

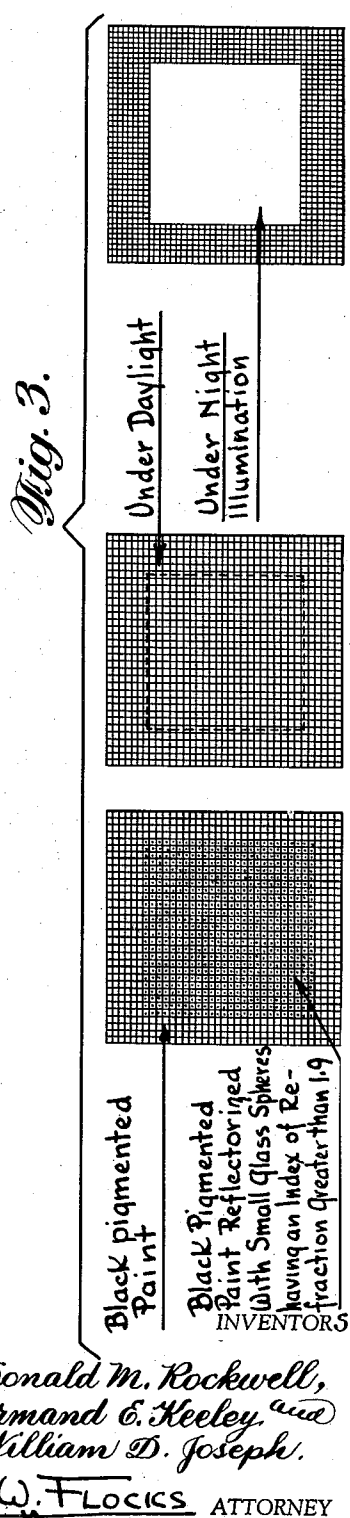
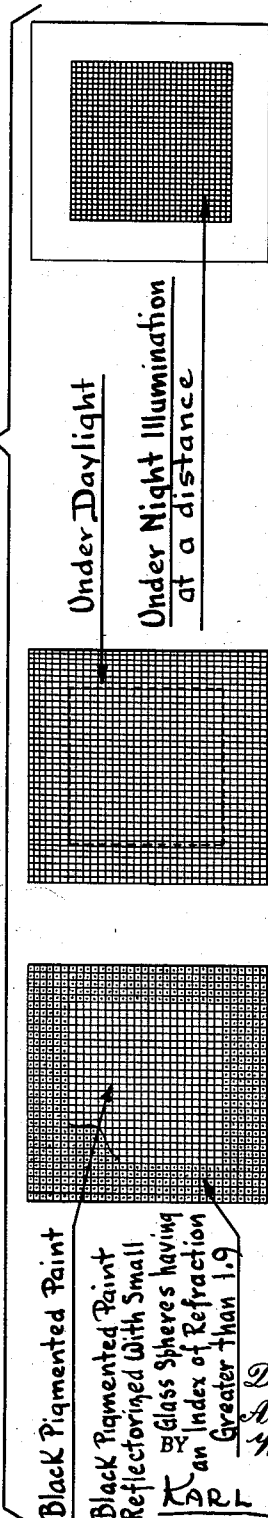
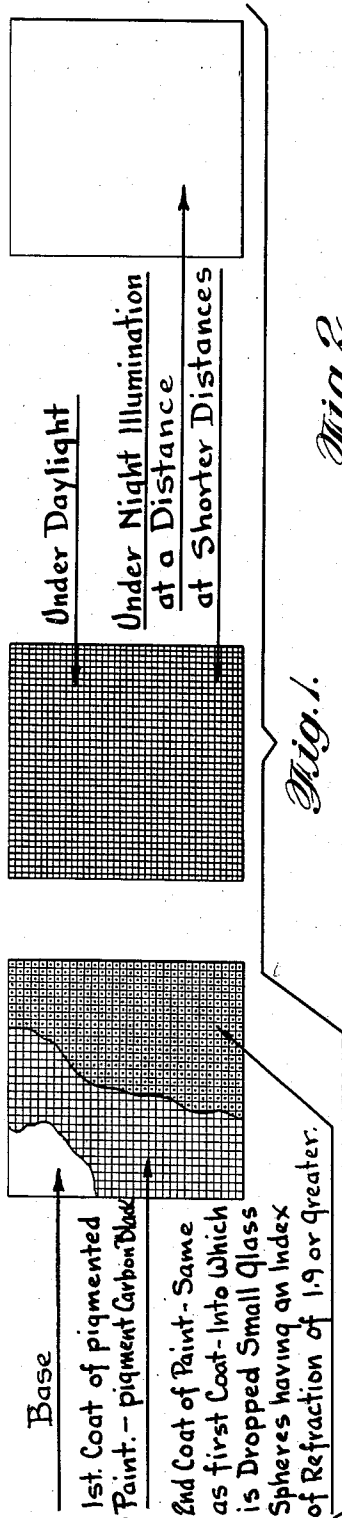
April 21, 1959

D. M. ROCKWELL ET AL
MARKER MATERIAL AND METHOD

2,882,632

Filed Oct. 25, 1955

2 Sheets-Sheet 1



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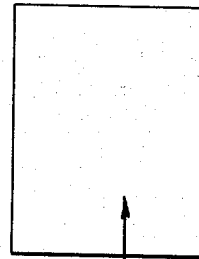
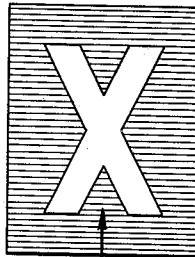
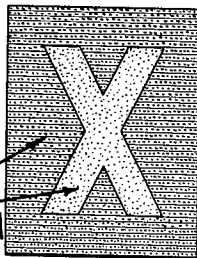
2,882,632

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2 Sheets-Sheet 2

Blue pigmented Paint
Reflectorized with Small
Glass Spheres having an
Index of Refraction
Greater than 1.9

White Paint Reflectorized
With Small Glass Spheres
having an Index of Refraction
In the Range of 1.5-1.7



Under Night Illumination on
Closer Approach With an
Increasing Divergence Angle

Under Night Illumi-
nation at a distance
With a Small
Divergence Angle

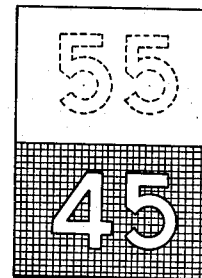
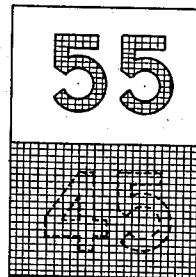
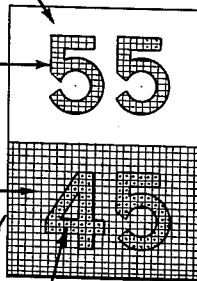
White Background.

Fig. 4.

Black Paint.

Black Paint.

Black Paint Reflectorized
With Small Glass Spheres
having an Index of Re-
fraction greater than 1.9



Under Daylight

Under Night
Illumination
at a distance

Fig. 5.

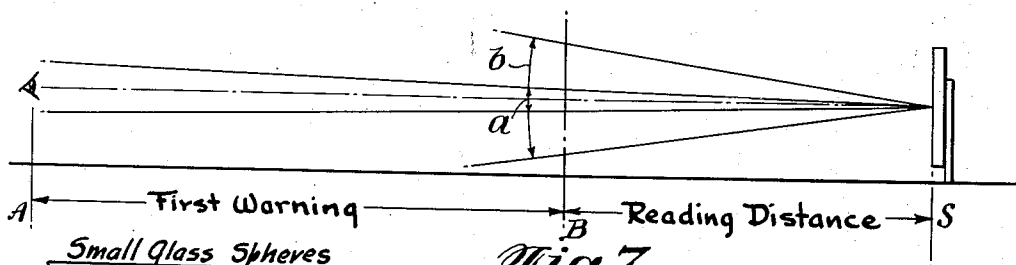


Fig. 7.

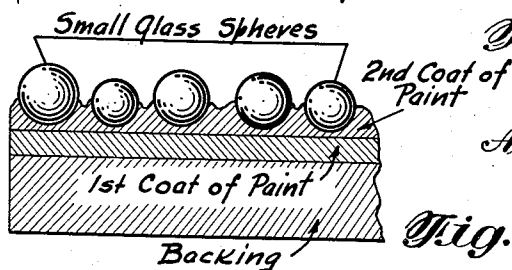


Fig. 6.

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2,882,632

MARKER MATERIAL AND METHOD

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Application October 25, 1955, Serial No. 542,632

9 Claims. (Cl. 40—135)

This invention relates to reflex light reflectors, and more particularly to road signs and markers of the reflex type.

It has been previously proposed to use small regularly shaped elements of transparent material, such as glass, and preferably in the form of spheres, as light-returning members for attracting attention for signs and markers, and for decorative purposes. It has further been found that by placing these elements closely together, and providing a large number of such elements in a layer, a bright reflex reflection can be obtained. Such reflectors have the property of directing a brilliant cone of light back toward the source of an angularly incident beam of light. Road signs and markers of the reflex type have greater visibility at night to the occupants of an approaching vehicle since the reflected light is concentrated in a narrow cone which automatically returns toward the headlights and occupants of a vehicle.

It is an object of the present invention to provide a reflector which appears black when viewed by daylight and yet has a brilliant silvery appearance when viewed at night under reflex reflecting conditions.

A further object of the present invention is to provide a reflector which appears to be a particular color when viewed by daylight, has a brilliant silvery appearance when viewed from a long distance at night under reflex reflecting conditions, and which, at shorter distances under the same conditions, has the color as seen in the daylight.

A still further object of the present invention is to provide a marker which combines high target visibility at a distance and good readability at nearer viewing.

Other objects and the nature and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings, wherein:

Figs. 1-5 are plan views of various forms of markers embodying the present invention;

Fig. 6 is a highly magnified diagrammatic view showing the sectional structure of the marker of Fig. 1; and

Fig. 7 shows in diagram form a marker and the reflex reflected cone of light returning toward the source of the beam.

This invention is based upon the discovery that when small glass spheres having a refractive index of 1.9 to 2.0 or greater embedded in a pigmented binder are used, the combination of auto-collimating effect plus the considerably increased surface reflection serves to give a great brilliance of light return at all angles of incidence with low divergence angles. This reflected light at a great distance is essentially silvery white, whereas at shorter distances the color of the pigment becomes more apparent.

The small glass spheres used as reflective elements may be directly embedded in a pigmented binder with the upper surfaces of the spheres exposed or by embedding the spheres in a clear binder over a pigmented background. This coating may be directly applied to the sur-

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face to be reflectorized or may be applied to a flexible carrier sheet of plastic, paper, fabric or other material, which may be later affixed to the article to be reflectorized.

Glass spheres with a refractive index in the range of 1.9 to 2.20 have been found preferable. Examples of glass compositions resulting in a refractive index within the range specified are disclosed in a copending application by Guy E. Rindone, Serial No. 484,853, filed January 28, 1955, entitled "Glass Composition." The preferred size for the glass spheres is in the range of 4-10 mils average diameter, the beads being screen graded if necessary so as to avoid an undue variation in size and provide a relatively smooth surface on the product. The spheres may, however, be smaller or larger than this, but it is best not to go outside the range of about 3-50 mils average diameter.

In the example illustrated in Fig. 1, a marker is shown having a background coat of black paint in which the only pigment is carbon black. Upon the surface of this, a second coat of the same binder is applied into which is dropped small glass spheres having an index of refraction of 2.0. Under daylight, this marker appeared to be black. Under illumination at night, this marker appeared as a brilliantly silvery-white panel from a distance. This same effect is obtained with any background color desired, such as red, yellow, blue, or the like. The nature of this system is such that at a distance the color of the light returned is essentially that of the source, while at shorter distances, say 20 to 50 feet, the color of the background becomes apparent. Thus, with the black background as illustrated in Fig. 1, the marker gives a brilliant silvery white reflection to light at a distance and at shorter distances converts to black again, as in the daylight.

This effect is not obtained when using glass beads having an index of refraction less than 1.9, as has been used conventionally heretofore.

In the example illustrated in Fig. 2, a marker is shown having a similar background to that shown in Fig. 1, with a black pigmented binder reflectorized with glass spheres having an index of refraction greater than 1.9. In the center of this background is a symbol which is painted onto the background using a black paint without the glass beads. In daylight, the symbol and the background are practically indistinguishable and the entire marker appears to be black. At night at a distance, using a beam of light with a small divergence angle, the background appears to be a silvery white and the symbol appears sharply defined in black.

Conversely, as shown in Fig. 3, the black symbol may be reflectorized on a non-reflectorized black background. Here again in daylight, the symbol and background are practically indistinguishable, whereas at night under illumination, it appears as a brilliant symbol on a black background. It is notable that in either of these systems, the night appearance, under illumination, possesses a curious three-dimensional quality, the letter having the appearance of not lying in the same plane as the background. This effect serves to sharply define the letter, thereby rendering it more readable even at a considerable distance. It is not necessary that the color used be restricted to black, since a red letter on a red background, or yellow on yellow, may equally well be used with the same "camouflage" effect.

In the example illustrated in Fig. 4, a marker is shown having a blue background reflectorized with glass spheres having an index of refraction of greater than 1.9 with a symbol painted thereon in white paint reflectorized with glass spheres having an index of refraction in the range of 1.5-1.7. In the daylight, the marker appears as a white symbol on a blue background. At night, at a distance within a small divergence angle, when illuminated,

the entire marker appears as a silvery white object. On closer approach with an increasing divergence angle, the brilliance of the background decreases and the symbol becomes bright. Within reading distance, the marker appears as a bright white symbol on a blue background since the observer is now outside the small divergence angle for the background. Using an 18" circular sign, prepared as shown in Fig. 4, under night illumination, this sign appeared as a right spot of light at 1500 feet. On closer approach, the background gradually decreased in brilliance while the symbol became brighter so that the symbol could be clearly read at 700 feet. Background color was not clearly visible until the distance was reduced to 400 feet or less.

The advantage of this system is that it combines high target visibility at a distance with absence of glare, and good readability at nearer viewing.

The marker shown in Fig. 5 is an example of a sign marker for day and night use, indicating speeds for day and night driving. The portion for daytime use is painted with black paint on a white background in the usual manner. The portion of the sign for night use, has a background of black paint onto which is painted the symbols utilizing black paint reflectorized with glass spheres having an index of refraction greater than 1.9. This portion of the sign appears black in the daylight, but at night when illuminated shows up as silvery white symbols on a black background.

As illustrated in Fig. 7, the sign is identified as S, and a ray or pencil of rays of light is shown as coming from a distant source and impinging on the reflex reflector. The spheres interposed over the reflector surface collimate the light and a cone of brilliant light is returned toward the source with the axis of the cone being substantially the same as the axis of the incident ray or pencil of rays. At the point A, within the small divergence angle marked a , using spheres of 1.90 or greater index of refraction, the reflection regardless of color of background appears to be silvery white. At the point B, within the greater divergence angle marked b , the reflection reflects the color of the background under the spheres of 1.90 or greater index of refraction. Thus, when traveling between points A and B, the driver receives a first warning of a sign by the silvery white blur. From point B to the sign, the sign can be read.

This silvery effect is produced in accordance with this invention without the use of aluminum flakes or other reflective surfaces previously proposed.

The theory of why a silvery white reflected light will be reflected by a black surface without reflecting material embedded therein covered with transparent spheres having an index of refraction of at least 1.90 is not completely understood. It is believed that the light entering the spheres at a low divergence angle is reflected back from a point within the spheres without reaching the binder; however, at greater divergence angles and at closer distances the light entering the spheres is reflected back from a point either on the rear surface in contact with the binder or from a point behind the sphere within the binder, thereby reflecting the color of the binder. The latter is similar to the phenomenon when using glass spheres of lower refractive indices.

This invention has many applications such as in stadi-metric devices, advertising, railway signals, and the like. Utilizing the color change phenomena pointed out heretofore, distances can be measured. Many additional effects can be obtained by mixing together glass spheres of low index of refraction with glass spheres having an index of refraction greater than 1.90. This combination of spheres combines the effect of distance brilliance with near readability and color definition.

Utilizing this invention, it is now possible to make a reflective sign or similar device having great brilliance at a distance but without glare at distances where read-

ability of the sign is desired. Previous devices have not successfully combined these two features.

It will be obvious to those skilled in the art that various changes may be made without departing from the spirit of the invention and therefore the invention is not limited to what is shown in the drawings and described in the specification but only as indicated in the appended claims.

What is claimed is:

1. A reflex light reflector comprising a layer of minute transparent spheres, whose refractive index is high enough such that the point of focus of the light returned is within the spheres partially embedded in a non-reflecting pigmented binder material essentially consisting of a binder material and a non-reflecting pigment and having no reflective material therein whereby at a great distance within low divergence angles the color of the light returned is essentially that of the source regardless of the color of the pigment.

2. A reflex light reflector comprising a layer of minute transparent spheres whose refractive index is high enough such that the point of focus of the light returned is within the spheres partially embedded in a black non-reflective pigmented binder material essentially consisting of a binder material admixed with a non-reflecting black pigment and having no reflective material therein whereby at a great distance within low divergence angles the color of the light returned is silvery white even though no reflective material is included in the binder and whereas at reading distance the reflector appears black.

3. In a sign adapted for outdoor highway use, a reflex light reflecting area comprised of a layer of small transparent spheres having a refractive index high enough such that the point of focus of the light returned is within the spheres partially embedded in a non-reflecting pigmented binder, said binder essentially consisting of a binder material and a non-reflecting pigment having no reflective material therein.

4. In a sign adapted for outdoor highway use, a plurality of light reflecting areas, each having different light reflecting characteristics, one area of which is comprised of a layer of small transparent spheres having a refractive index of at least 1.90 partially embedded in a binder, said binder essentially consisting of a binder material and a non-reflecting pigment, and another area of which is comprised of a layer of small transparent spheres having a refractive index of 1.5-1.7 partially embedded in a pigmented binder.

5. In a sign adapted for outdoor highway use, a reflex light reflecting area comprised of a layer of small transparent spheres partially embedded in a binder, some of which have a refractive index of at least 1.90 and the balance having a refractive index of 1.5-1.7.

6. In a sign adapted for outdoor highway use, a non-reflex light reflecting area comprised of a non-reflecting pigmented binder and a reflex light reflecting area comprised of a layer of small transparent spheres having a refractive index high enough such that the point of focus of the light returned is within the spheres partially embedded in a binder, said binder essentially consisting of a binder material and a non-reflecting pigment and having no reflective material therein.

7. In a sign adapted for outdoor highway use that can be read only at night, a reflex light reflecting area comprised of a layer of small transparent spheres having a refractive index high enough such that the point of focus of the light returned is within the spheres partially embedded in a pigmented binder, said binder essentially consisting of a binder material and a non-reflecting pigment and having no reflective material therein and the remaining area comprised of said pigmented binder without the spheres embedded therein whereby the two areas utilizing the same pigmented binder are practically indistinguishable in daylight yet under night illumination with low divergence angles the area containing the

spheres becomes reflex light reflecting in contrast to the area without spheres.

8. In a sign in accordance with claim 7, wherein the pigmented binder essentially consists of said binder and a non-reflecting black pigment.

9. A sign adapted for outdoor highway use, comprising a first portion of said sign carrying insignia to indicate the allowable daytime driving speed, a second portion of said sign carrying insignia to indicate the allowable night-time driving speed, said first portion comprising said insignia painted of one color on a background of a second color whereby said insignia is clearly visible in daylight, said second portion comprising a coating of a non-reflecting pigmented binder having said insignia indicated thereon by a layer of small transparent spheres having a refractive index in the range of 1.9-2.2 partially embedded in said coating, said binder essentially consisting of a binder material and a non-reflecting pigment and having no reflective material therein, whereby in daylight the insignia in said second portion appears indistinguishable from the remainder of said portion yet under night illumination the insignia becomes reflex light reflecting in contrast to the area without spheres.

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Dedication

2,882,632.—*Donald M. Rockwell, Armand E. Keeley, and William D. Joseph*,
Huntingdon, Pa. **MARKER MATERIAL AND METHOD**. Patent
dated Apr. 21, 1959. Dedication filed Apr. 13, 1976, by the assignee,
Prismo Universal Corporation.

Hereby dedicates to the Public the entire term of said patent.

[*Official Gazette July 6, 1976.*]