Oct. 11, 1966 G. A. WISWELL 3,277,800

TRAFFIC MARKER

Original Filed Sept. 1, 1961 4 Sheets-Sheet 1

Fig. 1.

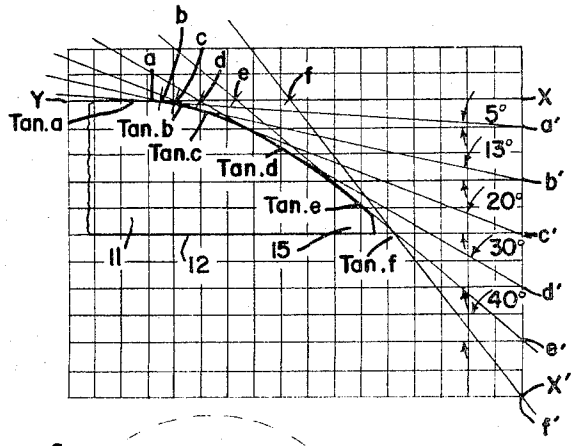
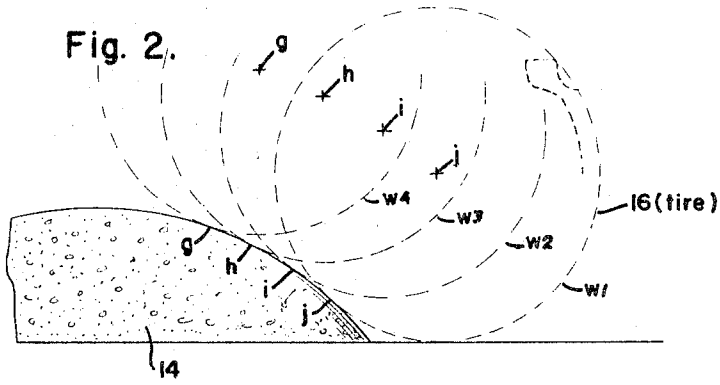


Fig. 2.



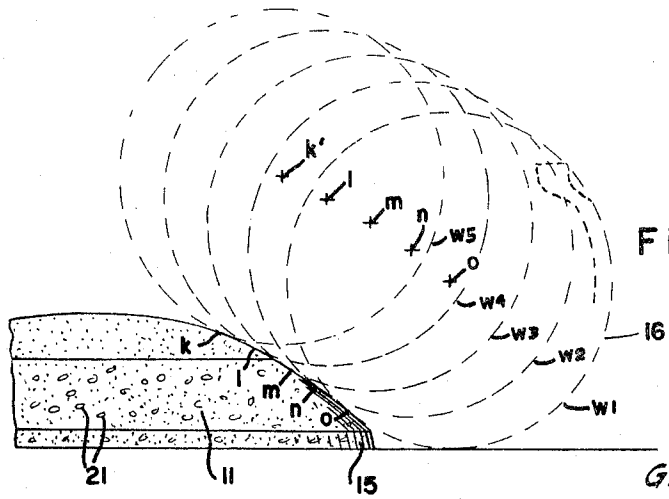


Fig. 3.

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TRAFFIC MARKER

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Fig. 4.

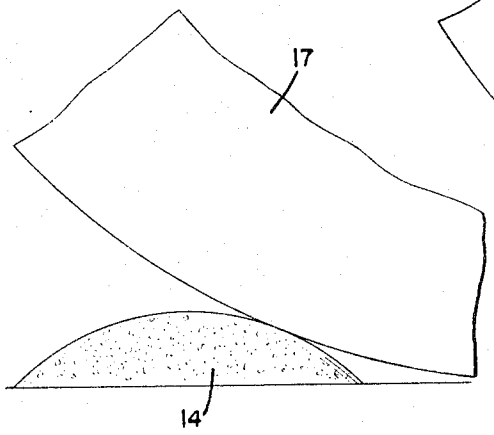


Fig. 5.

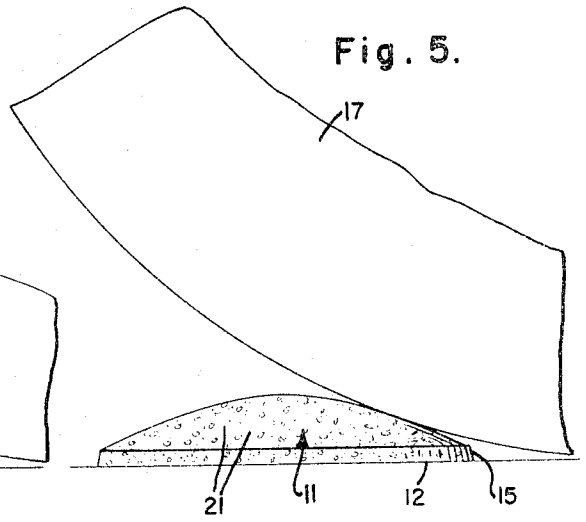


Fig. 8.

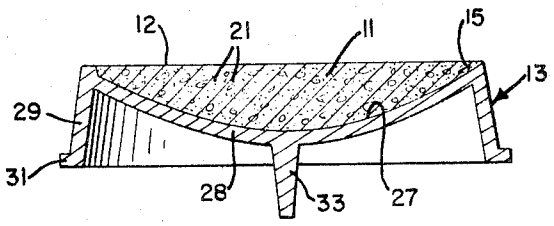
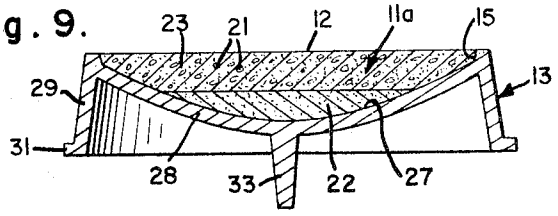


Fig. 9.



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Fig. 6.

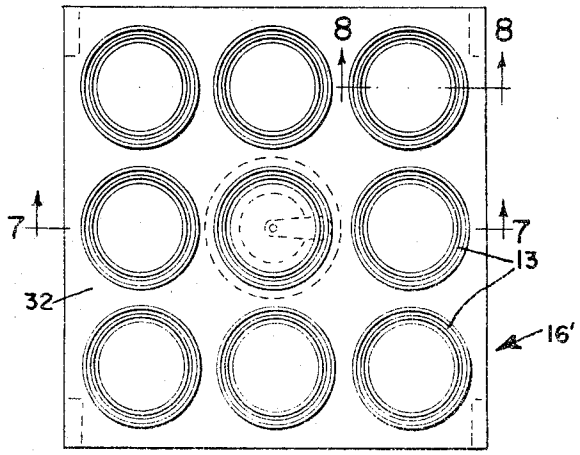


Fig. 7.

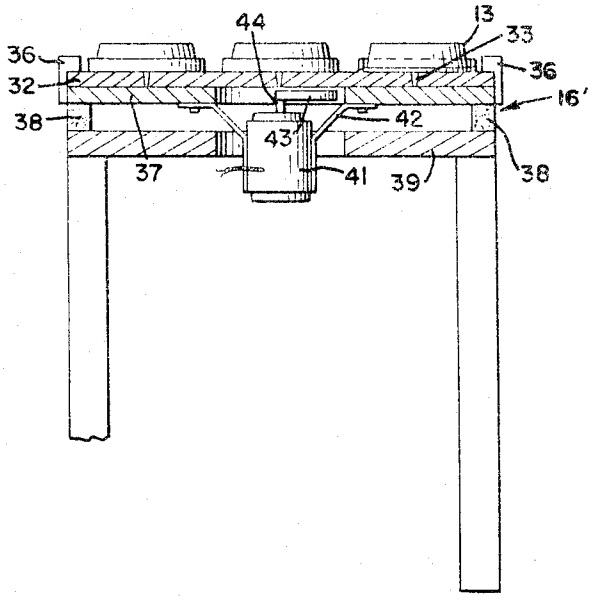
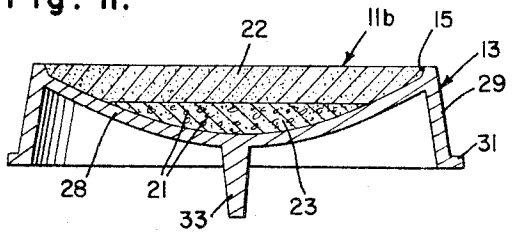


Fig. 11.



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TRAFFIC MARKER

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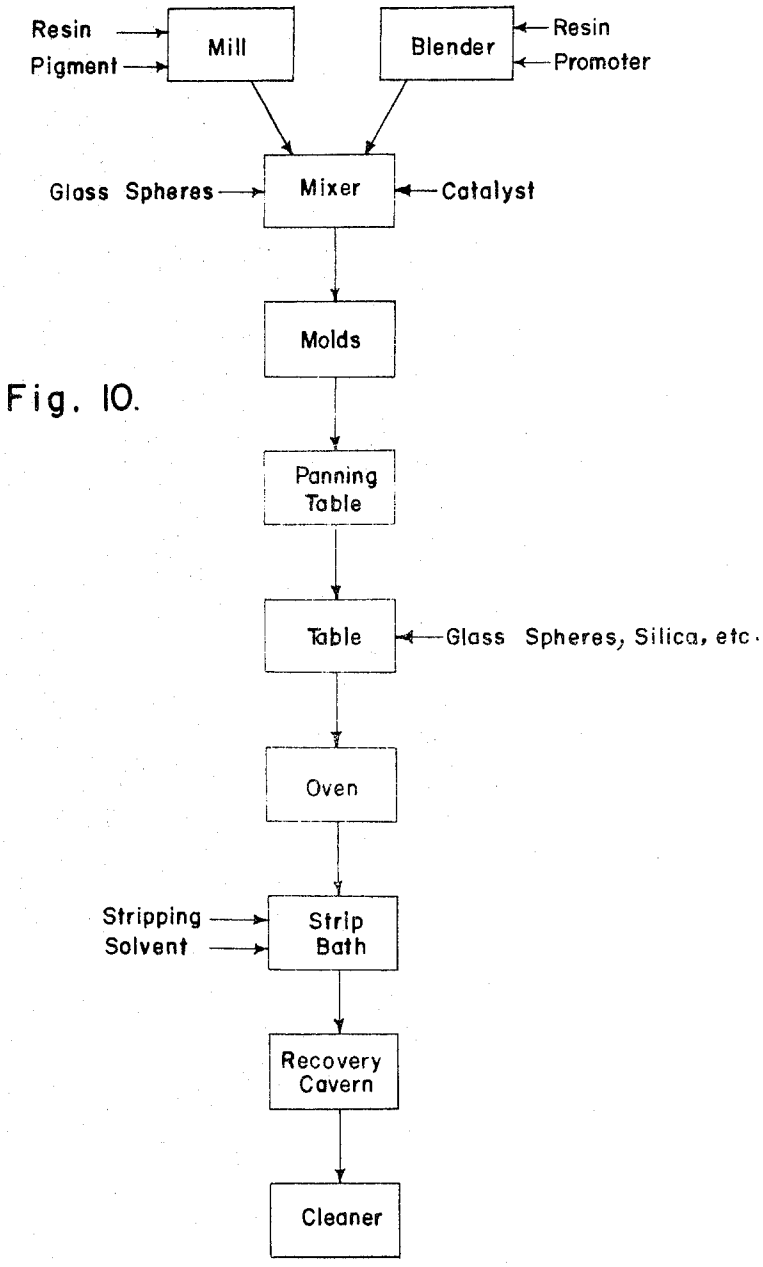


Fig. 10.

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United States Patent Office 3,277,800 Patented Oct. 11, 1966

3,277,800

TRAFFIC MARKER

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Original application Sept. 1, 1961, Ser. No. 135,668, now Patent No. 3,225,123, dated Dec. 21, 1965. Divided and this application Jan. 12, 1965, Ser. No. 424,926
2 Claims. (Cl. 94—1.5)

This invention relates to a new and improved marker to delineate traffic lanes and the like, and to a method of producing the same. This application is a division of co-pending application, Serial No. 135,668, filed September 1, 1961, now patent No. 3,225,123.

One of the features and advantages of the marker is the fact that it provides a highly visible, tough plastic device which may be affixed to the pavement by a suitable adhesive. Preferably, a plurality of such markers is affixed in a pattern, such as an interruped line, to mark traffic lanes or the like. For such purpose, the device hereinafter described in detail has numerous advantages, among which are the following:

(a) Provides optimum visibility under all lighting conditions, whether daylight, artificial light from fixed sources adjacent to roadways or from moving sources such as car headlight, such visibility being effective day and night and regardless of weather;

(b) Is sturdy enough to withstand the severe service of heavy automobile and truck traffic for many years;

(c) Can be produced at low cost and installed at low cost;

(d) Notifies car drivers, by rumbles or bumps, that a car wheel is beginning to cross into another or the wrong lane, or right of way;

(e) Does not present an obstruction or skid-promoting shape on the road.

Road markers have been installed on streets and highways which give fair to good reflectivity at night, but which are relatively unnoticeable in the daytime. Others show up well in good daylight, but do not do so in bad weather or at night. Furthermore, some markers will do a fair job of delineating at night when lighted by headlights, but a poor job when the same markers are installed where there is overhead street or freeway lighting. Since lighted intersections and freeway interchanges, involving numerous lanes of fast-moving traffic, must have the best possible delineation of lanes, gores, islands, bend-outs, etc., a good day or night, fair weather or foul weather type of marker is badly needed. This is provided by the present invention.

To understaind the advantages provided by the invention, some facts concerning reflectivity of road and street marking and their effectiveness in providing good visibility to drivers should be kept in mind. Although fundamental, and in some respects quite elementary, some characteristics of traffic marking and visual apprehension thereto are as follows:

(1) For utmost safety to drivers, the delineation of lane separation, obstructions, bend-outs or curves should be visible to the driver so far in advance of the position of the vehicle as to permit him to alter the vehicle's speed or direction, without abrupt change, so that he may change lanes or safely maneuver without conflict with other vehicles.

(2) In dry, daytime driving, a well-painted traffic stripe is usually adequate for delineation and channelizing; however, even good paint does not deter so-called "lane line riders" from unintentionally crowding in upon cars in adjoining lanes.

(3) When roadways become rain swept, traffic paint

tends to disappear completely as a film of water forms, and all delineation is lost; furthermore, some types of paint actually become hazardous by providing a smooth base upon which water, plus oil particles and dirt, become a lubricant, thus promoting loss of wheel traction and skidding.

(4) Three dimensional, high visibility traffic delineation is being sought by traffic engineers, generally, and a number of devices are on the market. Various traffic buttons are being offered for lane separators, and cast, elongated pyramids, called "raised bars," are used extensively for channelizing.

(5) Traffic buttons on freeways are intended to replace painted white striping. On some locations the buttons are reflectorized, that is, glass spheres are imbeded in the body of the markers and are exposed at the surface to provide retro-reflection of light from car headlights. On some locations the traffic buttons are a solid white color, providing reflectivity only, day or night, as from a painted surface. It is observed that the glass sphere type of buttons is very bright at night, but tends to appear gray under overhead lighting or sky light. On the contrary, solid white buttons provide very good delineation under overhead lighting or sky light, but tend to appear gray in front of car headlights. Either type, in day or night driving, provides the three dimension marker desired by traffic engineers, and both are recognized as doing a much better job than afforded by traffic paint.

(6) The visibility of plain white, non-reflectorized markers, in the daytime, is a function of the amount of incident light they reflect in the form of a spheroid—that is, the marker is equally visible from any direction or aspect above the surface. At night, such non-reflectorized markers attain their relative visibility from the light falling upon them, whether overhead lighting or headlights; their visibility is from the light they reflect, in general, over a spheroid pattern. Their effectiveness also depends, to a degree, upon the contrast in color they produce against their background. Also, since they are reflecting the light falling upon them, they appear brightest when the viewer is nearest them and dissolve into the background at a distance, due to the fact that the intensity of the light they are reflecting varies inversely with respect to the distance.

(7) Light reflected from reflectorized markers (glass beads exposed) is returned in more or less the same direction from which the light originated (retro-reflection) and is collimated to a considerable degree. Car headlights are reflected back to the driver with considerable intensity (depending upon the strength of the driver's headlights) over considerable distances and, since the reflected light is more or less a beam of parallel light rays, the distance is not so much inversely related to the efficiency of the reflected light as is the case with markers which are not reflectorized. It is noted, too, that light falling upon reflectorized markers from sky or overhead lighting, no matter how intense, is reflected back toward its sources, and not toward the driver of a car, unless, of course, the light source is immediately in front of the driver (as is the case with headlights) or somewhat immediately behind the driver.

(8) Summarizing points 6 and 7 above, an ideal traffic button would be highly retro-reflective for night drivers and highly reflective for overhead lighted locations or in daytime, but the laws of physical science deny this dual characteristic. The present invention combines in one marker an area which is retro-reflective and an area which is highly reflective. Since compromise or division usually entails a giving up of some values on both characteristics, it is interesting to note that, due to the psy-

chological nature of human sight sense, this invention results in a marker which does not yield very much from optimum nighttime and daytime effectiveness.

In the matter of day or night visibleness, under different types of lighting, from skylight to intense artificial (incandescent, mercury vapor, fluorescent, or a combination of two), almost every individual environment has particular requirements peculiar to the needs of that environment. In some cases, traffic buttons may be the simple reflectorized type, which reflect light from car headlights; in other cases the traffic engineer may require traffic buttons which have a top portion non-reflectorized and a reflectorized bottom section; in other environments the top should be reflectorized and the bottom section plain surface. There may even be reqiurements of two different colors, top or bottom, since traffic engineers are beginning to employ color coding for guiding motorists to various areas. This invention, then, provides for such multi-purpose needs and variations in reflectorized and non-reflectorized and color relationships and a method for producing such varied modifications economically.

Another consideration, in specifying traffic markers which will serve for high visibleness, is the need for cleaning such markers so that their effectiveness is never impaired by excessive and clinging dirt, grease and grime present on and about all roadways. The general shape of traffic buttons produced in accordance with this invention is such that they are cleaned as crossing tires wipe off foreign film from button surfaces.

While optimum visual delineation is essential on the high speed and crowded roadways of the world, and while three-dimensional road marking is a recognized need, careful and studied consideration must be given to the shapes and sizes which will permit improved visibleness and, yet, will not cause car wheels to slide or slip or promote loss of the driver's control over the car's steering. It will be seen that safety considerations and visual requirements are both incorporated in the specifications and descriptions herein.

The present invention has as a principal feature its adaptability, size and type to satisfy the requirements of traffic engineers.

The shape of the bottoms of all of the traffic buttons shown herein is generally round at the base, since a circle is the most economical shape to form in tooling for of fabricating markers, entailing use of turning lathes; however, those practiced in mechanical art can accomplish the same purpose with polygon-figured bases and the novel characteristics of the invention may be served by non-circular bases.

Tires which come in contact with raised bodies tend to be affected in two general ways. First, there is shock of impact, related to the velocity of the wheel's forward motion, the height of the raised body and the ratio of elevation to horizontal travel from the forward base edge to the crown. Second, there is the tendency of the wheeel to slip "downhill," at right angles to the direction of travel, which is a function of the angle of inclination of the tangent to the point of maximum pressure upon the tire side, or tread area. The amount of force of either of the moments referred to is insignificant when the size of the base is very large as compared to the height of the raised button or when the wheel's forward velocity is low. However, the forces become enormously magnified as the button height becomes higher with relation to the base size or as forward velocities increase. To reduce these relationships to practical considerations, a conventional type or traffic button having a base of less than 4" diameter and a height of less than about 5/8" will have no appreciable effect upon an average-sized tire on a vehicle traveling at speeds under 60 m.p.h., in dry weather. However, from about 4" diameter and above and heights above about 5/8", a simple spherical segment becomes a less-than-safe shape, particularly if the roadway is wet and the vehicle speeds are high. As smaller sizes of tire cross-sections and smaller wheel diameter sizes become more general in use, (compact and sports cars), the novel configuration of the buttons hereinafter defined becomes very important, from the standpoint of safety.

In accordance with this invention the most desirable shape for traffic buttons with more or less circular bases satisfies the requirements that the shape withstand compressive loads and distribute the load equally over the button's base and thus over the pavement area beneath; that the shape withstand impact and, conversely, cushion the shock for the passing wheel; that the shape best provides skid resistance to wheel treads crossing buttons when the center of the tread is one side or the other of the apex of the button. These requirements are to a high degree satisfied by the shape herein defined.

The marker, which has been previously mentioned, may be produced in several ways. However, one of the features of the present invention is an improved method of producing the marker which affords numerous advantages, among which is a saving in labor in the production of the same, the close control in the steps of the method which is made possible by the practice thereof, the adaptability of the method in the manufacture of markers of different visual characteristics and the adaptability of the method to mass production of the markers.

Other features and advantages of the method will appear in the description which follows.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings in which similar characters of reference represent corresponding parts in each of the several views.

In the drawings:

FIG. 1 is a fragmentary sectional view of a marker showing a preferred shape thereof and illustrating schematically the geometric development thereof.

FIGS. 2 and 3 are fragmentary schematic views illustrating contact of the cross-section of a vehicle tire with a spheroidal marker and a marker according to FIG. 1, respectively.

FIGS. 4 and 5 are schematic views illustrating in side elevation contact of portions of a vehicle tire with the markers of FIGS. 2 and 3, respectively.

FIG. 6 is a plan view of a device useful in the method of manufacture of a marker.

FIG. 7 is a sectional view taken substantially along line 7—7 of FIG. 6.

FIG. 8 is an enlarged view through a mold for a marker as taken substantially along line 8—8 of FIG. 6.

FIG. 9 is a view similar to FIG. 8 of a modified marker construction wherein the crown of the marker is of different composition from the base.

FIG. 10 is a flow sheet of a preferred method of producing a marker according to FIG. 1.

FIG. 11 is a view similar to FIG. 9, showing a reversal of the different compositions.

In one preferred shape of the invention shown in the accompanying drawings the marker **11** is preferably made of plastic material by the method hereinafter described. The shape of the marker is as follows:

In plan, the marker **11** is circular, having a diameter of about 4". The bottom **12** is preferably flat so that good adherence to pavement will result. The best adherence is obtained if the bottom **12** is rough and this is attained if the plastic is loaded with glass beads or with less expensive powdered glass or silica or similar granular material so that the finished bottom is sandy to the touch but no loose particles flake off.

In cross-section the crown of the marker is preferably a surface of revolution since this facilitates manufacture of the molds **13** used in casting the marker and, also, simplifies placement on the pavement inasmuch as proper

alignment of the marker with respect to its vertical axis is not required.

The preferred curvature of the cross-section of the surface of revolution of the crown of the marker is a curve constructed based on the "Tractrix" or "Scheile" curve, defined in part: "a curve such that the part of the tangent between the point of tangency and a given straight line is constant"; in other words, the outside of the so-called "frictionless curve" and the involute of the "catenary" curve. Other curves similar in configuration are as satisfactory, such as the catenary, the hyperbolic and the parabolic. Plotting all curves, it will be found that all are so close to juxtaposition, in the short distances being plotted, that they serve almost as well. On the other hand, it has been found by studies of all types of convex forms that the spherical segment or the cone are both lacking in the required characteristics sought.

Turning to FIG. 1, line X–X' represents a straight line on which equal distances *a'*, *b'* . . . *f'* have been marked. Line Y–X is a line at right angles to X–X'. Arcs of equal radius have been constructed with points *a'*, *b'* . . . *f'* as centers and the intersections with line Y–X marked *a*, *b* . . . *f*, respectively. The surface of marker **11** is, therefore, a smooth curve tangent to lines *aa'*, *bb'* . . . *ff'*.

FIGS. 2 to 5 show the wheel, tire, button profile, line of force and declination relationships which illustrate the superiority of the configuration of the present invention for sizes of about 4" button diameter and larger, for wheels about 30" diameter and tires of over 3" diameter.

Turning now to FIG. 1, which shows in profile one-half of a traffic marker, the traffic side being viewed from the aspect of an approaching wheel, the points tan *a'*, tan *b'*, etc. show points on the surface of the marker where maximum pressure will be exerted as car tire passes partly or completely over the half of the button shown. Tangents are drawn at these points and are designated: *a–a'*, *b–b'*, *c–c'*, etc., and it may be noted that the angle of inclination of the first, *a–a'* is about 5°, that of the next is about 13°, and so on. These are significant angles and related to the lateral forces upon tires which would tend to cause them to slip off at right angles to line of travel and affect vehicle steering or direction.

FIG. 2 shows schematically the cross-section of a vehicle tire traveling alongside a traffic button **14** with a spheroidal form, as contrasted with the preferred shape shown in FIG. 1. Note that the angles of inclination at points *g* to *j* are relatively steep as the tire **16** shown schematically as a series of circles and arcs starts to mount the button from ground points immediately below *g'*, *h'*, etc. Thus, a strong lateral force is imparted to the tire, tending toward skidding and loss of drive control of steering.

FIG. 3 shows the cross-section of a tire traveling alongside buttons of the preferred profile design and illustrates the advantage over FIG. 2. The angles of inclination for the tire positions *w–1*, *w–2*, *w–3*, etc., are substantially less in FIG. 3 than in FIG. 2.

FIGS. 4 and 5 show at right angles to the line of forward travel a section of a 30" wheel **17** (toward the left of the drawing) as the wheel starts to cross over a spheroidal button **14** (FIG. 4) and the preferred button **11** (FIG. 5). Note that the area of support is substantially greater in FIG. 5 and that the form of FIG. 5 is much blunter against the tire tread than in FIG. 4. These are significant differences when one evaluates the forces at work when the vehicle is traveling at high speed. At 60 m.p.h. the tire shown will mount the apex of FIG. 4 in about $\frac{1}{500}$ of a second after the tire first contacts the button—a very sharp impact which is destructive of the button. Note also that in FIG. 5 there is a wiping motion of the tire over the button surface which tends to maintain it clean and improve visibility.

The forces inter-acting between tire and marker become enormously magnified as the button height becomes greater with relation to the base diameter and/or as forward velocities increase. The effect upon vehicle wheels varies inversely to the mean diameter of the tire cross section and the wheel diameter. For example, a small motor scooter with 4" diameter tire cross-section will be affected by the presence of a 4" diameter x ¾" high traffic button, whereas a large truck tire would completely envelope the raised body with no effect whatsoever. Thus, the type of vehicles and their velocities become factors to be considered when traffic engineers specify traffic button for particular locations. The preferred form of this invention is much safer for smaller tires. However, recognizing that there is a minimum size of tire to be found on high-speed freeways and expressways, the above relationships have been reduced for practical considerations.

The chemical properties of marker **11** will more fully appear in the description of the method which follows. In brief, the marker is a hard, light-weight plastic material which will withstand the impact of heavy traffic. Dispersed throughout all, or throughout pre-selected portions of, the markers are preferably glass beads **21** or spheres which impart retro-reflectivity and pigment which imparts reflectivity. Either all of the marker **11** may be retro-reflective (FIG. 8), or the top **22** may be reflective and the bottom **23** retro-reflective (FIG. 9), or the top retro-reflective and the bottom reflective (FIG. 11). Choice of the foregoing characteristics depends upon condition of installation and cost considerations. Further, the separate sections may be of no different colors.

Method

In practicing the method hereinafter described in detail, standard equipment is employed, with the exception of a "panning table" **26** or **26***a* used to hold the molds **13** during and immediately after the material is filled into the molds. The table **26** imparts a motion to each mold **13** which materially improves the characteristics of the markers **11** produced. This motion is akin to that imparted to minerals in panning for gold.

Each mold **13** has a surface **27** complementary to the shape of the crown of marker **13**. Surface **27** may be the top of a thin-walled mold bottom **28** having peripheral skirt **29** with a plurality of outward directed ears **31** which may be used to attach the mold to a supporting tray **32**. Alternatively, a horizontal flange may be substituted for ears **31**. When ears **31** are used, various means of attachment to tray **32** may be employed, such as screws. Cement may be used to fix the flange above mentioned to the tray. A further optional feature of the invention is a central, downward tapered stem **33** depending below the lower edge of skirt **29** which may be inserted in a complementary hole in tray **32** to locate the mold in place. Nine or more molds **13** may be positioned on each tray.

In accordance with the invention and as shown particularly in FIGS. 8 and 9, molds **13** shaped to produce the markers **11** previously described are inserted into tray **32** which is clamped by means of clamps **36** or other convenient means to table **37**. Table **37** is supported by rubber blocks **38** or other resilient means above base **39**. Vertically disposed motor **41** is mounted on table **37** by brackets **42** and the upper end of its shaft **44** carries weight **43** which is slightly eccentric to the axis of shaft **44**, weight **43** lying in the same horizontal plane as table **37**. The eccentricity of weight **43** imparts a circular motion to table **37**, which is of high frequency and small amplitude.

The action of the panning table **26** is such that each mold **13** describes a circular path of small diameter of the general range of .020 to .25 inch on a horizontal plane, which the result that the contents of each mold receive a uniform "panning" action. Small glass spheres, under .001" in diameter, require the smaller diameter circular moment while larger spheres, .030" in diameter and over, require a wider circle of panning, up to .25 inch

in diameter. Thus, after the proper amount of "panning" the glass spheres **21** in all molds are worked down against surface **27** of the molds, uniformly.

The panning action also accomplishes rapid leveling of the contents of all molds on the tray and, when the resinous mass is quite viscous, leveling of bottom **12** is accomplished thusly where it would not be if simple gravitational force were used.

The panning action may also be accomplished by different equipment. Thus, panning table **37** may be resiliently mounted on a frame and actuated by two vibrators linked to the free-floating table at right angles to produce a motion similar to that previously described.

The materials used in practicing the method and producing the markers previously described are subject to some variation. Preferred materials are hereinafter described, the quantities mentioned being sufficient to produce about 800 markers 4" diameter and 5/8" high, fully reflectorized.

The selection and preparation of the components for molding thermo-setting types of resins combined with glass spheres are very important in the case of producing serviceable traffic buttons. For utmost tensile strength, elongation, etc., there shall be a maximum of resinous binder; for strong color there must be a practical minimum of pigment; for optimum reflectance there must be a maximum amount of exposed glass spheres. Practical balance of major components for a 100-pound batch of molding materials requires:

	Lbs.
Isophthalic polyester resin	20
Finely ground pigment	5
Clean glass spheres	70

Foregoing quantities, plus 5%, minus 0%.

The above batch is processed and partially cured, as per the below step-by-step method, at which time from 1.0% to 3.0% of either glass spheres or round silica particles is added by sprinkling over the top of the mold (bottom **12** of the button being molded) to construct the roughened bottom surface.

The isophthalic polyester resin may be Reichold Chemicals, Inc. Polylite 31–830. The characteristics of this product are as follows:

Viscosity, Brookfield, 77° F. cps.	600–900
Specific gravity	1.14–1.15
Weight per gallon	lbs. 9.56
Percent polymerizable	% 100
Color APHA	300–500
SPI gel test[1]:	
Gel time	min. 4–5
Cure time	min. 7–8
Peak exotherm temperature	305°–325° F.

[1] 3" depth of resin in 19 x 150 mm. test tube immersed in 180° F. water bath. Resin catalyzed with 1% benzoyl peroxide.

A suitable peroxide catalyst for the above resin is between .05% and 2.0% of 60% methyl ethyl ketone peroxide and a promoter of between 0.30% and 0.75 of 6% cobalt naphthenate or equivalent. Curing at these proportions is best carried out at from 100° to 200° F. for three to five minutes.

Pigment suitable for white markers may be finely ground TiO_2 of a size of about 0.3 micron.

The method employs the following steps:

Step 1.—18 lbs. titanium dioxide (TiO_2) finely ground to a particle size of about .3 micron is thoroughly ground or milled, until thoroughly dispersed in 18 lbs. of polyester resin.

Step 2.—About ½ lb. of 6% cobalt naphthenate is blended into 54 lbs. of polyester resin, using a conventional blender.

Step 3.—36 lbs. of the pigmented white paste produced by Step 1 is combined with the 54 lbs. of cobalted resin produced by Step 2, and thoroughly blended together by mechanical mixing. When this mass is homogeneous, an amount of catalyst such as methyl ethyl ketone peroxide is added and quickly and thoroughly mixed into the mass. The amount of catalyst added varies from about 30 cc. to about 100 cc., depending upon the ambient temperature at time of mixing. This amount of catalyst is a carefully controlled variable which is adjusted for each type of button being made, so that the cure time will be correct for button size and curing conditions.

Step 4.—200 lbs of clear class spheres **21**, of the type used for dropping on paint striping on roadways to make them reflective, is dispersed into the catalyzed resin mixture by mechanical mixer and prepared for the mold-filling operation immediately following. In a preferred form of the invention the glass spheres **21** are of two sizes mixed between 60% and 40% by weight. The larger spheres are preferably in the range 700 to 1,000 microns and the smaller in the range 20 to 50 microns.

Step 5.—Molds **13** in tray **32** are already at hand for the mold-filling operation. The blended mass is served into the individual mold cavities by means of a hand dipper, of the type commonly used for ice cream, or by automatic or other suitable means. The scoop is first loaded and then leveled off at the top so that the correct amount of blended mass is dropped into the mold. Molds **13** are on trays **32** in multiples of nine or more, and tray **32** for each group is held on the panning table **37** tightly, so that the molds and contents receive the panning effect required to settle and level the resinous mass. Each tray of molds is removed from the panning table as soon as the material in the molds is settled and leveled and placed on a conveyor which carries the loaded tray to the next operation. As soon as one tray of molds is completed and transferred off, another tary is fixed upon the panning table and the filling operation cycle repeated.

Step 6.—As soon as the resinous mass in molds **13** starts to "gel," glass spheres or various silicas or similar material are sprinkled onto the bottoms of the molded pieces. Sufficient of this is sifted on to insure that, as some spheres are settled into the uncured resinous layer present over the tops of the curing buttons, there will be an ample quantity of the spheres exposed so that there will be no area of resin without glass or silica after the button completely cures.

Step 7.—Trays received from Step 6 are placed on a continuous conveyor which conveys them through a baking oven with very accurate thermostatic controls. The conveyor runs the length of this oven carrying stacks of trays and the molds thereon. Average sized markers, made of the formulation shown above, require a full hour of post-curing treatment at a temperature of 200° F. for complete curing of the buttons so that they will have the high-strength characteristics required.

Step 8.—At the end of the oven, trays are moved from the conveyor and the molds are emptied of the cured buttons and the excess glass, silica and the like is salvaged. The emptied molds continue along the conveyor to be ready for the beginning of a new molding cycle at Step 5.

Step 9.—The markers produced in Step 8 are stripped. In this step preferred equipment is a tank of methylene chloride. The molds are set on racks which slide on tilted glides to take the buttons into the bath. The length of time in the bath may vary from about 60 to 180 seconds, depending upon the type of finish desired on the buttons. If an extremely coarse finish is desired the bath is continued for 180 seconds. When polyester resin-cured is immersed in methylene chloride the resin absorbs the methylene chloride at the surface, causing the resin to increase in volume, or swell. This reaction, upon the thin films of cure resin covering the individual glass spheres causes the film to burst, causing surfaces of glass-containing buttons to take on a "feathery" or "snow-flake" texture. The smaller glass particles are interspersed between the larger spheres **21** and hence the spheres **21** are held apart by the smaller ones. The stripping agent under-

mines the sockets for the smaller particles, thereby facilitating their later removal. At the same time, the penetration of the stripping agent is slowed and kept adjacent the surface.

Step 10.—This step recovers the solvent and completes stripping. Preferred equipment is a closed, low-topped cavern where air and methylene chloride vapor are trapped without turbulence. The vapor is in contact with the markers and allows the surfaces to uniformly "feather." This economizes on methylene chloride and makes full use of the vapors. The recovery procedure is terminated to prevent over-reaction from the treatment.

Step 11.—Cleaning of the surface of the markers. Equipment may consist of an arrangement of brushes and/or air jets which mechanically or pneumatically remove the fluffy surface cover of the treated buttons. Because methylene chloride is so volatile and reactive, it is important that the fluffy cover be removed as quickly as possible after the buttons come out of the vapor soak, Step 10, and that the fluffy cover be removed to expose the underneath surface (glass bead surfaces) to quick evaporation of residual methylene chloride. The brushing operation has to be a "gentle" action so as not to tear glass spheres out of sockets or crack and weaken the resinous margins around the spheres. For this reason, non-metallic brushes are employed or air jets. When the marker is cleaned, the top two or three layers of small glass particles are removed because the stripping agent has dissolved the resin surrounding them. This exposes the larger spheres at the surface, without undermining such spheres. When the markers are installed in place this effect is beneficial, particularly at low angles of visibility, because of the fact that the spheres stand out from the surrounding matrix.

Subsequently, the buttons are inspected and, if necessary, re-stripped in that Steps 9 to 11 may be repeated. The completed markers are stored, packaged and shipped.

A feature and advantage of the invention is the use of procedures making possible the production of markers having composite physical characteristics. Thus, as in FIG. 9, a portion **23** of the marker **11***a* may be retro-reflective and another portion **22** reflective, or different portions may be pigmented with different colors. The following is an alternate to Step 5, above:

When markers are required in two finishes or in two colors, FIG. 9, two separate filling operations are entailed. Catalyzed and blended mixture corresponding to the characteristics desired for the crown **22** of the marker (i.e., with or without glass beads and with any desired color material) is dropped into molds **13** at Step 5, above, except that a smaller dipper is used so that the mold is only partially filled. Following this filling, the molds and contents are "panned" on table **16** and then allowed to set until the beginning of "gel," at which time there is a second filling to the proper mold level. The mixture for this second filling has been earlier prepared of components dissimilar to those used in the first filling. To further explain:

When a traffic button is required with a reflective top portion **22**, see FIG. 9, the first filling shall be of a glass-containing catalyzed, resinous mixture with pigment and without glass spheres, and the second filling shall be with a type of filler **23**, such that a retro-reflective finish will result in the finished product as by use of glass spheres **21** in the resin. Reverse order is illustrated in FIG. **11**.

As a further example:

When a two-color traffic button is required, the first partial filling shall be pigmented with the color specified for the top of the button, and the second filling shall be pigmented as specified for the lower section of the two-color button.

Irrespective of the combination of either colors or fillers required for the first and second filling, as noted above, the second filling is not made until the resin of the first filling starts to "gel." This sequence procedure is necessary; otherwise, the admixture of the second filling would intermix with the uncured first fill.

Subsequent steps are substantially the same as in Step 6 and following.

A further alternate method of producing a button, which is reflective in one surface area and retro-reflective in another surface area, may be achieved by proceeding as in the preferred method of the invention up through Step 8, i.e., the retro-reflective material such as glass spheres are dispersed throughout the marker. The surface which is to be reflective is then masked as by screening or spraying liquid latex on the surface and allowing to harden, or by applying a pressure sensitive stencil. The marker is then stripped as in Steps 9 and 10 and the mask removed. After cleaning, as in Step 11, the spheres are exposed only in the previously unmasked portion and the previously masked portion is reflective because the spheres are cancelled by the resin coating.

Although the foregoing invention has been described in some detail, by way of illustration and example for purposes of clarity of understanding, it is understood that certain changes and modifications may be practiced within the spirit of the invention and scope of the appended claims.

What is claimed is:

1. A traffic marker formed of a unitary piece of tough, hard plastic and having imbedded and dispersed therein throughout at least a defined portion of said marker a mixture of retro-reflective glass spheres consisting substantially entirely of two different size ranges, a first said range being 700 to 1,000 microns diameter and a second said range being 20 to 50 microns diameter, the first range spheres being exposed at the surface of the marker and standing out from the surrounding matrix, consisting of a mixture of first and second range spheres, the mixture of said ranges being substantially constant throughout said defined portion of said marker.

2. A marker according to claim **1**, in which a second defined portion of said marker is reflective.

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