# United States Patent [19]

**Douglas**

[11] **3,758,190**

[45] **Sept. 11, 1973**


[54] **JUMPING REFLEX-REFLECTION**


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[73] Assignee: **Nu-Pro, Inc.,** St. Paul, Minn.



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[21] Appl. No.: **251,431**

[52] **U.S. Cl.** ..... **350/97,** 40/39, 350/99

[51] **Int. Cl.** ..... **G02b 5/12**

[58] **Field of Search** ..... 350/97, 99, 103, 350/288; 40/39, 126 B; 116/63



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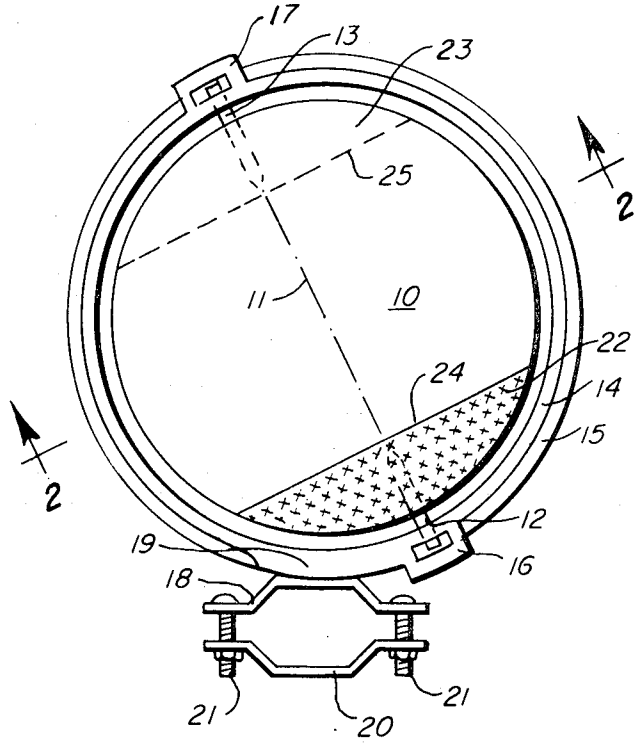
*Assistant Examiner*—Michael J. Tokar
*Attorney*—Robert C. Baker



[57] **ABSTRACT**

The jumping reflex-reflectors disclosed are eye-catching attention-getting safety devices. They have at least one primary rotatable part, an axis means establishing a predetermined axis for rotation of the primary rotatable part, and holding means for the axis means to permit the rotation, especially a wind-actuated rotation. The primary rotatable part comprises a form-retaining body, preferably a base sheet material. This base sheet is aligned with substantially all portions of it extending substantially parallel with the predetermined axis for its rotation. It is contoured at least in portions outwardly from the axis; and patterned areas of reflex-reflecting material and of non-reflex-reflecting material (preferably fluorescent) are disposed on opposite sides of it. The patterned area of reflex-reflecting material on one side is relatively displaced in axial relationship from the patterned area of reflex-reflecting material on the other side. In all cases, at least 50 percent of the area coverage of each reflex-reflecting pattern on opposite sides of the sheet material is in locations relative to the axis which do not coincide as viewed during rotation of the rotatable part. The patterned areas of non-reflex-reflecting material on opposite sides of the sheet material also are relatively displaced in axial relationship to each other. The arrangement is such that, at substantially all practical rotation speeds for the primary rotatable part about the predetermined axis, a viewer under reflex-reflecting conditions gains the impression of shifting flash patterns of light return suggestive of the patterns of the areas of reflex-reflecting material. A variety of rotatable bodies and reflex-reflecting pattern arrangements are disclosed.


**22 Claims, 9 Drawing Figures**



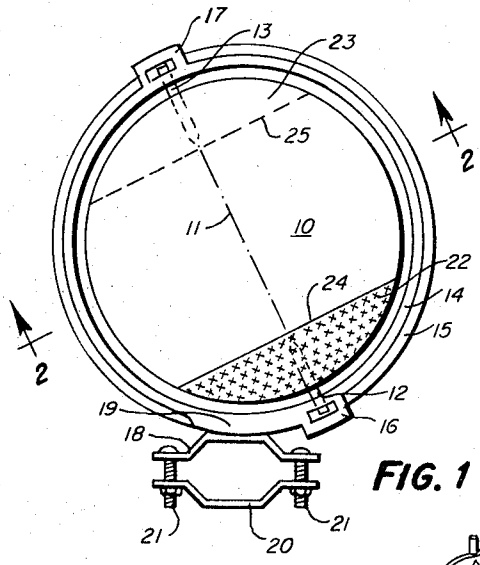



FIG. 1

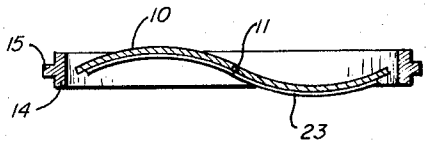



FIG. 2

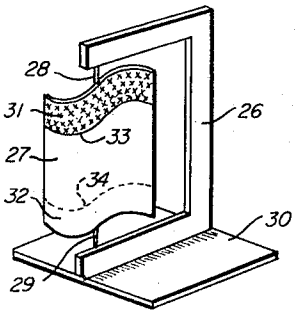



FIG. 3

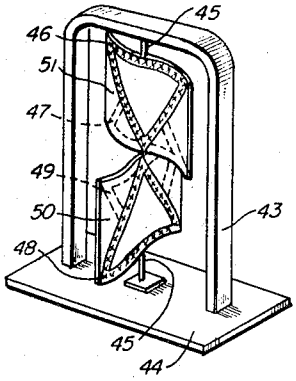



FIG. 5

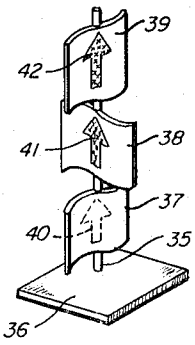



FIG. 4

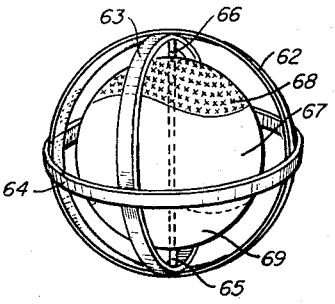



FIG. 7

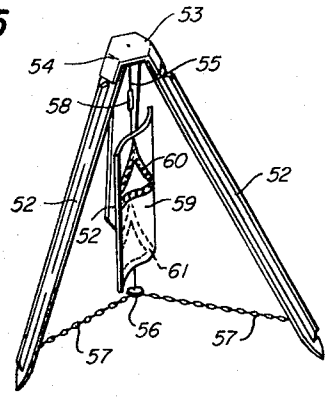



FIG. 6

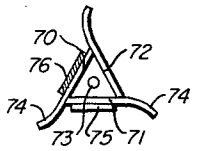



FIG. 8

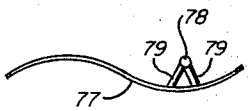



FIG. 9

# JUMPING REFLEX-REFLECTION

This invention relates to safety warning devices, and more particularly to eye-catching attention-getting safety devices having patterned areas of reflex-reflecting material thereon.

All safety warning devices of this invention are adapted to exhibit a functional performance which provides a viewer under reflex-reflecting conditions with the impression of leaping or shifting or jumping flash patterns of light return; and the devices hereof exhibit such functional performance entirely throughout a circle of 360° around them.

A daytime safety warning feature for reflex-reflecting devices hereof is created by additionally employing special patterned areas of fluorescent material in such a way as to cause leaping or jumping patterns of fluorescent light.

In primary structural embodiments of this invention, a form-retaining contoured base sheet material is so aligned with respect to a predetermined axis that substantially all portions of the sheet material extend substantially parallel with that axis. Rotation of the sheet material takes place about that axis; and wind actuation of the rotation is normally relied upon. Patterned areas of reflex-reflecting material and of non-reflex-reflecting-material (e.g., fluorescent) on the base sheet material provide a viewer under reflex-reflecting conditions with the leaping or shifting or jumping flash patterns more fully discussed hereinafter.

Reflex-reflective teachings herein may be incorporated in a variety of structural and functional relationships, especially in combination with fluorescent patterns, to provide devices useful as safety warning devices for moving vehicles, especially slow moving vehicles such as bicycles, farm vehicles, and the like. Devices hereof may also be used at stationary locations, such as on a road bed or shoulder near a stalled vehicle, or at various elevated locations, such as on a post or sign frame or support. When mounted or placed at a stationary location, with air currents or wind relied upon to effect rotational movement, it is desirable to choose a location which is apt to receive gusts of wind or a churning or turbulence of air (as commonly caused by a passing vehicle) sufficient to effect the desired rotational movement; but powered means to effect the rotational movement, although not desired and certainly not necessary in practicing the preferred teachings hereof, may optionally be employed. A major purpose of the invention is that of providing eye-catching attention-getting safety devices relying upon wind or air movement for the rotational effects.

One problem in gaining wide-spread usage of safety warning devices by bicycle riding youngsters is that of creating a strong desire on the part of the youngsters to possess the device and to display it properly. The present invention provides youngsters with an exciting motion device, activated by the movement of the bicycle down a road. Combined with the excitement of the motion aspect is the functional feature of intermittent reflex-reflection of jumping or shifting character. A night time driver of an automobile approaching a bicycle equipped with the motion device of the present invention sees jumping flashes of reflex-reflected light which attract his eye and command his attention. For daytime safety, fluorescent patterns preferably also are present. Thus, bicycle riding youngsters get excitement and satisfaction from the motion aspect, while the driving public gains the benefit of an attention-getting alert for the protection of the youngsters.



Of course, a wide variety of spinning or rotatable devices are known, some including rotating reflex-reflectors; and the following U. S. patents are illustrative: Oliver No. 214,694; Warner No. 1,225,379; Dodson No. 1,258,541; Canby No. 1,275,384; Addition No. 1,798,052; Valk No. 1,906,668; Learnard No. 2,679,711; Fuller et al. No. 2,781,017; Gladen No. 2,797,621; Sly No. 2,890,536; Barker No. 2,943,416; Levey No. 2,948,257; Simmons No. 2,965,991; Trigilio No. 3,292,569; Lusebrink No. 3,320,920; and Beaubien No. 3,391,487.

However, the reflex-reflecting pattern arrangements as taught herein, particularly the relatively displaced arrangements as explained more fully hereinafter, and the special benefits and functional results flowing therefrom, are not, insofar as is known, recognized or suggested in the prior art (not even in prior art dealing with rotary reflex-reflectors, such as Fuller et al. U.S. Pat. No. 2,781,017, and Trigilio U.S. Pat. No. 3,292,569).

An especially important feature of this invention is that of the flexibility or variety of possible arrangements for the patterns of the reflex-reflecting material on the primary rotatable part of the devices herein. This is achieved suitably by employing bead-type reflex-reflecting material which is capable of assuming essentially any curvature or contour as desired. Alternatively, cube-corner type reflex-reflectors may be employed; but such reflectors are not as easily handled in creating varied design arrangements, as preferred.

Reflex-reflectors are, of course, well known; and illustrative bead-type teachings, here incorporated by reference, are contained in the following U. S. Pat. Nos.: Gebhard et al. 2,326,634; Palmquist 2,407,680; Palmquist 2,963,378; McKenzie 3,025,764; Palmquist 3,043,196; Nellessen 3,099,637; Nellessen 3,251,704; and Vanstrum 3,274,888. Teachings from these patents as well as still other suitable reflex-reflecting sheet materials and coatings are useful in the practice of the invention.

Basically reflex-reflectors cause an incident beam of light impinging thereupon to be retro-directed back toward the direction of the light source itself, more or less in a brilliant cone having the incident beam as its axis. The light so returned is considered to be retro-reflected or reflex-reflected; and this is to be distinguished from light returned from a specular flat surface such as a mirror or polished metal surface. Angular light reflected by a specular surface is returned at an angle opposite to normal but approximately equal to the angle at which it impinged upon the specular surface. In reflex-reflection, the light returned from the surface is in a cone with the incident beam as its axis even when the incident beam strikes the reflex-reflecting surface at angles rather substantially away from a true normal angle (that is, 90°). It is this feature, plus the improved quantum of light return toward a source over that exhibited by a specular surface (when both are revolving), that makes the reflex-reflecting patterns and relationships taught herein of critical character in practicing the invention.

Characteristically, bead-type reflex-reflectors comprise a layer of small transparent glass beads or sphere lenses or microspheres, plus an underlying opaque re-

flecting material, preferably of a specular type such as metal flakes or coatings (see, for example, the teachings of the aforenoted patents directed to bead-type reflex-reflectors). Light entering a bead or sphere-lense of the bead layer is refracted, strikes the underlying reflective material, and then is again refracted on its return trip through the bead. The result is that the light is returned back toward its source in a brilliant diverging cone.

Eye-catching attention-getting safety devices of the present invention comprise at least one primary rotatable part actuatable into rotation, preferably by wind acting thereupon. An axis means is also provided and establishes a predetermined axis about which rotation of the primary rotatable part takes place. Holding means for the axis means permits rotation of the rotatable part.

In the primary embodiments of the invention, the primary rotatable part comprises a form-retaining base sheet material which is so aligned that its major portion or substantially all portions of it extend substantially parallel with the predetermined axis of rotation. This sheet material is preferably contoured, usually in a continuous sweeping manner as it extends outwardly from an axis of rotation for it. It should at least be contoured in portions outwardly from the predetermined axis, so as to facilitate wind actuation of its rotation. Patterned areas of reflex-reflecting material and of non-reflex-reflecting material are on opposite sides of the base sheet material. The patterned area of reflex-reflection on one side of the sheet material is relatively displaced in axial relationship from the patterned area of reflex-reflecting material on the other side thereof. In essence, at least 50 percent of the areas of the reflex-reflecting patterns on opposite sides of the sheet material are in locations relative to the axis means which do not coincide as viewed during rotation of the primary rotatable part. The patterned areas of non-reflex-reflecting material on opposite sides of the sheet material also are relatively displaced in axial relationship to each other. Thus, rotation of the primary rotatable part, that is, the base sheet material, about its predetermined axis provides a viewer under reflex-reflecting conditions with the impression of shifting flash patterns of light return; and these flash patterns are suggestive of the patterns of the areas of reflex-reflecting material on opposite sides of the base sheet. Especially significant is the fact that the single primary rotatable part performs such as to provide the shifting flash pattern effect, which is quite distinct from the teachings in the prior art, and the fact that the displaced pattern arrangement as taught herein is such that the shifting light return therefrom is capable of resolution by the human eye under practical use conditions.

Preferably, the reflex-reflecting pattern on one side of the rotatable base sheet material is substantially identical in overall shape to the reflex-reflecting pattern on the other side thereof; but the patterns on opposite sides are relatively displaced with respect to each other. Further, the predetermined axis of rotation for the base sheet material generally but not always will extend along a line substantially coinciding with a line in the plane of the base sheet material. Displaced reflex-reflecting patterns on opposite sides will preferably extend across the area of the sheet material at the predetermined axis of rotation, which contributes significantly to the gaining of light return of shifting character resolvable as shifting flashes by the human eye.

In several alternate embodiments of the invention, the primary rotatable part comprises a form-retaining body having surface viewable areas completely surrounding and spaced outwardly from the predetermined axis of rotation for the body. At least two patterned areas of reflex-reflecting material on background areas of non-reflex-reflecting material are on the body, with the patterns relatively displaced from each other in both axial relationship and radial relationship on the surface viewable areas. At least one of the patterns of reflex-reflecting material does not extend in a circumferential direction on the surface viewable areas any more than 180° about the predetermined axis. Preferred structural bodies comprise at least three discrete surface viewable areas connected in angular relationship to each other, with no pattern of reflex-reflecting material extending more than about 120° in a circumferential direction.

The invention and various functional benefits and advantages flowing from it will further be described with the aid of a drawing, made a part hereof, wherein:

FIG. **1** is a plan view of a safety warning device of the invention especially adapted for affixing to the handlebar or a frame part of a bicycle;

FIG. **2** is a cross section taken on lines **2—2** of FIG. **1**;

FIGS. **3, 4, 5, 6,** and **7** are schematic perspective views of alternate embodiments of the invention;

FIG. **8** is a schematic cross-sectional view of a rotatable part comprising a body having three discrete surface viewable areas connected in angular relationship to each other and completely surrounding and spaced outwardly from a predetermined axis for the rotation thereof; and

FIG. **9** is a schematic cross-sectional view of a rotatable sheet material part for a safety device according to the invention, with the axis of rotation displaced from a line extending through the plane of the rotatable sheet material part.

The safety device illustrated in FIGS. **1** and **2** will first be described. That device comprises a rotatable part **10** which is a form-retaining base sheet material. "Form-retaining," as used herein, means a rigid or semi-rigid or even somewhat flexible type material, but one which, after possible deformation under pressure, returns to its original shape or contour. Generally such sheets are relatively stiff. This part **10** is actuatable into rotation by wind acting thereupon. An axis means **11**, suitably formed by stub shaft elements **12** and **13**, is provided and establishes a predetermined axis about which rotation of the primary rotatable part takes place. Stub pivot elements **12** and **13** extended outwardly from perimeter portions of the rotatable sheet material part **10.** Rotatable sheet part **10** is essentially circular or disk-like in overall perimeter shape; and the axis pins **12** and **13** suitably may be molded or formed at the same time part **10** is formed. Illustratively, these parts may be formed out of organic plastic materials such as polystyrene, polyethylene, polyvinyl chloride (or any of a variety of organic plastic materials) as well as, if desired, aluminum, or any of a variety of metallic or metal materials.

A closed loop frame **14** of ring-like character, suitably with a reinforcing ridge **15**, serves as a stationary protective frame for rotatable part **10** and for holding

the axis pins **12** and **13** for it. Bearing surfaces or socket recesses **16** and **17** are suitably molded as an integral part of frame **14** for receiving the pivot stubs or shafts **12** and **13** in a manner permitting their rotation.

A bracket **18** may be riveted or otherwise fixed to frame **14**, especially at a reinforced portion **19** thereof; and the bracket **18** suitably is one adapted to be fixed to a round bar such as a bicycle handlebar or the like. A cooperating closure part **20** for the bracket **18** suitably is provided for attachment as by bolts **21** to the bracket **18.** Observe that the means **18** for mounting the frame **14** (and therefore the safety device per se) to a base object such as a bicycle handlebar is preferably fixed to frame **14** at a location not in alignment with the axis means **11** nor a location perpendicular thereto. The significance of this is that the rotatable part **10** rotates on an axis angularly disposed with respect to the location of mounting means **18,** the angle being between 0° and 90°; and this in turn contributes to the desired disposition of light reflecting patterns received from the device as it is mounted on a bicycle handlebar.

The patterns of reflex-reflecting material on the device will now be discussed. These are located on the primary rotatable part **10,** which illustratively consists essentially of a form-retaining base sheet material, as aforenoted. This base sheet material is aligned with substantially all portions of it extending substantially parallel with the predetermined axis of rotation for it. However, the base sheet material may be and preferably is contoured as it extends outwardly from the axis of rotation, with the contour creating oppositely outturned leading and trailing edges removed from the axis of rotation. It is curvi-planar. The contour facilitates wind or air pick-up by the rotatable part, and therefore contributes to the wind actuated rotation of it. In short, the oppositely outturned edges are adapted to differentially intercept air flowing by them, which in turn causes rotation of part **10.**

On one face side of the sheet material **10** is located a patterned area **22** of reflex-reflecting material. Illustratively, the reflex-reflecting material employed may consist of a flexible prefabricated sheet **22** adhesively fixed on base sheet part **10.** As shown in FIG. **1,** the area **22** of reflex-reflecting material covers all portions of the area of the base sheet material **10** from one stub pivot **12** up to about one-fourth the axial distance across part **10** from stub **12** to stub **13.** The remaining three-fourths of the face side of the base sheet material **10,** as viewed in FIG. **1,** is illustratively entirely free of reflex-reflecting material, and is non-reflex-reflecting.

Conversely, the reverse side of the base sheet material **10,** as viewed in FIG. **1,** is equipped with a pattern of reflex-reflecting material **23** extending up to about one-fourth of the axial distance across part **10** from the pivot stub **13** toward stub **12.** Apart from the two noted reflex-reflecting portions **22** and **23** on opposite sides of the base sheet material **10,** the surfaces of part **10** are non-reflex-reflecting. Those remaining surface portions suitably may be coated with fluorescent material or a fluorescent paint (to provide daytime brillance), but preferably are not coated or formed with a specular or mirror-type reflecting material. If the rotatable disk **10** is formed out of metal exhibiting a specular reflecting character, all portions not covered by the pattern of reflex-reflecting material preferably are painted or covered with fluorescent paint or layer, or a non-fluorescent but diffuse reflecting paint or layer, so as to remove the specular reflecting character from the rotatable disk or base sheet material **10.** The reason for this is to remove interference for the refelx-reflecting pattern as would be caused (under some but not all conditions of reflex-reflective viewing) by a specular or mirror reflecting surface adjacent a reflex-reflecting pattern area on the rotatable part **10.**

Reference to viewing under reflex-reflecting conditions, as used herein, refers to viewing a safety device hereof at a location generally radially outward from (and not in line with) the axis of rotation for the primary rotatable part of the safety device, and with the eyes of the viewer near a source of incident light striking the safety device (such as, for example, is the characteristic viewing circumstance for the driver of an automobile with the auto headlights operating).

An important feature of the patterned areas of reflex-reflection in the device illustrated in FIGS. **1** and **2** is that the area of reflex-reflection identified at numeral **22** becomes viewable only once during each complete revolution of the rotatable part **10.** Likewise, the area of reflex-reflection identified by numeral **23** becomes viewable only once on each complete revolution of rotatable part **10.**

An especially important characteristic of the reflex-reflecting pattern arrangements taught herein, is that at least 50 percent of the area coverage of each reflex-reflecting pattern on opposite sides of the sheet material is in locations relative to the axis which do not coincide as viewed during rotation of the rotatable part. In other words, a face view of one side, followed by a face view of the other side, will reveal to the viewer that at least 50 percent of the reflex-reflecting area coverage on one side lies in areas not reflex-reflecting when the base sheet material is reversed for viewing its opposite or other side. As a practical matter, preferred pattern arrangements of the invention are such that 100 percent of the pattern on one side does not coincide with the other when the base sheet material is reversed. But in all cases, even when slight overlapping of pattern impressions occurs on rotation, the reflex-reflecting areas on opposite sides are relatively displaced in axial relationship, that is, in their relative orientation to the axis. In fact, they are preferably very substantially spaced from each other on opposite sides of rotatable sheet **10** in a direction parallel with the axis--not only with no axial overlapping or coinciding of the pattern on one side with the pattern on the other, but with a substantial non-reflex-reflecting space between.

The substantial spacing in an axial direction (or direction parallel to the axis), plus the fact that the areas of reflex-reflection extend across the axis of rotation as viewed under reflex-reflecting condition, together with the requirement of a complete revolution before either area of reflex-reflection repeats or unfolds itself, and even, to some extent, the substantially continuous contour of the rotatable sheet **10** from the axis **11,** all contribute to the desired feature of providing a viewer, under reflex-reflecting conditions, with the impression of jumping flash patterns of light return which are resolvable under substantially all practical conditions as flash patterns or flickers by the human eye.

This resolvability feature is of utmost importance, and is to be distinguished from the great tendency toward blurring response as commonly characteristic for heretofore known devices having reflex-reflectors of identical character not relatively displaced in an axial

relationship on opposite sides of a single revolving vane. Such heretofore known devices, where the sheet or vane actuatable into rotation by wind is provided with reflex-reflectors, have invariably spaced the reflex-reflecting areas radially outward from the axis of rotation, with the area of reflex-reflection on one side coinciding with the area on the other under viewing conditions. Such areas of reflex-reflection move by rotation through a sweeping arc into view for a viewer, with both areas presenting themselves to a viewer during a single complete rotation, whereas the patterned reflex-reflecting areas illustrated in FIG. **1**, (which are axially displaced and extend across the axis of rotation) tend to give the result of "unfolding," with each presenting itself only once and only momentarily during each complete revolution, which effectively causes the result of a momentary maximum retro-direction of incident light at a particular area on the device just once during each revolution. The arc sweeping aspect inherent for any portion of a reflex-reflecting area extending radially outward from the axis of rotation is substantially overcome or minimized by virtue of the "unfolding" characteristic of reflex-reflecting patterns which extend over the axis of rotation, as illustrated in FIG. **1**. Such is to be distinguished from a blurring swash-buckling or streaking effect characteristic of arc sweeping reflecting areas spaced from the axis of rotation and not extending over the axis.

Of especial pertinence is that the effect of shifting flashes, as distinguished from the impression of a single blur, is preserved for the viewer of devices equipped with the pattern arangements as taught herein, even when the rotatable part spins at a rate in excess of about 1,000 revolutions per minute, which in effect demonstrates that the benefit of shifting flash performance persists under all practical environmental wind conditions, at least up to about hurricane velocity (and hurricane velocities are not looked upon as practical). Also, if desired, devices hereof may be equipped with means to cause a braking effect as rotation approaches hurricane velocity; and illustratively, selective high velocity braking may be accomplished by adding a small propeller unit to the axis of rotation. The propeller unit will be substantially ineffective to axially shift the axis means at low velocity of rotation, but will shift the axis means at raised velocities and frictionally press the axis into a bearing for its rotation, thereby retarding rotation. But this is not really necessary.

As a general rule, the pattern of reflex-reflection on one side of the base sheet **10** should be, or preferably is, substantially identical in overall shape to that on the other side of the sheet **10.** But, the pattern frequently is preferably inverted on one side with respect to the other. Thus, the pattern **22** is substantially the mirror image of the pattern **23** on the reverse side, or vice versa. While circular patterns may be employed, non-circular patterns (or patterns whose perimeter is non-circular) of reflex-reflection are vastly preferred from the standpoint of creating recognizably distinct flash return of light on rotation of the device under reflex-reflecting conditions. Circular patterns, even when portions of the interior are broken away or removed to create an image which appears recognizably different on forming a mirror inversion of it, are nevertheless not preferred simply because the human eye, on very rapid rotation of the rotatable part **10,** is somewhat taxed to resolve a detailed specially created design of non-reflex-reflecting character within the circle. Under all circumstances, a full disk of reflex-reflection is not preferred as a pattern. Geometric patterns of some other perimeter shape, such as triangle, rectangle, oval, half moon, a strip, or the like (but preferably not optional alphabet letter or numbers), are much more attention-getting and do not appear as a "light bulb." Even a relatively large ring can give useful preferred type results. But solid disk-like reflex-reflectors generally are not preferred. However, cube-corner reflex-reflectors of varied pattern shapes can be useful, especially where flexible cube-corner sheet materials are employed in making the patterns.

Bead-type reflex-reflecting sheet materials or coatings permit convenient formation of a variety of shapes or patterns for the reflex-reflecting areas in an economical manner. No problem exists in reflex-reflectorizing curved or peculiarly shaped surface areas when bead-type reflex-reflectors are employed. For example, reflex-reflecting structures of any contour may be formed by applying paint compositions which upon drying exhibit a reflex-reflection (as, for example, taught in U. S. Pat. No. 3,251,704). Preferably, however, the patterns are formed by adhesively affixing or otherwise fixing to the rotatable part **10** a pattern cut from previously fabricated thin bead-type reflex-reflecting sheet material, and an especially desired sheet to employ is one having a transparent cover film over a base exposed lense structure such as shown in Gebhard et al. U.S. Pat. No. 2,236,634, with a honeycomb pattern of line seals securing the transparent cover film to the base structure and forming a plurality of cell spaces of reflex-reflecting character.

The most preferred pattern arrangements for shifting reflex-reflection are axially separated on opposite sides by an axial spacing distance of at least about one-third the axial distance of the rotatable sheet material (the distance of separation being preferably greater as anticipated rate of rotation increases), with all other areas covered with fluorescent material for daytime attention-getting properties. Optionally, the fluorescent pattern areas may be separated by an axial spacing distance equal to or lesser or greater than that for the areas of reflex-reflection.

In the safety device illustrated in FIG. **3,** an open loop frame or U-shaped frame **26** is employed for holding the essentially square or rectangular contoured base sheet material **27** for rotation about a predetermined axis formed by pivot stubs **28** and **29.** A base plate **30** may be employed as a foundation piece for holding frame **26** in an upright position. Form-retaining base sheet material **27** is provided with a strip of reflex-reflecting material **31** on one side, with the edge **33** of that strip extending perpendicular to the axis of rotation at a point preferably no more than about one-third of the distance from the top edge of the base sheet to the bottom edge thereof. Another patterned strip of reflex-reflecting material **32,** on the opposite side of base sheet **27,** extends with its edge **34** about one-third the distance from the bottom of the base sheet **27.** Shifting reflex-reflective performance for the structure in FIG. **3** is substantially similar to that for the structure illustrated in FIG. **1.**

The device illustrated in FIG. **4** is a device capable of performing analogously to moving lights of a display sign; but no source of power is needed. In FIG. **4,** a single axis means **35,** such as a shaft or rod, is mounted for

rotation in a base plate or holding means **36.** Only one end of the axis shaft **35** is illustrated as being so mounted. Spaced along the axis shaft **35,** and rotatable about the axis means provided by rod **35,** are a plurality of rotatable parts, including a base or primary rotatable part **37,** plus a secondary part **38,** with optionally a still further secondary rotatable part **39.** The rotatable parts are all axially displaced from each other; and each rotatable part, in the showing of FIG. **4,** consists essentially of a form-retaining curvi-planar sheet material aligned with substantially all portions thereof extending substantially parallel with the predetermined axis of rotation established by axis means **35.** Further, the sheet material of primary rotatable part **37** is radially displaced in orientation (as at a **90°** angle) from the sheet material of rotatable part **38.** Indeed, the sheet material of rotatable part **39** may be radially displaced in orientation from both of the rotatable parts **37** and **38;** but optionally, the sheet material of rotatable part **39** may be substantially oriented in a radial manner comparable or radially identical to rotatable part **37,** as is the case in the showing of FIG. **4.** (If desired, the axially-oriented ends of the rotatable parts may be connected together by webs of material so as to give a screw effect or appearance to the entire rotating assembly; but this is not preferred and is merely an expedient for giving a joined appearance to the parts.) A patterned area of reflex-reflecting material **40, 41,** and **42,** illustratively shaped in the form of an arrow, is fixed to one side of each of the sheet materials comprising the rotatable parts **37, 38** and **39.** Arrow **40** is on the reverse side of part **37** as shown in FIG. **4;** and arrows **41** and **42** are shown on the side of sheet parts **38** and **39** which one views when looking at FIG. **4.** The arrows are all displaced in axial relationship from one another and preferably extend over the axis area of rotation. The opposing surface or opposite surface (not carrying an arrow) of each rotatable part is preferably entirely free of reflex-reflecting material in the embodiment illustrated in FIG. **4.** Each base sheet material part **37, 38,** and **39** suitably is contoured to promote rotation as effected by wind acting thereupon. The effect of the arrangement in FIG. **4,** when viewed under reflex-reflecting conditions, is that of providing the viewer with the impression of an arrow jumping along a line and then returning to its point of beginning and again jumping along a line. Thus the impression of a repetitive series of arrows is gained. The arrangement (or alternate orientation of arrows or other directional shapes) is especially useful as a roadside sign alerting drivers on the highway to the presence of a curve ahead or the like. It also is useful to alert drivers to change lanes where a lane is blocked further ahead. In principle, it is even useful as an alternate arrangement (optionally with the arrow pattern replaced by a different shape) for safety warning devices for bicycle riders.

The device of FIG. **5** comprises a perimeter frame member **43** of closed loop character. The closed loop is formed by the frame legs and top fastened to a base plate **44.** Axis means or shaft **45** is mounted for rotation in bearing surfaces at the top of the frame **43** and the base **44.** Two form-retaining base sheet materials **50** and **51** are disposed approximately at right angles to each other (or radially displaced) and in axially displaced positions on the axis shaft **45.** Each is contoured or curvi-planar with substantially all portions in alignment with axis **45** and extending outwardly therefrom. Patterned areas of reflex-reflecting and non-reflex-reflecting material are on opposite sides of each base sheet **50** and **51.** The rotatable part identified as base sheet material **50** is equipped on one side with a strip pattern **48** of triangular shape in reflex-reflecting material, with a triangular center portion of the triangular shape of reflex-reflecting material being non-reflex-reflecting. All triangular shaped border areas of reflex-reflecting material, as illustrated in FIG. **5,** are characterized by having a center triangular area of non-reflex-reflecting material. The triangular reflex-reflecting pattern identified by numeral **49** is on the reverse side of the base sheet **50;** and to be observed is that the border triangular reflex-reflecting pattern **49** is the mirror reciprocal or inversion of the reflex-reflecting pattern **48** on the face side of base sheet **50** as viewed in FIG. **5.** Thus the patterns are relatively displaced in axial relationship and at least **50%** of the area coverage of each reflex-reflecting pattern on opposite sides is in a location relative to the axis which does not coincide as viewed during rotation. In a comparable manner, the secondary base sheet material **51** in FIG. **5** is equipped with a border triangular pattern **46** of reflex-reflecting material **46** on one side; and the reverse side of that base sheet **51** is equipped with a comparable border triangular pattern of reflex-reflecting material **47.** Again the patterns on opposite sides of the base sheet **51** are suitably substantially identical in overall shape; but the pattern on one side is inverted and therefore of different axial orientation from the pattern on the other. All areas of these base sheets **50** and **51,** apart from the triangular strip patterns of reflex-reflecting material, are non-reflex-reflecting and non-specular reflecting. Illustratively, the center island triangles on both sides of each base sheet **50** and **51** may be and preferably are covered with fluorescent material such as a fluorescent paint. If desired, all of the areas of the base sheets **50** and **51,** apart from the reflex-reflecting areas, may be coated with fluorescent material. But preferably, the areas of base sheets **50** and **51** external to the border triangulation of reflex-reflecting material are transparent. Upon rotation of the base sheet **50** and the secondary base sheet **51** about the axis **45** under the influence of wind striking the base sheets **50** and **51,** the viewer under reflex-reflecting conditions gains the impression of shifting flash patterns exhibiting alternate or inverted mirror image characteristics; and during daytime or dawn or dusk conditions, the alerting benefit of jumping fluorescent light is exhibited by the rotating device. This makes the pattern arrangements especially useful on farm vehicles and other slow vehicles as a safety warning member having greater attention-getting qualities than a stationary marker on the vehicles. The rotating-arrangement is attention-getting even as the vehicle approaches a highway from a side road.

The device in FIG. **6** comprises a tripod frame, with three legs **52** hinged to an apex plate **53.** Hinge **54,** especially when apex **53** and legs **52** are formed out of organic plastic, may consist of a fold of plastic material. Alternately, metal hinges or other suitable hinging means may be employed. Axis means **55,** illustratively a simple string or strand or flexible wire with a swivel connector **58** interposed along the length thereof, depends downwardly from apex **53.** The lower end of the axis strand **55** likewise is swivelly mounted, as at **56.** Element **56** is suitably held in place by flexible links **57**

extending substantially horizontally from it to tripod legs **52**. Links **57** brace or limit the spread of the legs. Contoured from-retaining base sheet material **59** on axis **55** is actuatable into rotation by wind acting thereupon. A border strip triangular pattern of reflex-reflecting material **60** on non-reflex-reflecting background is carried on one side of base sheet **59**; and a comparable reflex-reflecting pattern **61** is carried on the other side, optionally with fluorescent material within the triangles, as aforenoted. Pattern **61** is shown substantially axially displaced from the pattern **60**. Viewed under reflex-reflecting conditions, the alternate flashing effect of the patterns occurs at two distinctly different levels.

In FIG. **7**, a safety warning device comparable to that illustrated in FIG. **1** is shown, with the exception that the frame structure for the device consists of a series of ring elements **62, 63** and **64**. Ring elements **62** and **63** may be looked upon as disposed at right angles to each other and oriented analogously to great circles of longitude (by analogy to a globe). Ring element **64** is oriented at a location comparable to an equator line intersecting with the ring element **62** and **63**. Stub shafts **65** and **66** are suitably mounted in bearing surfaces at the pole intersections of ring elements **62** and **63**. Rotatable base sheet material **67** of contoured design (comparable in contour to that illustrated in FIGS. **1** and **2** for the base sheet material **10** shown therein) is equipped with patterned areas **68** and **69** of reflex-reflecting material on opposite sides thereof, with the patterns substantially displaced from each other so that no portions overlap as the device is viewed under reflex-reflecting conditions. Other areas of the primary rotatable part **67** are non-reflex-reflecting.

In FIG. **8** (which is a cross section through a form-retaining body), three discrete surface viewable areas **70, 71**, and **72**, are connected together in angular relationship to each other. These areas completely surround and are spaced outwardly from the predetermined axis of rotation identified by shaft **73**. Fin-like projections **74** extend outwardly, suitably in curved contour, from the mass of the body defined by areas **70, 71** and **72**. They provide the means for wind actuation of the rotation of the composite body. Surface viewable areas **70, 71** and **72** preferably contain or comprise at least substantial portions which are substantially parallel with the axis of rotation **73** for the body. Patterned areas of reflex-reflecting material, such as, for example, a star body of reflex-reflecting material, are suitably positioned on each viewable area **70, 71** and **72** at axially displaced locations, without radial overlap of the reflex-reflecting material on any side with respect to the others as the structure is rotated and viewed under reflex-reflecting conditions. In any event, at least **50%** of the area coverage of reflex-reflection on any one side or portion of the surface viewable areas should be in locations not coinciding (to a viewer of the rotating device under reflex-reflecting conditions) with the patterned area of reflex-reflection at other radially displaced surface viewable areas. Illustratively, a discrete reflex-reflecting pattern on one surface viewable side of the body may be located as at numeral **75**, and another as at numeral **76**. The reflex-reflecting material at numeral **76** is shown in cross section to illustrate the face that only part of the reflex-reflecting material at that location is viewed in the cross-section through the body. No reflex-reflecting material is shown on the surface viewable area identified at numeral **72** inasmuch as, hypothetically, the cross section for the body illustrated in FIG. **8** is taken at an intermediate plane or section along its length below the location for the pattern on side **72**.

In concept, surface viewable areas completely surrounding and spaced outwardly from an axis of rotation may comprise or form a cylinder, or even a shape suggestive of a globe or a cone; but usually, the shape will be formed of discrete surface viewable areas or planes (or curvi-planar surfaces) connected together in angular relationship about the axis.

FIG. **9** constitutes an illustration of a curviplanar or contoured base sheet material **77** serving as a primary (or secondary) rotatable part for devices according to the invention, but with the axis **78** for rotation of the sheet material displaced laterally from the body of the sheet material. In short, the predetermined axis of rotation **78** lies in a line not substantially coinciding with a line through the sheet material **77**; but the sheet material is nevertheless so aligned with the axis that substantially all portions of the sheet material, even though it is suitably contoured, extend substantially parallel with the axis **78** of rotation. Sheet material **77** is suitably mounted for rotation about axis **78** through, or by means of, a bracket member **79**. While not preferred, this Figure illustrates that the structural relationship between a rotating body or base sheet material (such as sheet material **77**) and the axis of rotation for it (such as axis **78**) need not be such that the rotation of the body or sheet material **77** is a perfectly balanced disposition of the body or sheet material for rotation about an axis.

The base physical materials useful for fabricating devices of the invention may vary widely, with metal and organic plastic being most prefered from the practical standpoint of ease and economy in forming (by molding or pressing) a variety of rotatable sheet or body shapes and frame structures. The most essential feature, in terms of reflex-reflection, is that of forming the pattern arrangements according to the teachings herein so as to gain the aforediscussed unique flickering performance under practical use conditions, even at relatively high velocity of rotation.

That which is claimed is:

**1.** An eye-catching attention-getting safety device comprising at least one primary rotatable part, an axis means establishing a predetermined axis about which rotation of said primary rotatable part is adapted to take place, and holding means for said axis means to pemrit said rotation, said primary rotatable part comprising a form-retaining base sheet material aligned with substantially all portions thereof extending substantially parallel with said predetermined axis, said sheet material being contoured at least in portions outwardly from said axis, and patterned areas of reflex-reflecting material and of non-reflex-reflecting material on opposite sides of said sheet material, the patterned area of reflex-reflecting material on one side of said sheet material being relatively displaced in axial relationship from the patterned area of reflex-reflecting material on the other side thereof, at least 50 percent of the area coverage of each said reflex-reflecting pattern on opposite sides of said sheet material being in locations relative to said axis means which do not coincide as viewed during rotation of said rotatable part, the patterned areas of non-reflex-reflecting material on

opposite sides of said sheet material also being relatively displaced in axial relationship to each other, whereby substantially all practical rotation speeds for said primary rotatable part about said predetermined axis provide a viewer under reflex-reflecting conditions with the impression of shifting flash patterns of light return suggestive of the patterns of said areas of reflex-reflecting material.

**2.** The safety device of claim **1** wherein the reflex-reflecting pattern on one side of said base sheet material is substantially identical in overall shape to the reflex-reflecting pattern on the other side of said sheet material.

**3.** The safety device of claim **1** wherein said reflex-reflecting pattern on said one side is of a shape which provides a recognizably different pattern when ivnerted.

**4.** The safety device of claim **3** wherein said reflex-reflecting patterns on opposite sides of said sheet material are substantially identical in overall shape but are inverted with respect to each other.

**5.** The safety device of claim **4** wherein at least a portion of said patterned areas of non-reflex-reflecting material on opposite sides of said base sheet material comprises fluorescent material.

**6.** The safety device of claim **1** wherein substantially all of the patterned areas of non-reflex-reflecting material on opposite sides of the base sheet material consists of fluorescent material.

**7.** The safety device of claim **1** wherein said reflex-reflecting patterns on opposite sides of said base sheet material contain no portion which overlaps as veiwed during rotation of said primary rotatable part.

**8.** The safety device of claim **1** wherein said predetermined axis extends along a line substantially coinciding with a line in the plane of said base sheet material.

**9.** The safety device of claim **8** wherein said reflex-reflecting patterns on opposite sides of said base sheet material extend across the axis area of said sheet material.

**10.** The safety device of claim **1** wherein said axis means extends in opposite directions from said base sheet material and said holding means comprises a frame member having means cooperatively associated with each end of said axis means to permit wind-actuated rotation of said primary rotatable part.

**11.** The safety device of claim **10** wherein said frame member comprises a tripod and said axis means depends downwardly from the apex of said tripod.

**12.** The safety device of claim **1** additionally comprising a secondary rotatable part mounted for rotation about said predetermined axis, said secondary rotatable part being axially and radially displaced from said primary rotatable part and comprising a secondary form-retaining sheet material aligned with substantially all portions thereof extending substantially parallel with said predetermined axis.

**13.** The safety device of claim **1** wherein at least a portion of said patterned areas of non-reflex-reflecting material on opposite sides of said base sheet material comprises fluorescent material.

**14.** The safety device of claim **13** wherein said reflex-reflecting patterns on opposite sides contain no portion which overlaps in an axial direction during rotation of said primary rotatable part.

**15.** The safety device of claim **1** wherein said primary rotatable part is actuatable into rotation by wind acting thereupon, wherein said reflex-reflecting pattern on each side of said sheet material is of a shape which provides a recognizably different pattern when inverted, and wherein said reflex-reflecting patterns on opposite sides contain no portion which overlaps in an axial direction during rotation of said primary rotatable part.

**16.** An eye-catching attention-getting safety device comprising at least one primary rotatable part, an axis means establishing a predetermined axis about which rotation of said primary rotatable part is adapted to take place, and holding means for said axis means to permit said rotation, said primary rotatable part comprising a form-retaining body having surface viewable areas completely surrounding and spaced outwardly from said predetermined axis, and at least two patterned areas of reflex-reflecting material on background areas of non-reflex-reflecting material, said reflex-reflecting patterns being relatively displaced from each other in both axial relationship and radial relationship on said surface viewable areas, with at least one of said patterns of reflex-reflecting material not extending in a circumferential direction any more than **180** degrees about said predetermined axis, whereby substantially all practical rotation speeds for said body about said predetermined axis provide a viewer under reflex-reflecting conditions with the impression of shifting flash patterns of light suggestive of the patterns of said areas of reflex-reflecting material.

**17.** The safety device of claim **16** wherein the portions of said surface viewable areas carrying said reflex-reflecting material are disposed substantially parallel to said predetermined axis.

**18.** The safety device of claim **16** wherein said surface viewable areas of said body are disposed to form at least three discrete surface viewable area portions connected in angular relationship to each other.

**19.** The safety device of claim **16** additionally comprising means facilitating wind actuation of the rotation thereof.

**20.** An eye-catching attention-getting safety device comprising at least one primary rotatable part, an axis means establishing a predetermined axis about which rotation of said primary rotatable part is adapted to take place, holding means for said axis means to permit said rotation, and at least one secondary rotatable part mounted for rotation about said predetermined axis, said secondary rotatable part being axially displaced from said primary rotatable part, said primary rotatable part and said secondary rotatable part each consisting essentially of a form-retaining base sheet material aligned with substantially all portions of the sheet material extending substantially parallel with said predetermined axis, said sheet material of said primary rotatable part being radially displaced in orientation from said sheet material of said secondary rotatable part, and a patterned area of reflex-reflecting material on one side of each said sheet material, the other side of each said sheet material containing no area of reflex-reflection axially overlapping said patterned area of said one side, whereby substantially all practical rotation speeds for said rotatable parts about said predetermined axis provide a viewer under reflex-reflecting conditions with the impression of shifting flash patterns of light return suggestive of the patterns of said areas of reflex-reflecting material.

**21.** The safety device of claim **20** wherein said patterned area of reflex-reflecting material on said one

side of said sheet material of said secondary rotatable part is identical to said patterned area of reflex-reflecting material on said one side of said sheet material of said primary rotatable part.

**22.** The safety device of claim **20** additionally comprising means facilitating wind actuation of the rotation thereof.

* * * * *

# UNITED STATES PATENT OFFICE

# CERTIFICATE OF CORRECTION

Patent No. 3,758,190 Dated September 11, 1973

Inventor(s) Donald J. Douglas

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 11, line 65, "face" should read -- fact --.

Column 12, line 51, "pemrit" should read -- permit --.

Column 13, lines 16-17 (claim 3), "ivnerted" should read -- inverted --.

Signed and sealed this 21st day of May 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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