March 10, 1970 N. JONNES ETAL 3,499,371

MARKERS

Filed Dec. 8, 1966

FIG. 1

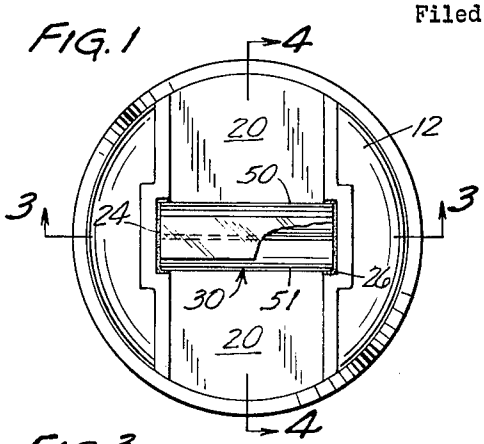


FIG. 2

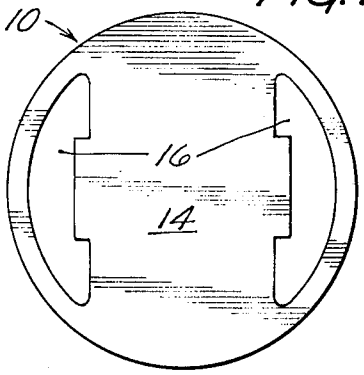


FIG. 3

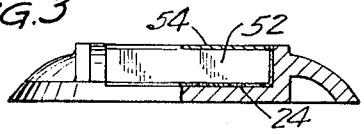


FIG. 4

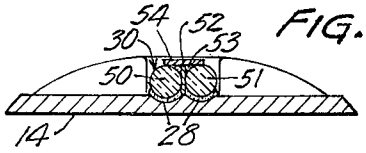


FIG. 5

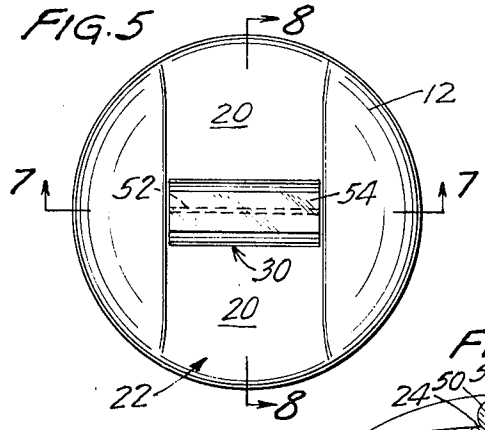


FIG. 6

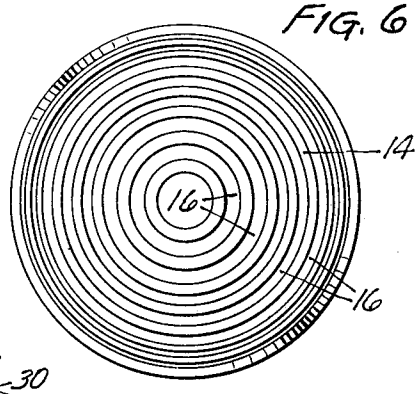


FIG. 8

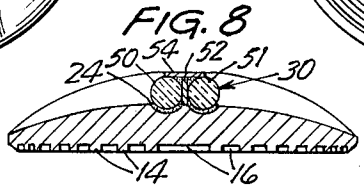


FIG. 7

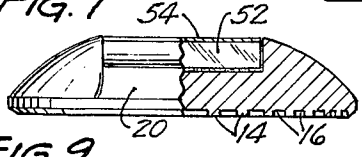


FIG. 11

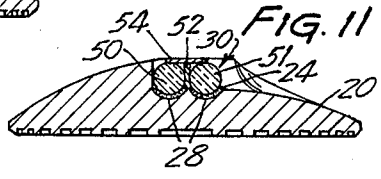


FIG. 9

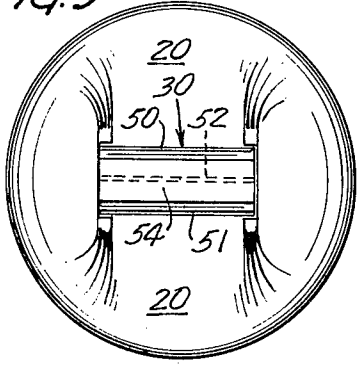


FIG. 10

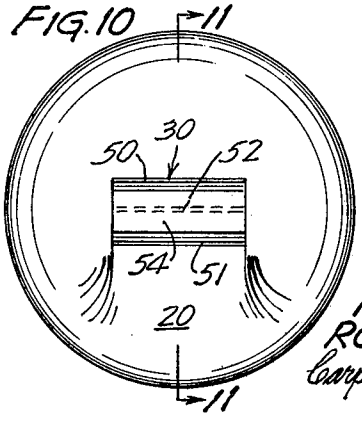
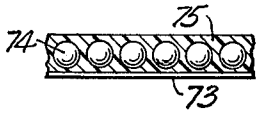


FIG. 12



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MARKERS

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U.S. Cl. 94—1.5 8 Claims

ABSTRACT OF THE DISCLOSURE

Reflective and reflex-reflective traffic markers especially adapted for use on pavement surfaces to delineate traffic lanes, center lines and the like are disclosed, the markers comprising a base member for attachment to a pavement and having a channel formed in its upper surface for receiving a horizontally reflex-reflecting marker.

The present invention relates to new and useful reflective and reflex-reflective traffic markers especially adapted for use on pavement surfaces to delineate traffic lanes, center lines and the like.

Delineation of pavement surfaces to mark traffic lanes, center lines, etc. has long been accomplished by the use of reflex-reflecting material, usually small glass beads of about 1.5 refractive index, partially embedded in a light-reflecting pigmented paint-like film. Such traffic markings have performed quite well in clear weather. However, when such markings are covered with a film of water during inclement weather, their reflex-reflecting ability is seriously impaired. Continued vehicular abrasion of the glass beads tends to flatten their upper surfaces, thus tending to impair their reflex-reflecting ability even under dry conditions.

Prior workers have attempted to overcome the aforenoted difficulties encountered with the beads-on-paint structures. One such attempt is illustrated in United States Patent No. 3,240,132, which is directed to a three-dimensional traffic marker having two zones, one for daytime reflection and the other utilizing glass beads for nighttime reflex-reflection of incident light. A problem encountered in combination structures has been that of providing sufficient nighttime reflex-reflective qualities while retaining sufficient diffuse daytime reflection since glass beads to be effective must occupy a major portion of the marker surface, thereby "graying-out" the diffuse daytime reflectivity of the marker.

The present invention provides simply configured traffic markers which exhibit a higher intensity reflex-reflection of light under dry conditions on pavement surfaces than the beads-on-paint constructions heretofore used as well as a brilliant high intensity reflex-reflection of light under wet conditions. In addition, the markers are visible as attractively colored objects during daylight to provide daytime traffic delineation.

The present invention utilizes refractive high index transparent glass beads for pavement marking purposes, while at the same time protecting such beads from the abrasive action of traffic passing thereover. Although high index beads have been known for some time, they have been sparingly used in traffic marking applications since they are significantly less wear resistant to traffic than the lower index beads. Traffic markings of the beads-on-paint type and even of the type disclosed in U.S. Patent No. 3,240,122 have, therefore, utilized relatively low refractive index glass beads, typically on the order of 1.5.

The invention will be described by reference to a drawing, made a part hereof, in which:

FIGURE 1 is a top plan view, partly broken away, of a marker of the present invention;

FIGURE 2 is a bottom plan view of the marker of FIGURE 1;

FIGURE 3 is a sectional view taken along line 3—3 of FIGURE 1 showing the relationship of the various elements of the marker;

FIGURE 4 is a sectional view taken along line 4—4 of FIGURE 1;

FIGURE 5 is a top plan view of another embodiment of a marker according to the present invention;

FIGURE 6 is an alternative bottom plan view of a marker according to the present invention;

FIGURES 7 and 8 are sectional views of the marker of FIGURE 5 taken along the lines 7—7 and 8—8, respectively;

FIGURE 9 is a top plan view of a still further embodiment of a marker according to the present invention;

FIGURE 10 is a top plan view of a one-way marker according to the present invention;

FIGURE 11 is a sectional view of the marker of FIGURE 10 taken along the line 11—11; and

FIGURE 12 is a schematic sectional view of beaded reflex-reflecting materials useful in forming part of the marker hereof.

Referring now to the drawing, it will be seen that the traffic marker **10** of the present invention comprises a base member **12** having a substantially planar bottom **14** and a substantially flat horizontally reflex-reflecting marker **30** fitted into a recess **24** in said base member **12**.

Base member **12** is typically a segment of a sphere and measures approximately 3–5 inches in diameter at its base and is about ½ to ¾ inch high and may be formed of any suitable material such as malleable iron, high strength plastics or fired clay. The base member **12** may take other forms and thus can be square, rectangular or elliptical; when the base is square or rectangular, the corners are usually taken down to a radius. It is, of course, understood that the base members would be suitably painted or colored. The malleable iron base members are typically painted with an epoxy-based paint; the plastic members would be pigmented during fabrication and the ceramic or clay members would contain additives or ceramic material as the pigment or a pigmented fired ceramic glaze coat. The markers will ordinarily be colored white or yellow (standard traffic marking colors) or may be variously colored to serve special purposes, such as for marking exit or entrance ramps on high-speed highways.

The bottom **14** of base member **12** is substantially planar and may be provided with surface irregularities which may take the form of surface concavities **16** which aid in adhering the marker to the pavement surface. The concavities **16** may be in the form of cavities of various shapes formed in the base during fabrication as shown in FIGURE 2, or may conveniently be in the form of concentric depressions as shown in FIGURE 6. Texturing may be used to produce such surface irregularities.

As previously noted, the top surface **18** of base member **12** is dome shaped and smoothly arcuately convex. A central groove or channel **20** is formed in the top surface **18** and depending on the use to which the marker **10** is to be used, i.e., as a lane delineator where traffic flow is in one direction or as a center line delineator, the groove or channel **20** will partially or completely bisect the top surface **18**. Groove or channel **20** is configured so that the bottom surface thereof generally forms a ramp **22**. The central portion of said ramp **22** is suitably provided with a recess **24** adapted to receive a substantially flat horizontally reflex-reflecting marker **30**; although a recess, as such, is not necessary. The bottom of said recess **24** may

also be provided with a pair of concave depressions **28** conforming to the bottom surface of reflex-reflecting marker **30**.

In the embodiment illustrated in FIGURES 1 and 9, the central portion **26** of groove or channel **20** is wider than the remainder of groove or channel **20**. Such a widened central portion **26** will serve as additional protection to reflux-reflecting marker **30** against vehicular abrasion in use.

Reflex-reflecting markers **30** comprise preferably a mass in the nature of a rod **50**, plus an optional mass or rod **51** aligned with the first rod **50** (at least one and preferably both rods being transparent) and at least one and preferably two layers or strips **52** of reflex-reflecting material inserted between the rods with the reflex-reflecting faces of each layer **52** directed respectively toward the rod with which it is in closest proximity. Rods **50** and **51** are spaced from each other a distance at least sufficient to allow reflex-reflecting layer **52** to be inserted therebetween.

Strips **52** are bonded together and are firmly bonded (and essentially encapsulated or embedded in resin) in position between rods **50** and **51**, thereby to provide a resulting marker in which the reflex-reflecting material is protected against traffic wear by solid rod-like masses associated integrally therewith. Of course, the binder material **53** located between the reflex-reflecting face of at least one strip **52** and a transparent rod in front of the same must be transparent. In usual practice the binder between the face of the strips **52** and transparent rods in front thereof is transparent in order to achieve reflex-reflective performance for both lateral faces of the reflex-reflecting marker **30**.

While not absolutely essential, it is preferred to provide a build-up of cured resinous material, or wear-cap **54** over the area of juncture containing the reflex-reflective material between the rods **50** and **51**. Such caps further shield embedded reflex-reflective material within the marker from traffic wear and reinforce the rod members against breakage when the composite marker is positioned with its bottom in recess **24**. Reflex-reflecting marker **30** may be modified to consist of only one of the rod elements and associated structure for use as a one-way lane delineator as in FIGURE 10.

Suitable layers or strips **52** of reflex-reflecting material for use in forming marker **30** of the invention are shown in Palmquist et al. U.S. Patent No. 2,407,680 granted Sept. 17, 1946, the disclosure of which is here incorporated by reference. Briefly, these reflex-reflecting materials include a back reflector **73**, a compact monolayer of transparent beads or spheroids **74**, and a binder layer **75** to hold the beads in position in front of the reflector **73**. The binder layer **75** in these structures has a flat front face; and this necessitates a special relationship between the refractive index of the spheroids **74** and the material of layer **75** interposed in front of the spheroids **74**. The relationship is such that the refractive index of the spheroids **74** is at least 1.15 times that of the refractive index of the transparent covering **75** in order to gain the desired intensity of light reflex-reflection. Preferably the relationship is such that the index of the spheroids **74** is at least about 1.3 times that of the transparent covering **75**. Additionally, improvements in reflex-reflective brilliancy are gained in structures of this type by spacing the transparent spheroids **74** slightly from the reflective layer **73**, as taught in the aforenoted Palmquist et al. patent. This spacing is gradually reduced to zero as the refractive index of the spheroids approaches a figure of about 1.9 times that of the refractive index of the transparent covering. Since the refractive index of most transparent binders useful in forming structures of this type is at least about 1.3 up to about 1.5 or slightly higher, the refractive index for spheroids for these structures is generally required to be above about 1.8 or 1.9, and preferably above about 2.1, so as to maintain the proper relative relationship between the spheriod and binder refractive indices and reduce the spacing required for brilliant reflex-reflection of light.

Although reflex-reflecting beaded sheet material of the flat front face type as aforenoted is preferred for use in forming structures according to the invention, and allows for thorough embedding of the reflex-reflecting strips within the body of the markers **30**, it is also possible to use reflex-reflecting sheet material of the lenticular type in preparing structures satisfying fundamental requirements of the invention. Useful lenticular structures are taught in detail in Gebhard et al. U.S. Patent No. 2,326,634 granted Aug. 10, 1943, the disclosure of which is here also incorporated by reference.

The height of reflex-reflecting marker **30** should preferably not be greater than about 10 or 20 millimeters (between the base surface and the upper or top surface). Area dimensions perpendicular to the height dimension should be at least about 1.2 times greater than the height dimension, and preferably at least about 2 times greater than that dimension. As a practical matter, one area dimension perpendicular to the height dimension should be no greater than 80 times the height dimension; longer markers are susceptible too readily to breakage as traffic passes thereover. Also, from a practical standpoint in regard to conservation of material, the area dimension transverse to the aforementioned area dimension preferably is not greater than about 4 or possibly 6 times the height dimension of the marker.

Reflex-reflective strip **52** has transparent glass microspheres of about 15 to 100 microns in diameter in a compact monolayer transparently spaced by resin in the amount of about 10 or 15 microns from a back reflector of aluminum and held in a resin binder layer of about 1.5 refractive index having a flat front surface. The microspheres in the structure have a refractive index of about 2.26, or about 1.5 times the refractive index of the transparent covering binder.

This beaded reflex-reflective sheet material is suitably coated with about a 6 mil thick coating of a viscous liquid resinous mixture consisting of approximately equal parts of an epoxy resin ("Epon 828") and a polyamide resin ("Versamid 125"). "Epon 828" is a liquid epoxy resin, which melts at 8–12° C., and has a Gardner-Holt viscosity at 25° C. of Z5 to Z6, and an epoxide equivalent of about 190 to 210. In other words, about 190 to 210 grams of this resin contain one gram equivalent of epoxide, i.e., oxirane oxygen. The polyamide resin reacts with the epoxy resin to produce hardening of the composition. "Versamid 125," is stated by its manufacturer, General Mills, Inc., to have an average molecular weight of 2,000, an acid number of 7, and a Brookfield viscosity of about 45,000 to 55,000 centipoises at 23° C.

Useful small horizontally reflex-reflecting markers of substantial flatness are taught in detail in Vanstrum United States Patent No. 3,292,507, issued Dec. 20, 1966, the disclosure of which is hereby incorporated by reference.

In the embodiment illustrated in FIGURES 1–4, base member **11** was fabricated of malleable iron and had a diameter of approximately 4 inches with a height of approximately ⅝ inch. A groove or channel **20** about 7/16 inch deep at its maximum depth (i.e., its central point) and about 1.75 inches wide was provided. A central recess **24** measuring about ⅞ inch by about 2 inches with a pair of grooves **28** was also provided to receive a reflex-reflecting marker **30**. The bottom **14** of base **12** was provided with surface concavities **16** to assist in adhering the marker **10** to a pavement surface. The concavities **16** were generally crescent-shaped and were approximately ⅛ inch deep at their deepest points.

Base **12** was painted with an epoxy-based paint formulated from a liquid epoxy resin (ERL–2774), TiO_2 pigment (TiPure R610) and a polyamide resin (Versamid 125) in a ratio of 2:1:2. ERL–2774 is a liquid condensa-

tion polymer of epichlorhydrin and Bisphenol A having an epoxide equivalent of 185–200, an average molecular weight of 350–400 and a viscosity at 25° C. in the range of 10,500–19,500 cps.

Reflex-reflecting marker **30** was then cemented in place in recess **24** using a conventional two-part epoxy resin composition.

Traffic markers **10** were cemented in place in pavement surfaces to test their reflection qualities. The markers were set into the pavement surface about ⅛ to ¼ inch deep in recesses drilled into the pavement with an epoxy resin adhesive composition formulated from an epoxy resin (EC–1614B) and a polyamide resin (Versamid 125) in a 1:1 ratio. EC–1614B is a modified bisphenol A based epoxy resin having an epoxide equivalent of about 160 and a viscosity at 75° F. of about 600,000 cps. as measured on a Brookfield viscosimeter with a No. 7 spindle at 4 r.p.m. Reflection, both diffuse (daytime) and reflex-reflecting (nighttime) was excellent.

Markers as illustrated in FIGURES 5–8 were fabricated from an epoxy resin composition comprising epoxy resin (EC–1614B) and polyamide resin (Versamid 125) in a 1:1 ratio to which was added 50 p.h.r. TiO_2 pigment (TiPure R610). A groove or channel **20** about one inch wide was formed through the center of top **18** of base member **12**. Reflex-reflecting marker **30** measuring about one inch by 3/16 inch high was cemented in the center of groove **20** with an epoxy resin adhesive. These markers **30** were then installed into pavement surfaces following the earlier described procedure and gave excellent daytime and nighttime reflection.

The marker illustrated in FIGURE 9 is generally similar to the marker of FIGURE 1. However, groove or channel **20** does not extend diametrically through the top **18** of base member **12** but rather only occupies the central portion thereof and is, in effect, formed by building up the edges defining recess **24** on a disc.

The marker of FIGURES 10 and 11 is designed to be used as a one-way delineator. As clearly shown in the drawings, the central groove or channel **20** extends only past the midline of base **12** by an amount sufficient to accommodate one-half of reflex-reflecting marker **30**. In this manner, marker **30** will only perform its reflex-reflecting function when the headlights of a vehicle strike it through the exposed rod **50**. It will be readily seen that reflex-reflecting marker **30** may consist of only one rod element **50** and its associated structural elements; in this event, groove or channel **20** would, of course, only extend to the midline of base member **12**.

While reflex-reflecting marker **30** has been described herein as comprising a mass in the nature of a rod **50** plus an optional mass or rod **51** aligned therewith and at least one and preferably two layers or strips **52** of reflex-reflecting material interposed therebetween, it is contemplated that other reflex-reflecting devices such as cube-corner reflectors reflex-reflecting sheet material preferably protected by a build-up of resinous material and large reflex-reflecting spheres may be substituted therefor.

The traffic markers of the present invention, because of their raised three-dimensional shape, perform an audible delineation function in addition to their diffuse and reflex-reflecting functions by alerting the driver when a car wheel is beginning to cross into another lane of traffic by readily noticeable rumbles or bumps as the car wheel travels thereover.

What is claimed is:

1. A traffic marking structure comprising in combination

a tough wear-resistant base member having a substantially planar bottom surface provided with surface irregularities for adhesive attachment to a pavement,

the top surface thereof being smoothly convex and having a channel formed therein,

the central portion of said channel having a transverse recess, and

a small horizontally reflex-reflecting marker of substantial flatness affixed within said recess in said channel,

said reflex-reflecting marker comprising a layer of re-reflex-reflecting elements vertically oriented and a protective transparent facing member over the layer of reflex-reflecting elements.

2. A traffic marking structure according to claim **1** wherein the base member is a segment of a sphere having a diameter of about 3 to 5 inches at its base and a height of about one-half inch to about one inch.

3. A traffic marking structure according to claim **2** wherein said base member is formed of malleable iron.

4. A traffic marking structure according to claim **2** wherein said base member is formed of a high strength plastic.

5. A traffic marking structure according to claim **2** wherein said base member is formed of fired clay.

6. A traffic marking structure according to claim **1** wherein the channel in the top surface of the base member completely bisects said top surface.

7. A traffic marking structure according to claim **1** wherein the channel in the top surface of the base member extends from the outer edge of said base member to its approximate midline.

8. A traffic marking structure comprising in combination

a tough wear-resistant base member in the form of a segment of a sphere having a diameter of about 3 to 5 inches at its base and a height of about one-half inch to about 1 inch having a substantially planar bottom surface provided with surface concavities for adhesive attachment to a pavement,

the top surface thereof being smoothly convex and having a channel formed therein,

the central portion of said channel having at least one transverse concave depression therein, and

a small horizontally reflex-reflecting marker of substantial flatness,

said reflex-reflecting marker having an essentially flat base surface with area dimensions perpendicular to the height dimension being at least 1.2 times greater than said height dimension and no greater than 80 times said height dimension,

said reflex-reflecting marker comprising at least one layer of a reflex-reflecting monolayer of glass beads having a refractive index of at least 1.7 and underlying specular reflective means oriented essentially perpendicular to the flat base surface thereof, and

at least one solid scratch-resistant transparent rod-like mass oriented in front of said layer of reflex-reflecting material within the dimensional limits aforedefined and firmly fixed by transparent cured resinous bonding material in front of said reflex-reflecting material,

said reflex-reflecting marker being affixed within said channel with the bottom portion of said at least one solid scratch-resistant transparent rod-like mass fitting within said at least one transverse concave depression.

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JACOB L. NACKENOFF, Primary Examiner