Sept. 8, 1970 J. D. TOMLINSON ET AL 3,527,518

SHOE INSTEP REFLECTOR

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FIG. 1

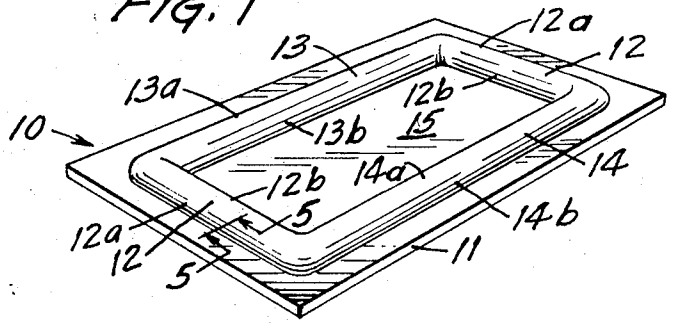


FIG. 2

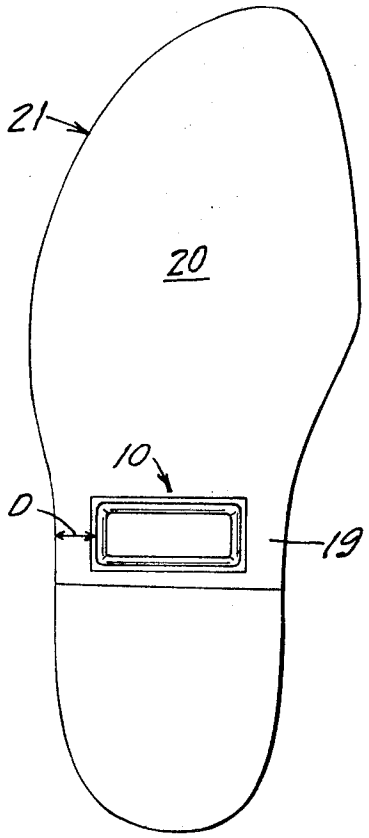


FIG. 3

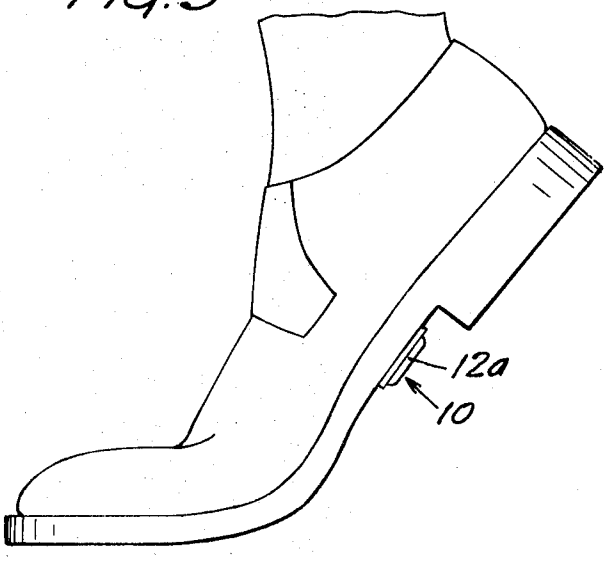
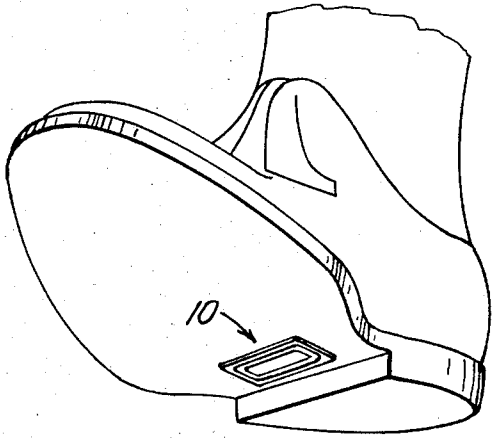


FIG. 4



INVENTORS
JOHN D. TOMLINSON
CHARLES V. SEVELIN
BY Kinney, Alexander
Sell, Steldt & DeLa Hunt
ATTORNEYS

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FIG. 5

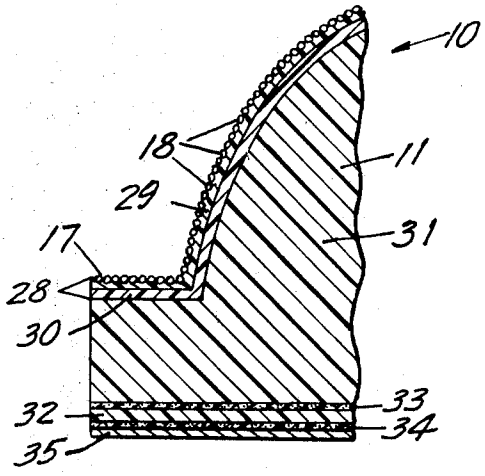


FIG. 6

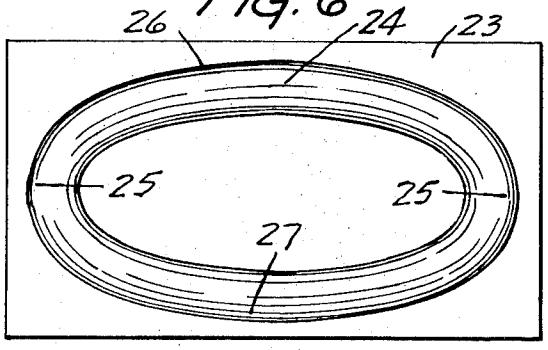


FIG. 7

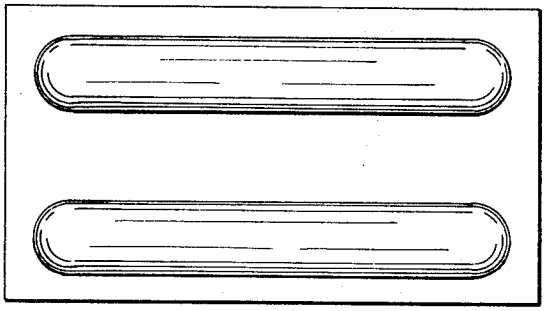


FIG. 8

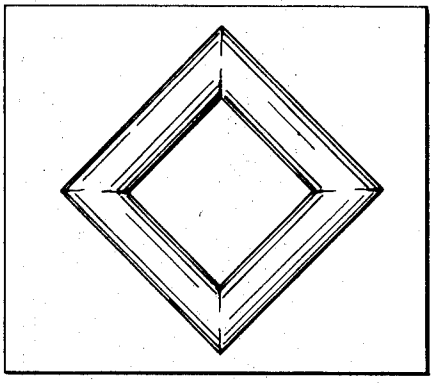
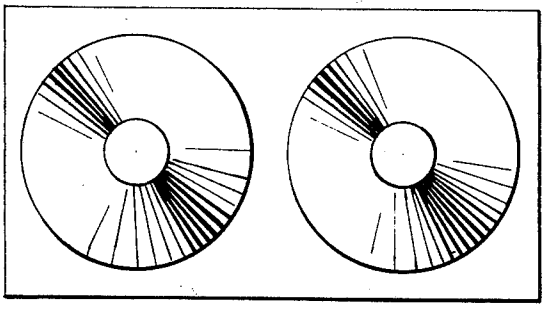


FIG. 9



INVENTORS
JOHN D. TOMLINSON
CHARLES V. SEVELIN
BY Kinney, Alexander, Sell, Steldt & DeLaHunt
ATTORNEYS

United States Patent Office 3,527,518 Patented Sept. 8, 1970

3,527,518

SHOE INSTEP REFLECTOR

John D. Tomlinson, St. Paul, and Charles V. Sevelin, St. Paul Park, Minn., assignors to Minnesota Mining and Manufacturing Company, St. Paul, Minn., a corporation of Delaware

Filed Apr. 1, 1968, Ser. No. 717,842
Int. Cl. G02b 5/12
U.S. Cl. 350—98 4 Claims

ABSTRACT OF THE DISCLOSURE

A reflex-reflector for attachment to the depressed instep 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 that 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 instep 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 high—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 section 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 elastomeric 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 elastomeric 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 instep portion of a shoe, such as the instep 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 **12***a* and **12***b*, viewable at times from the side of a shoe, reflex-reflective front surfaces **13***a* and **14***a*, viewable at times from the front of the shoe, reflex-reflective rear surfaces **13***b* and **14***b*, 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 **12***a* 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 warning signal. Preferably, however, the reflex-reflective side surface **12***a* 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 **12***a* 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 **12***a* and **12***b*, 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 sporadically will there be any reflection from the central flat surface **15** of the reflector to a motorist at the side 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 **12***a*.

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 **13***a* 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 having 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 reflex-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, **13***a* and **14***a*, which is even more preferred.

As illustrated in FIG. 3, the heel of a typical pedestrian is sufficiently elevated as he prepares 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**. Accordingly, a very good warning signal would be provided a motorist approaching from the rear a pedestrian wearing reflectorized shoes that did not have reflex-reflective rear surfaces such as **13***b* and **14***b* 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. While the same minimum 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. 7–9.

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, reflex-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 objects or otherwise be noticeable 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 embedded surface covered with aluminum (the sheet **28** may be prepared, for example, by coating a layer of a solution of elastomeric or elastomeric precursor material on a carrier; cascading glass beads that have been each vapor-coated with aluminum onto the layer whereupon 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 comprises an elastomer formed from an epoxy resin and a long-chain diamine having high adhesion to the aluminum-coated beads; and the layer **30**, which comprises neoprene rubber and which is included to improve adhesion 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 facilitated by heating the 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 polyol and polyisocyanate 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 the 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.

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PAUL R. GILLIAM, Primary Examiner