are angularly related so as to extend substantially along a radial path toward the center of the marker. The width of each tab is such that a space 54 (FIGS. 2 and 4) is provided between each tab and the next adjacent tab. Each tab terminates short of the center of the vault in an edge 55, which, in the preferred embodiment shown, is a straight edge parallel to the fold line 50. The tabs 36 serve to support the marker on the pavement and provide a substantial surface, typically horizontal, for adhering the marker to the pavement, as with an adhesive 58, shown in FIGS. 3 and 5. The space 54 between adjacent tabs provides a recess for receiving a portion of the adhesive 58, when the marker is pressed against the adhesive. That portion of the adhesive that extrudes upward between adjacent edges of the tabs serves to key the marker in a fixed position, so that it better resists shear forces that tend to move the marker relative to the supporting pavement. The variety of angles at which the generally radially extending edges of the tabs extend serve to effectively resist forces applied in any direction in the plane of the base.

For adequate support, and to assure adequate adhesive area, the base area provided by the lower surfaces of the inturned tabs 36 should be equal to at least one-fourth of the area covered by the marker. In the preferred construction shown, the area of the tabs is approximately 40 percent of the area covered by the marker. It should be apparent that a substantially greater base perimeter is provided with the tab construction, as compared with an uninterrupted flange of equal area, which substantially increases the ability of

the marker to resist shear forces. The adhesive **58** is preferably a thermoplastic material or so-called hot melt, which is easy and convenient to apply, which has good adhesive qualities, and which does not become so hard or brittle that the bond between the marker and pavement is broken under typical use. Alternatively, an epoxy adhesive can be used, but such materials are somewhat more difficult to apply and are typically more brittle after curing.

Another construction of a marker embodying the present invention is indicated to **60** in FIGS. **6** to **9** of the drawings. This construction is similar to the embodiment shown in FIGS. **1** to **5**, but has a modified vault configuration. As shown in the drawings, the marker **60** has a vaulted portion or upper surface **62**, a base **64**, and is constructed of sheet metal, initially stamped to the shape shown in FIG. **7**, with base forming tabs **66** extending outwardly, as indicated in phantom. Subsequent to stamping, the tabs **66** are bent inward into the dotted line position shown, beneath the vaulted portion **62**.

The vaulted portion **62** has a continuous, solid, surface with a generally octagonal perimeter **68** about the base. The top is formed with eight generally radiating ridges **70***a–h* separated by eight radially extending and peripherally spaced depressions **72***a–h*. The ridges **70** originate at the level of the base of the marker, at the perimeter, at corners of the octagonal shape. From the perimeter, they curve upward and inwardly toward the center of the marker, sloping the entire way. As a result, the center C of the marker is the highest point. The curvature of the ridges and the steepness of the contour is greatest adjacent the perimeter and decreases toward the center of the marker. The depressions **72** start at a flat triangular shaped part **72'***a–h* at the perimeter of the vault, which triangular shaped parts form sides of the octagonal perimeter. The depressions rise from the apex of each triangular flat portion, to the center of the dome, are generally straight in configuration and are inclined more steeply on the average, than the ridges. The curvature of the ridges and facet surfaces, plus a lower profile, constitute the main differences from marker **30** in FIGS. **1** to **5**. Other features of construction and usage are the same as described in connection with marker **30**.

Another embodiment of the present invention is shown in FIGS. **10** to **14**, and comprises a marker **80** similar to the embodiment shown in FIGS. **1** to **5**, but with a modified vault shape and tab configuration. As shown in the drawings, the marker **80** has a vaulted portion or upper surface **82**, a base **84**, and is constructed of sheet metal, initially stamped to the shape shown in FIG. **11**, with base-forming tabs **86** and **86***a* extending outwardly, as indicated in phantom. Subsequent to stamping, the tabs are bent inward into the dotted line position, shown beneath the dome portion **82**. The marker **80** is especially adapted to provide an optional opening or aperture **87** to receive a reflector **88**, shown in more detail in FIGS. **15** to **20**.

The vaulted portion **82** has a continuous, solid, surface with a generally octagonal perimeter **89** about the base. The vault **82** is formed with four generally radiating ridges **90***a–d* separated by four radially extending and peripherally spaced depressions **92***a–d*. Two diametrically opposite ridges **90***a*, **90***c* are substantially wide, extending across two sides of the octagonal perimeter, with a substantially planar, pie-shaped top surface. The other two ridges **90***b*, **90***d* are substantially narrower, are also diametrically opposite each other, and extend essentially at 90° from the central diametric axes of the wider ridges. The narrower ridges are separated peripherally from the wider ridges by the depressions **92***a –d*. The two narrower ridges **90***b*, **90***c* originate at corners of the perimeter of the marker at base level and incline upward and inwardly of the marker, to the maximum height of the marker at locations MH (see FIG. **13**) a radial distance of less than half the total radial distance to the center C of the marker. They are substantially flat and parallel to the base along the major portion of their length, from the location of maximum height MH, inward. The wide ridges **90***a*, **90***c* each originate along a straight line **91***a*, **91***c* that extends across two sides of the octagonal base, at a position radially behind a flat portion **90'***a*, **90'***c* and each has an outwardly direct face **95***a*, **95***c* that slopes upwardly and inwardly at a steeper angle from the horizontal than does the face of each narrower ridge, as can be seen from a comparison of FIGS. **12** and **13**, and terminates in a transverse ridge at a location of maximum height MH' of the marker somewhat outward, radially from the equally high location MH of the narrower ridges.

The depressions **92** include flat triangular-shaped parts **92'***a–d* at the perimeter of the vault, in part forming the sides of the octagonal perimeter. The portions of the vault forming the depressions **92***a –d* then slope upward and inward from the apex of each triangular part **92'***a–d* to the center C of the vault at a more gradual angle than the ridge-forming slope of portions **90***a–d* and are somewhat longer in length. This provides a contour form the highest part of the ridges to the lowest part of the depressions that acts as a supplementary reflecting surface, which increases the total light receiving surface area and tends to gather or reflect light from any source and thereby supplements the brightness of the more directly prominent inclined portions **95***a*, **95***c* of the ridges.

In the inserted reflector version of this embodiment, one or two apertures **87***a*, **87***c* are formed by flaps **98***a*, **98***c* cut through the faces **95***a*, **95***c* along three sides, leaving an upper fold line **100**. Preferably, the apertures and flaps are rectangular in shape. Each flap, when folded inward, is inclined inwardly and downwardly to form a recess behind the respective face for the reflector **88**. The length of each flap **98** is great enough to extend below the plane of the base formed by the tabs **86**, **86***a* for reinforcing the top of the marker with solid support beneath the adhesive.

The base construction of the marker **80** is essentially the same as that in the other embodiments described above, except for a variation in the shape of the tabs **86***a*, which are cut away as shown in FIG. **11** to provide clearance for the reflector **88** and which, in the embodiment shown, allow the reflector to be pivoted at the opening bottom to snap it in place and retain it against the flaps **98**.

As in the other embodiments described, either a bright protective or a beaded light-reflective coating (not shown) is applied to the upper portion of the marker. A beaded reflective coating is functional only in the absence of an opening and inserted reflector.

As best shown in FIG. **19**, the reflector **88** is shaped with a base surface **104** that lies in the bottom plane of the marker, a back surface **106** that abuts the respec-

tive flap **98**, and a front face **108** inclined just slightly more from the vertical than the respective face **95** so that an upper edge **109** of the front face is slightly recessed from the face **95** and the fold line **100** of the flap **98** for protection. A lower front edge **110** of the reflector face abuts the lower edge of the respective aperture so that movement of the reflector is restricted.

A preferred construction of the reflector **88** is shown in detail in FIGS. **15** to **18** and **20.** The preferred construction provides efficient reflectance, maximum reflective area, high strength and has a face oriented in use at an angle that tends to enhance self-cleaning. The reflector **88** is of two-piece construction, preferably molded of thermoplastic components. The reflector is comprised of a reflector lens element **112** and a support base **114** that are peripherally joined. A back flat surface **116** of a peripheral portion **117** of the lens element abut a peripheral front portion **119** of the support base. The two parts are joined by ultrasonic bonding or with other bonding means.

The reflector lens element **112** has an inside surface **120** formed in a multiple cube-corner light-reflecting pattern arranged for highest light return perpendicular to a plane common to cube points **121** of the pattern, i.e., perpendicular to an imaginary plane P illustrated in FIG. **20,** in which the cube points are located, and parallel to the central axis A of each cube corner **121.** The plane P is inclined from the vertical in an inward and upward direction relative to the base surface **104** of the reflector, when the reflector is oriented in the manner illustrated in FIG. **19.** The flat outside front face or obverse surface **108** of the reflector lens element is inclined in an upward and rearward direction relative to the vertical and to the plane P of the cube-corner pattern, resulting in a generally wedge-shaped configuration of the lens element. The increased thickness of the lens element adjacent the base, due to the angular relationship between the plane P and the front surface **122,** provides high strength for resistance against impact during use. The angle of the surface **108** is approximately the same as that of the marker face **95,** inclined a little farther from the vertical so that the upper edge is recessed somewhat beneath the upper fold line **100** of the flap **98,** for protection. This angle promotes self-cleaning through run-off of rain water and the wiping effect of tire contact.

The plane P of the cube corners is oriented at an angle relative to the face **108** so that incident light at a low angle to the face is refracted parallel to the axis A of the cube corners. This eliminates the need for a specialized corner pattern for maximum reflectance, as would be required if the refracted angle of the incident light were not perpendicular to the plane P.

With the above arrangement, light from headlights incident upon the obverse face **108** of the reflector lens element **112** at a typical declination of 1 and ½° is refracted downward by the lens material to a direction parallel to the cube corner axes A and is reflected so as to return toward the surface **108** parallel to the entry path, i.e., along a path perpendicular to the plane P so as to exit the reflector parallel to the incident rays. By way of a particular example, a cube corner pattern plane P may be inclined 21° from the vertical, with an outer lens face **108** inclined at 50° from the vertical, where the lens material has a refractive index of 1.54. An incident light ray IR, as shown diagrammatically in FIG. **20,** at a declination from the horizontal of 1½° enters the lens at an angle of incidence of 48-½° relative to the plane of the face and is refracted downward an added 19-½° by the lens material, to a path parallel to the cube corner axis A. Because cube corner reflectors tend to minimize drop off loss, light rays deviating from the typical declination will nevertheless be efficiently reflected and a slight variation in the refractive index of the material can be tolerated. A suitable material for forming the reflector lens element is polycarbonate, which is rigid and of high transparency and is either clear white or can be tinted. Other materials, such as acrylics may also be used.

Side shoulders **125, 126** and a bottom shoulder **127,** which form a major part of the peripheral portion **117** of the reflector element **112** as provided for retaining the reflector within the marker. The shoulders are along side the obverse light receiving surface **108.** The size of the surface **108** fills the aperture **97** in the face **95** of the marker and the shoulders extend behind the face, adjacent to and beyond the sides and bottom of the aperture. As shown in FIG. **18,** the cube-corner pattern extends into the border area or should portions **125, 126, 127** of the reflector along opposite sides and along the bottom. Thus, the shoulders of the peripheral portion **117,** along which the lens element and support base are joined and which retain the reflector within the marker, do not reduce the reflective area visible within the confines of the aperture **97** of the marker. That is, the effective reflective area of the reflector is essentially equal to the entire exposed surface **108,** except for the small upper edge **109** above the cube-corner pattern.

The support base **114** comprises the majority of the base surface **104** of the reflector and also comprises the back surface **106,** both of which orient the reflector in proper position within the marker. The base portion includes a front surface **130** of which the peripheral portion **119** forms a marginal part. The front surface **130** of the base portion is inclined along a flat, lower, major portion **130*a*** thereof at an angle from the verticle that is greater than the angle of the plane P of the cube corners. A small flat portion **130*b*** of the front surface adjacent the top of the base is substantially more vertical and terminates short of the full width of the portion **130*b*** on opposite sides. This difference in angle between the surface **130*b*** and the plane P, coupled with the fact that the cube corner plane is recessed with respect to the peripheral portion **117** of the lens element results in an air space S between the cube corners and the support base. This eliminates the need to metalize the surface **120,** which would otherwise be necessary in the event of contact, as if the lens element were reinforced with a filler or the like. An air space is preferred, insofar as the reflective properties of the lens element are concerned, as compared to metalizing. It is possible to avoid filling the space S behind the lens element because of the relatively high strength provided by the thickness of the lens element **112,** which in turn is made possibly by locating the cube corner reflector part of the lens element substantially behind the obverse surface **108.**

The portion **130*b*** of the support base **114** is received within the upper peripheral portion **117** of the reflector lens element to form a lap joint, as shown in FIG. **20,** which serves to align the parts during assembly. The overall shape of the assembled parts **112, 114** is accommodated by the marker, as shown in FIG. **19,** and the

reflector is located by the flap **98** and base tabs **86***a*. The upper edge **109** of the assembled reflector is protected by the upper surface of the marker along the face in which the reflector is located, especially in view of the somewhat greater inclination from the vertical of the face surface **108** than the face **95**, which recesses the upper surface and thinnest portion of the lens element.

In use, incident light rays, indicated diagrammatically by the arrow IR in FIG. **20**, directed slightly downward toward the roadway, are refracted from their angle of incidence to a path parallel to the axes A of the cube corners, by the refractive properties of the lens element material. They are reflected by the surfaces of the cube corners **120**, are returned from the cube corners parallel to the axes A, and are refracted as they exit the lens element, in a direction parallel to the incident rays, as indicated by the arrow RR in FIG. **20**.

Although the cube corner reflector design is preferred for its efficient reflective properties, other advantageous features provided by the general arrangement of the reflector, such as the prism-like lens having greater thickness adjacent the lower end, recessed with respect to the face of the marker along the upper edge end, and with a reflective surface spaced substantially behind the obverse or outside surface of the reflector and of maximum width provided by shoulders located behind the aperture in the marker face, can be obtained with reflective surfaces of different construction with some modification in the structure. For example, a cavity can be provided within the reflector to receive a light-reflective element separate from the lens or prism-like face. Such an element may advantageously include glass microspheres on a reflective face.

While preferred embodiments and certain modifications thereof have been described in detail, it will be apparent to those skilled in the art that other modifications and alterations may be made therein without departing from the spirit and scope of the invention set forth in the appended claims.

What is claimed is:

1. A marker for use on roads to mark traffic lanes or the like, comprising a metal structure with an upper surface and a partial base beneath the upper surface, said partial base being comprised of tabs integral with the upper surface, extending inwardly from the periphery thereof, and spaced from each other along at least a substantial portion of their inward extent, and said upper surface having portions of different height.

2. A marker as set forth in claim **1** wherein said upper surface has ridges and depressions that extend in generally radial directions to form at least some of said portions of different height.

3. A marker as set forth in claim **2** including a ridge in said upper surface extending transversely of a radial ridge.

4. A marker as set forth in claim **2** wherein the periphery of said upper surface at the base thereof has a plurality of straight sides and said tabs extend inward from and in part form said sides.

5. A steel marker adapted to be adhered to a roadway, comprising a vault form and a flat base beneath the vault, said vault being comprised of a continuous surface that includes flat first portions spaced along and adjacent to the periphery of the vault, second portions that are centrally behind said first portions along a path through the center of said vault and rise to the maximum height of the vault, and third portions that rise from adjacent said periphery to the maximum height of the vault more steeply than said second portions and which are relatively flat adjacent a central portion of the vault, and said base being contiguous with the periphery of said vault, extending inwardly thereof, and only partially occupying the area beneath the vault.

6. A marker as set forth in claim **5** wherein said base includes vertical edges having a total length that is greater than the length of the periphery of said vault.

7. A marker as set forth in claim **5** in which said base is comprised of tabs that directly underlie and contact said flat first portions of said vault.

8. A marker as set forth in claim **5** wherein said third portions include a flat face inclined upwardly in a direction toward the center with an opening substantially the full height thereof formed by a flap in the vault that is bent inward about an upper horizontal line and that extends in a downward direction therefrom, said opening being adapted to receive a light reflector.

9. A marker as set forth in claim **8** wherein said flap terminates at a location below said flat base.

10. A marker as set forth in claim **8** including a light reflector insert located in said opening, said insert having a front face that essentially fills the opening and that is slightly recessed adjacent the top of the opening, relative to the plane of the face in which the opening is formed.

11. A marker as set forth in claim **10** wherein said light reflector insert has a reflective surface comprised of adjacent cube corners.

12. A steel marker adapted to be adhered to a roadway, comprising a vault form and a flat base beneath the vault, said vault being comprised of a continuous surface the perimeter of which is in the shape of a polygon, flat surface portions adjacent each side forming the perimeter, ridges extending generally radially from a central portion of the vault to adjacent the perimeter diminishing in height along at least a portion of their length considered in a direction toward the perimeter, depressions between said ridges sloping downwardly and outwardly from the central portion of the vault and terminating at said flat surface portions inwardly of the perimeter, and base-forming tabs contiguous with sides of the perimeter extending inwardly of the perimeter beneath and substantially parallel to said flat surface portions, each spaced from the next adjacent tab.

13. A marker as set forth in claim **12** wherein said ridges have the greatest slope adjacent the perimeter of the marker.

14. A marker as set forth in claim **13** wherein said perimeter is substantially in the shape of an octagon.

15. A marker set forth in claim **12** wherein the tabs underlie at least one fourth of the area covered by the marker but less than all of the area.

16. A marker as set forth in claim **12** including an opening in said vault and a light reflector insert in said opening, said insert essentially filling the opening and having a reflective surface comprised of adjacent cube corners.

17. A steel marker adapted to be adhered to a roadway, comprising a vault form and a flat base beneath the vault, said vault being comprised of a continuous surface the perimeter of which is in the shape of a polygon, flat surface portions adjacent each side forming the perimeter, ridges extending generally radially from

a central portion of the vault to adjacent the perimeter diminishing in height along at least a portion of their length considered in a direction toward the perimeter, depressions between said ridges sloping downwardly and outwardly from the central portion of the vault and terminating at said flat surface portions inwardly of the perimeter, and a means forming a base for securing the marker to a roadway.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,762,825 Dated October 2, 1973

Inventor(s) H. E. Reusser

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 11, line 42, Claim 1 should read:

--1. A marker for use on roads to mark traffic lanes or the like, comprising a metal structure with an upper surface and a partial base beneath the upper surface, said partial base being comprised of tabs integral with the upper surface, extending inwardly from the periphery thereof to provide a relatively flat peripheral base, said tabs spaced from each other along at least a substantial portion of their inward extent to provide vertical stabilizing surfaces extending generally radially and peripherally beneath the upper surface, and said upper surface having portions of different height.--

Signed and sealed this 15th day of January 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

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