ABSTRACT OF THE DISCLOSURE

A reflex-reflector for attachment to the depressed in-step portion of the sole of a shoe. When attached on the shoe, the reflector presents an exposed three-dimensional reflex-reflective face that includes side, front, rear, and top reflex-reflective surfaces which together provide a warning signal in all directions as a pedestrian wearing the shoe walks.

BACKGROUND OF THE INVENTION

Reflex-reflectors have been increasingly used to warn motorists driving at night of the presence of objects located on or along streets and highways. But no popular method has been found to warn motorists of the presence at night of pedestrians walking along or crossing a street or highway. Wearing apparel that is reflective or that carries reflective patches, reflective tags that dangle from a strap attached to clothing, and other reflective articles intended to be worn have at times been offered for sale, but few have purchased and worn them. The result is that most conventionally dressed pedestrians walking along a roadway at night under common artificial light conditions are surprisingly hard to see. Nearly all motorists driving at night have had the experience of suddenly discovering a pedestrian in the path of their car and of avoiding striking the pedestrian only by a dangerous swerve or by sudden, hard braking.

SUMMARY OF THE INVENTION

The present invention provides a reflex-reflector that can be conveniently worn at all times by a pedestrian without thought on his part—inconspicuously during the day but with bright, attention-getting conspicuity as he walks at night. This new reflex-reflector is attached to the depressed in-step portion of the sole of a shoe and generally comprises a flat body having a three-dimensional reflex-reflective surface on one face that provides reflex-reflective areas viewable both in plan views and in elevation views of the reflector. The reflector can be quite thin—it is generally less than 0.4 inch thick—but even when the reflex-reflective areas viewable in elevation are small, a quite bright signal is provided a motorist approaching a pedestrian wearing the shoe.

This is not the first occasion that shoes have been used in an attempt to provide warning signals protecting pedestrians wearing the shoes. For example, shoes having reflex-reflective tape or sheeting attached on the vertical edge of the shoe sole, as described in British Pat. 1,092,482, have been suggested. Such a shoe has the disadvantage of daytime conspicuity and has not been popular. Another infrequent prior practice has been to adhere reflex-reflective tape or sheeting to the bottom of a shoe sole, but the ineffective reflection from such a tape has provided incomplete protection, and this practice has also not been popular.

In contrast to these prior practices, the present invention offers both daytime inconspicuity and nighttime conspicuity: a pedestrian wearing shoes of this invention will seldom be conscious of the reflectors he wears and others will seldom be conscious of them during the daytime; but at night the pedestrian will be quickly noticed as he walks in the path of an auto, no matter from what direction the auto approaches him. As far as is known, no one, until the present invention, contemplated the inconspicuous attachment to the bottom of a shoe sole of a raised reflector having an exposed three-dimensional reflex-reflective face, and no one realized the high degree of protection that could be obtained from such a reflex-reflector on the bottom of a shoe sole.

The invention is further illustrated in the drawings in which:

FIG. 1 is a perspective view of one embodiment of a reflex-reflector of this invention;
FIG. 2 shows the bottom of a shoe with the reflector of this invention attached;
FIGS. 3 and 4 are side and front views, respectively, showing representative positions of a shoe of this invention as a person wearing the shoe walks;
FIG. 5 is a sectional view through a part of the reflector shown in FIG. 1, taken along the lines 5—5 in FIG. 1; and
FIGS. 6 through 9 show other embodiments of reflectors of this invention.

The three-dimensional reflex-reflector 10 shown in FIG. 1 includes an elastomorphic body 11 formed with side ridges 12, a front ridge 13, and a rear ridge 14, the ridges being connected and arranged in a rectangular pattern around a central flat area 15. This illustrative reflector 10 is made reflex-reflective by a surface layer 17 of transparent glass beads 18 (see FIG. 5), each partially embedded in the elastomorphic body 11 with vapor-deposited aluminum covering its embedded back surface. A layer of pressure-sensitive adhesive (not shown in FIG. 1) is carried on the flat bottom surface of the illustrative reflector 10, by which the reflector can be attached to the bottom of the depressed in-step portion of a shoe, such as the in-step portion 19 of the sole 20 of the shoe 21 shown in FIG. 2.

The bead-covered ridges 12, 13, and 14 and central flat area 15 provide a three-dimensional reflex-reflective face that is viewable at times from all locations around a typical pedestrian. This three-dimensional reflex-reflective face includes reflex-reflective side surfaces 12a and 12b, viewable at times from the side of a shoe, reflex-reflective front surfaces 13a and 14a, viewable at times from the front of the shoe, reflex-reflective rear surfaces 13b and 14b, viewable at times from the rear of the shoe, and a reflex-reflective top surface that includes the tops of the ridges and the central area 15 and which is viewable at times from various locations around a pedestrian walking.

The reflex-reflection provided by the reflector 10 can be described by reference to FIGS. 3 and 4 which show representative positions of the foot of a typical pedestrian wearing a shoe 21 of this invention. FIG. 3 is representative of the position that a pedestrian's foot takes as he shifts his weight from the foot illustrated to the other foot, and prepares to raise the illustrated foot into the air. In this position, the pedestrian exposes a large portion of the bottom of his shoe and lifts it so that the sole forms a large angle with the surface on which he is walking. FIG. 4 is representative of the position that the foot of a pedestrian takes while the foot is in the air preparatory to being placed on the walking surface. As will be seen, the front portion of the foot is substantially higher than the rear of the foot, and, typically, the front of the foot is somewhat turned out, and the inside of the foot is slightly higher than the outside. The rather small reflex-reflective side surface 12a shown in FIG. 3, which most of the time is exposed to
the side of a pedestrian as he walks and stands, provides a quite bright signal to an oncoming motorist. It has been found that a reflex-reflective side surface as small in area as 0.02 square inch and as low in height as 0.05 inch reflects a sufficient amount of light to provide an adequate signal. Especially, however, the reflex-reflective side surface 12a will have a height of 0.1 inch or more and a minimum area of 0.05 square inch.

The side surface should be somewhat near the side edge of the sole that it faces to provide the best warning signal, especially when the pedestrian is standing rather than walking. Preferably the distance D in FIG. 2 between the side surface 12a and the edge of the sole is more than one-eighth inch but less than one inch and more preferably less than one-half inch. This distance requirement is not as critical to the signal provided by a person walking, since a typical person when walking will expose to view from a single side of him both side surfaces 12a and 12b, as shown in FIG. 4. Reflectors of this invention are preferred that include, because of a plurality of reflective ridges, two or more side surfaces viewable at times from one side of the shoe. Only one may be any through the center flat surface 15 of the reflector to a motorist because of the size of the pedestrian, and the obtaining of a good warning signal to a motorist approaching from the side of a pedestrian has been found to require the presence of a side surface viewable in elevation such as the surface 12a.

The very good signal provided a motorist approaching the front of a typical pedestrian wearing a shoe of this invention also results from the presence of a reflective surface viewable in elevation, such as the front surface 13a of the reflector 10. While some light from an automobile approaching a pedestrian from the front will be reflected from the flat surface 15 or from some other top reflex-reflective surface occurring in an area of at least 0.02 square inch, the angle of incidence (the angle between the path of light and a line normal to the layer of reflective-reflective elements) is sufficiently high so that the warning signal from that reflection alone would be only adequate. It is preferred that a reflector of this invention include a reflex-reflective front surface having the same minimum and preferred dimensions described for the side surface. The depression in the center of the reflector 10 provides two reflex-reflective front surfaces, 13a and 14a, which is even more preferred.

As illustrated in FIG. 3, the heel of a typical pedes- trian, such as the one he is preparing to lift his foot while walking so that light from an automobile in back of the pedestrian has a low angle of incidence against the central flat surface 15 of the reflector 10. Accord- ingly, a very good warning signal would be provided a motorist approaching from the rear a pedestrian wearing reflex-reflective shoes that did not have reflex-reflective rear surfaces such as 13b and 14b but that did have a reflex-reflective top surface of at least 0.02 square inch. However, the signal is improved by use of such rear surfaces and such surfaces having the minimum and preferred dimensions described for the side surface are preferred. The preferred dimensions apply for the top reflex-reflective surface as for the side, front or rear reflex-reflective surfaces, as a practical matter the top reflex-reflective surface will generally be at least 0.1 or 0.2 square inch; and since the reflex-reflective top surface is often at a substantial angle to incident light, the increased size is quite helpful in providing a good signal.

It is not necessary that the whole area of a side, front, or rear reflective surface of a reflector of this invention be exactly perpendicular to the path of oncoming light. For example, a reflector, such as the reflector 23 shown in FIG. 6, which has a continuous oval ridge 24, will provide a sufficiently bright return of light. However, the curved reflex-reflective side, front, and rear surfaces 25, 26, and 27, respectively, should include portions having an area of at least the minimum or preferred dimensions described above to which light coming from exactly the side, front, or rear direction will not be at a high angle of incidence (at least less than about 70° and preferably less than 60°). In addition, in typical constructions, reflectors of this invention will include reflex-reflective side, front, and rear surfaces that gradually curve as they reach the top of the reflector, as shown in FIGS. 1 and 5. Other useful configurations for a three-dimensional reflective surface of a reflector of this invention are shown in FIGS. 7 and 8.

The body of a reflector of this invention is preferably elastomeric so that bumping of the reflector against a hard surface, such as the edge of a step or a curb, will be less likely to damage the reflective surface. An elastomeric reflector such as that shown in FIG. 1 having a surface layer of glass beads partially embedded and strongly adhered in the elastomeric body has been found to be very long lasting. However, reflectors of this invention can also be made by embedding reflex-reflective elements in a nonelastomeric body portion or by adhering nonelastomeric sheet-type reflex-reflective material over nonelastomeric blocks. So that the reflector will not catch on clothing or otherwise become entangled to the wearer, the reflector should generally be less than 0.4 inch high, and preferably less than 0.25 inch high.

The use of a layer of partially exposed transparent glass beads, embedded generally between 30 and 80 percent of their height, and strongly held in the body of the reflector, provides a high degree of reflex-reflection. In other useful constructions, the beads are covered by a transparent layer of material, such as a transparent layer of elastomeric material, and the transparent layer is colored to provide reflectors of different color. Thus, a differently colored reflector may be used on each of a pedestrian's feet, for example, to provide a signal that would be routinely associated with a pedestrian by a motorist.

A useful method for constructing a reflector of this invention can be described with reference to FIG. 5, which shows in more detail the construction of the illustrative reflector 10. As seen, the outer layer of the elastomeric body 11 of the reflector 10 comprises an elastomeric sheet 28 in which is partially embedded the layer 17 of transparent glass beads 18, which have an index of refraction between 1.8 and 2.0 and have their em- bedded surface covered with aluminum (the sheet 28 may be prepared, for example, by spraying a solution of elastomeric or elastomeric precursor mat- erial on a carrier; cascading glass beads that have been each vapor-coated with aluminum onto the layer where- upon the beads float in the layer; then drying or curing the layer; and finally etching away the aluminum from the exposed portion of the beads). In the embodiment of the invention illustrated in FIG. 5, the thin sheet 28 of elastomeric material comprises two layers: the layer 29 in which the beads are partially embedded, which com- prises an elastomer formed from an epoxy resin and a long-chain diamine having high adhesion to the alu- minum-coated beads; and the layer 30, which comprises neoprene rubber and which is included to improve ad- hesion to the main body portion of the reflector 10. The bead-carrying sheet 28 is laid over a die, with the beaded side down, and drawn by vacuum into depressions in the die that correspond to the ridges 12, 13, and 14; this forming operation may be repeated, for example, by making sheet 28 somewhat. The main body portion 31 of the body of the reflector 10 is formed by pouring into the conformed sheet 28 a curable mixture of polyl and polysiocyanate constituents, which are then reacted at room temperature to form a polyurethane. The reflector 10 is completed by adhering to the exposed surface of the main body portion 31 a vinyl sheet 32 that is coated on both surfaces with layers 33 and 34 of butadiene-styrene adhesive and carries a protective liner 35 of a release paper.
What is claimed is:

1. A reflex-reflector for attachment to the depressed instep portion of the sole of a shoe to provide a signal at night warning oncoming motorists of the presence of a pedestrian wearing the shoe, comprising a generally flat elastomeric body less than 0.4 inch high having a planar bottom surface carrying a layer of adhesive and having a raised three-dimensional reflex-reflective face extending therefrom that (1) is covered with a layer of transparent glass beads each partially embedded in the elastomeric body, with reflective means disposed underneath the embedded surface of the beads, and (2) includes (a) at least two oppositely facing reflex-reflective side surfaces viewable from different sides of the shoe, each having a reflex-reflective area of at least about 0.05 square inch and a minimum height of about 0.1 inch, (b) front and rear transverse reflex-reflective surfaces each having a reflex-reflective area of at least about 0.05 square inch and a minimum height of about 0.1 inch, and (c) a reflex-reflective top surface having a reflex-reflective area of at least about 0.05 square inch.

2. A reflector of claim 1 in which the elastomeric body comprises (a) a thin exterior elastomeric sheet providing the raised three-dimensional face and in which the layer of transparent glass beads is partially embedded, and (b) a main elastomeric body portion filling the interior of the said exterior sheet.

3. A reflectorized shoe having a sole that is depressed across its full width at the instep and a reflex-reflector of claim 1 attached to the depressed instep portion of the sole, with each side surface of the reflex-reflective face less than one inch from the edge of the sole closest to it.

4. A reflectorized shoe that provides a bright signal at night warning oncoming motorists of the presence of a pedestrian wearing the shoe, comprising a shoe having a sole that is depressed across its full width at the instep and a reflex-reflector less than 0.4 inch high attached to the depressed instep portion of the sole, said reflector comprising a generally flat elastomeric body and having an exposed raised three-dimensional reflex-reflective face extending above the surface of the sole that (1) is covered with a layer of transparent glass beads each partially embedded in the elastomeric body, with reflective means disposed underneath the embedded surface of the beads, and (2) includes (a) at least two oppositely facing reflex-reflective side surfaces viewable from different sides of the shoe, each having a reflex-reflective area of at least about 0.05 square inch and a minimum height of about 0.05 inch, (b) front and rear transverse reflex-reflective surfaces each having a reflex-reflective area of at least about 0.05 square inch and a minimum height of about 0.05 inch, and (c) a reflex-reflective top surface having a reflex-reflective area of at least about 0.05 square inch, with each side surface of the reflex-reflective face being less than one inch from the edge of the sole closest to it.

References Cited

UNITED STATES PATENTS
2,567,233 9/1951 Palmquist et al. ........... 350—105
2,581,549 1/1952 McGaugh ................ 350—98
2,607,130 8/1952 Pearson .................. 350—105 X
2,787,975 4/1957 Dunn ...................... 350—98 X

FOREIGN PATENTS
737,776 12/1932 France.
301,777 9/1954 Switzerland.

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