

Aug. 31, 1965

S. A. HEENAN

3,204,093

WARNING LIGHT REFLECTOR

Filed April 4, 1963

2 Sheets-Sheet 1

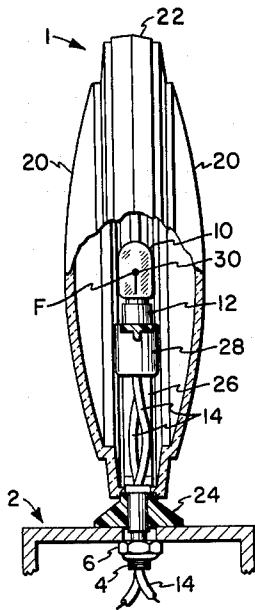


FIG. 1

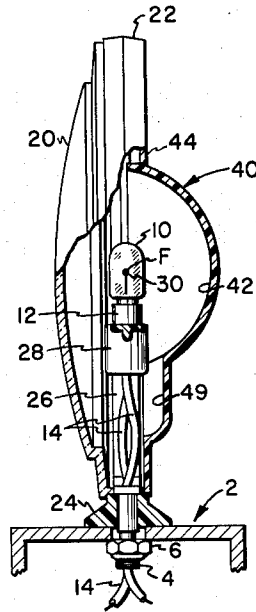


FIG. 2

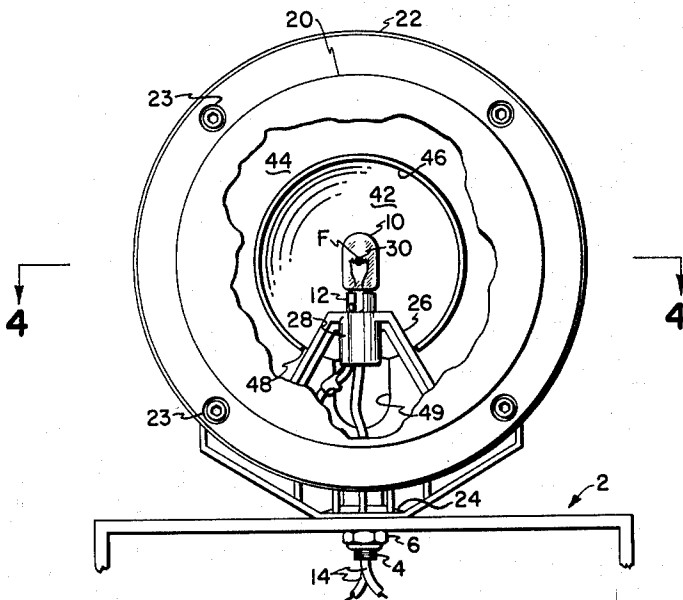


FIG. 3

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2 Sheets-Sheet 2

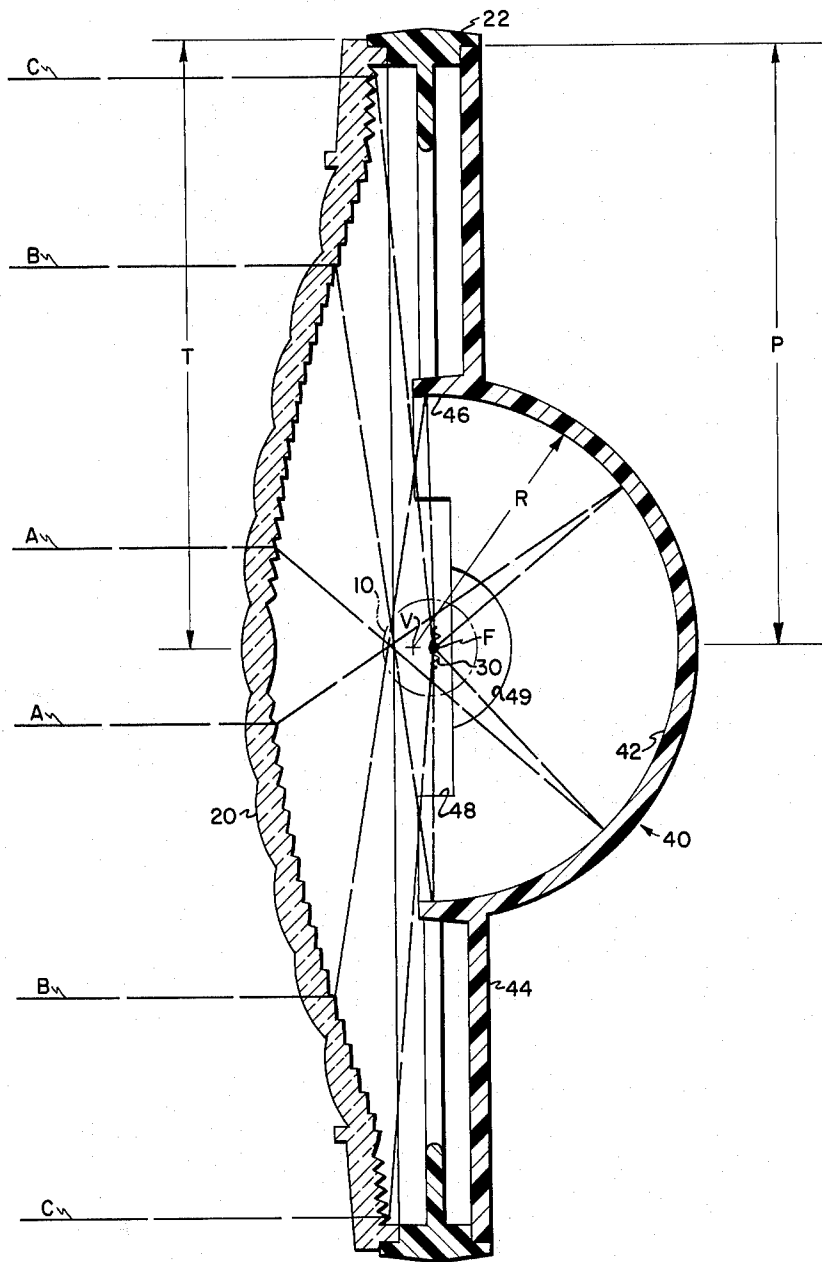


FIG. 4

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WARNING LIGHT REFLECTOR

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11 Claims. (Cl. 240-41.3)

The present invention relates generally to warning light assemblies and pertains more specifically to a reflector which aids in providing a mono-directional warning signal in such assemblies.

An effective and now commonly accepted method of warning of various hazards, particularly those along roads and highways and especially those arising out of construction work, is to display a flashing signal light in the vicinity of the hazard in order to call attention to its existence and location. Warning light assemblies employed in such installations are generally either mono-directional or bi-directional; that is, a flashing signal light is displayed at only one face in the former device while in the latter device a signal is visible at two faces, usually located in diametrically opposed relationship within the assembly. Particular installations may require either one type of assembly or the other, or some of each type, and it is difficult for the ultimate user, as well as for the manufacturer, to predict how many of each device should be made readily available.

It would be desirable, then, from the standpoint of manufacturing economy to be able to fabricate warning light assemblies of both the mono-directional and bi-directional types in which the maximum number of component parts are common to both so that only a minimum number of parts must be fabricated which can be employed in only one type of assembly, thus allowing economical quantity production of like parts. In addition, it would be desirable from the standpoint of the ultimate user to have available a warning light assembly in which only a minimum number of parts need be interchanged to obtain either a mono-directional or bi-directional device whenever either one or the other is required in a particular installation.

Because the sites at which warning light assemblies are installed are often remote from convenient sources of power, the warning signal lights are usually powered by self-contained power supplies, thus limiting the amount and duration of the power available. In addition, warning light assemblies are generally portable in nature and hence should be compact in size, thereby placing a further limitation upon the power available to light the signal. For these reasons it would be advantageous to have available a compact and rugged warning light assembly which is fabricated of a minimum number of relatively inexpensive parts and which is highly efficient in the utilization of power while providing an effective warning signal light.

It is therefore a primary object of the invention to provide a warning light assembly having means for displaying a mono-directional signal light, which means are readily interchangeable with means for displaying a bi-directional signal light in the assembly.

Another object of the invention is to provide means for displaying a mono-directional signal in a warning light assembly, which means effectively directs the greatest amount of light available in such an assembly into a visible mono-directional signal to obtain maximum optical efficiency and thereby minimize power requirements, the warning light assembly having a maximum number of component parts common to both mono-directional and bi-directional signal devices.

A further object of the invention is to provide a warning light assembly which is rugged and compact and which is assembled of a minimum number of component parts,

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which parts are capable of being simply and economically fabricated.

The invention may briefly be described as a reflector for providing a mono-directional visual signal in a normally bi-directional warning light assembly which generally has at least two diametrically opposed lenses in fixed relation with a lamp. The lenses are each of the type carefully derived to accept light emanating directly from a point and redirect such light into a desired zone from which the warning signal will be viewed, the point being the focal point of the lens. The filament of the lamp is located at a fixed point coincident with the focal points of the lenses, with at least one of the lenses being selectively removable from the assembly. The reflector has a semi-spherical reflecting surface with a relatively small radius in comparison to the radius of each of the lenses, and means cooperating with the reflecting surface and having a portion corresponding to the diameter of the removable lens so that the reflector is interchangeable with the removable lens in the assembly to selectively locate the reflecting surface in the assembly relative to the lamp and the remaining lens with the origin of the relatively small radius displaced a relatively short distance from the fixed point. The small radius is generally somewhat less than one-half the radius of each of the lenses in order to keep the dimensions of the reflector, and the assembly with the reflector therein, to a minimum. The relatively short distance between the origin of the small radius and the fixed point is great enough to preclude the projection of a shadow of the lamp filament upon the remaining lens by defeating the tendency for all of the light emanating from the filament and reflected by the reflecting surface to be concentrated at the fixed point and intercept the filament, and small enough to maintain the optical error arising from such a condition at a minimum compatible with the condition.

In order to explain the novel features of the invention more fully, as well as to make apparent additional objects and advantages of the invention, a detailed description of a particular embodiment of the invention is set forth below and should be read in conjunction with the accompanying drawings in which:

FIGURE 1 is a sectioned side elevational view of a bi-directional warning light assembly;

FIGURE 2 is a sectioned side elevational view of a mono-directional warning light assembly;

FIGURE 3 is a partially sectioned front elevational view of the assembly of FIGURE 2; and

FIGURE 4 is an enlarged partially diagrammatic sectional view taken along line 4-4 of FIGURE 3.

In FIGURE 1 a bi-directional warning light assembly 1 is shown fixed to a supporting structure 2 by means of a tubular bolt 4 and a nut 6. Generally, supporting structure 2 is a part of a housing for containing electrical power supply means (not shown) for energizing the lamp 10 which is fixed in a socket assembly 12 and is connected to such power supply means through insulated conductors 14 to provide a flashing visual signal when the warning light assembly 1 and the supporting structure 2 are located at the site where a warning signal is to be displayed.

The light emanating from the lamp 10 passes through a pair of diametrically opposed lenses 20 to provide a bi-directional visual warning signal, the signal being visible at either diametrically opposed face of the device. The lenses 20 are each of the type carefully derived to accept light emanating directly from a point and redirect such light into a desired zone from which the warning signal will be viewed, the point being the focal point of the lens, and are separably fixed to an annular rim 22 by means of readily removable fastener elements illustrated in the form of machine screws 23 (see FIG-

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URE 3), the rim being provided with threaded holes (not shown) for receiving the screws 23. The rim has an integral base portion 24 for mating the rim 22 to the supporting structure 2 as shown and is provided with a pair of integral bracket arms 26 (also see FIGURE 3) which support a socket holder 28 in which the socket assembly 12 is located and secured to fix the position of lamp 10 relative to the lenses 20. In order to achieve maximum optical efficiency, the relative position of the lenses and the lamp is such that the focal point of each lens is made to coincide at a common point F and the filament 30 of the lamp is placed at that fixed point. Thus, the greatest amount of the light emanating from the filament 30 is effectively directed into a beamed visual signal by the lenses 20.

In certain installations it is desirable to employ a mono-directional warning signal rather than the bi-directional signal described in conjunction with FIGURE 1. Because it is difficult to accurately determine in advance how many of each type of warning light assembly may be required by ultimate users, it would be practical as well as convenient for both the manufacturer and the ultimate user to be able to convert a bi-directional warning light assembly to a mono-directional assembly (and vice-versa) if such a conversion could be accomplished with ease and with the retention of the greatest number of component parts common to both assemblies. As seen in FIGURES 2 and 3, such an objective may be accomplished by replacing one of the lenses 20 in the warning light assembly of FIGURE 1 with a reflector 40 which now serves to direct all of the light emanating from the lamp 10 through the remaining lens 20 to provide a mono-directional signal visible at only one face of the device. Since the lenses 20 are separably fixed to the rim 22 by means of machine screws 23, the replacement of either lens 20 with the reflector 40 may be accomplished with ease, the reflector being removably secured to the rim by the same fastener elements. However, it will be appreciated that because the focal point of the remaining lens and the filament of the lamp still remain fixed at point F, the reflector must be of a configuration carefully derived to attain the maximum optical efficiency compatible with desirable dimensions, durability of the component parts of the assembly and ease of manufacture.

Ideally, all of the light which is to be displayed at the face of the device by the lens in the mono-directional device of FIGURES 2 and 3 should pass through the focal point of the lens, as is the case in the bi-directional device of FIGURE 1. Such a condition would require a reflector which will pass the reflected light through the focal point of lens 20, located at point F, and hence through the filament 30, as the light travels toward the lens 20. A spherical surfaced reflector having the origin of its spherical radius located at a source of light will reflect all incident light rays back through that source since the incident rays will strike the reflector at an angle of ninety degrees; hence, it would appear that the solution would be to construct reflector 40 with a semi-spherical reflecting surface in order to direct all of the reflected light emanating from filament 30 back through point F. However, a problem arises when all of the reflected light is made to pass back through point F and hence intercept the filament 30 in that such a relationship between the reflected light and the filament will cause a shadow of the filament to be projected upon the lens 20 and hence will interfere with the provision of a warning signal of maximum efficiency at the face of the lens. The choice of the radius of such a reflecting surface must be governed by such considerations as the desired overall size of the warning light assembly, the sturdiness of the device and the effect of the reflecting surface upon other components of the device, as well as by the overall optical efficiency of the combination of elements. Thus, while a radius which is small relative to the radius of rim 22 and lens 20 is desirable from the standpoint of maintain-

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ing the overall device compact in size, minimizing the amount of material required in the reflector and retaining structural sturdiness, problems arise in the dissipation of heat from the filament of the lamp and from the area immediately surrounding the lamp when the area is limited by the proximity of the reflector. If the reflected light is made to pass through the filament, there will be a concentration of heat at the filament and the useful life of the filament and the lamp will be seriously reduced. In addition, heat in the area of the lamp may damage the reflector itself. On the other hand, a reflector having a reflecting surface with a larger radius which would approach the magnitude of the radius of the rim and the lens, while alleviating some of the overheating problems, would become bulky and more readily susceptible to being damaged from rough handling and would require larger amounts of material in manufacture.

The reflector of the invention represents an effective compromise which takes into account all of the above factors. As best seen in FIGURES 3 and 4, reflector 40 has a semispherical reflecting surface 42 and a continuous integral flange portion 44, the flange portion having an overall radius P corresponding to the radius of annular rim 22 so that the entire reflector 40 may be secured in place in the rim by means of the screws 23 in a manner similar to the way in which lens 20 is fixed in the rim making the reflector readily interchangeable with either lens in the assembly. The radius R of reflecting surface 42 is made small relative to the radius T of lens 20 and rim 22 so as to minimize the overall dimensions of the assembly, but not so small as to unduly limit the dissipation of heat from lamp 10. In general, a reflecting surface having a radius R somewhat less than one-half the radius T of the lens has been found to reduce the overall size of the device to acceptable dimensions while allowing sufficient dissipation of heat to protect the reflector itself. In order to cope with the problem of projecting a shadow of the filament 30 upon the lens 20, the origin V of the radius R is displaced slightly from the point F, which is the focal point of the lens 20 as well as the location of the filament 30 as explained hereinbefore. Because of the slight offset (the distance between points F and V), the light rays which are incident upon the reflector will strike the reflecting surface at an angle which is somewhat less than ninety degrees and the reflected light rays, some of which are illustrated by dashed lines A, will not converge upon the point F and hence will not intercept the filament 30, but will pass very near to point F on the way to the lens 20 as long as the angle of the incident rays varies only slightly from the perpendicular to the reflecting surface. Although the offset thus introduces a slight optical error in that all of the reflected rays do not pass through the focal point of the lens, the reduction of the optical error produced as a result of the error is relatively insignificant when compared with the ability of the reflector to effectively use all of the light available at the filament in a mono-directional signal and insignificant when compared with the design spread of the lamp. Additional advantages are attained in allowing the radius of the semi-spherical reflecting surface to be reduced without the consequent concentration of heat upon the filament of the lamp since all of the reflected rays do not converge upon the filament. Hence, the offset is great enough to induce a condition where the projection of a shadow of the filament upon the lens is precluded by defeating the tendency for all of the reflected light to converge at the point F and intercept the filament, and small enough to maintain the optical error arising from such a condition at a minimum which is compatible with the existence of the condition. It has been found that a very small offset, which will introduce a very small optical error, will be sufficient to eliminate such shadowing as well as significantly increase the useful life of the filament through defeating the tendency for excessive heat to be concentrated at the filament by virtue of the con-

vergence of all of the reflected light at the filament. For example, in a warning light assembly having a lens with a radius T of about three and one-half inches and employing a reflector of the invention with a semi-spherical reflecting surface having a radius R of about one and one-half inches, an offset of only six-thousandths of an inch has been found adequate to attain a significant effect (the offset is exaggerated in FIGURE 4 in order to lend clarity to the illustration).

In order to increase the optical efficiency of the assembly, the reflecting surface 42 extends in the direction of the lens 20 a distance great enough to assure that all of the light emanating from the filament 30 will pass through the lens 20 and none of the light will be directed toward the rim 22 where it will be absorbed rather than transmitted. As illustrated by dashed lines B in FIGURE 4, light rays which emanate from the filament in the direction of the inner surface of the rim 22 will impinge upon an extended portion of the reflecting surface 42, illustrated in the form of a small lip 46, before these rays can reach the rim and will be reflected thereby to the vicinity of the edge of lens 20 so that the direct light rays which normally would have fallen uselessly upon the rim are now intercepted by the lip 46 of the reflecting surface 42 and usefully directed to the lens. The reflecting surface 42 in the form of lip 46 extends as far as the dashed lines C which indicate the limit beyond which direct rays are masked from the rim 22 by the lip 46 and become reflected rays directed to the lens 20. Thus, it can be seen that the maximum amount of the light emanating from the lamp is put to use in a visual warning signal assuring that the power available for the signal is used efficiently.

As best seen in FIGURES 3 and 4, a slot 48 is provided in the lip 46 to allow clearance for the bracket arms 26 and a depression 49 is formed within the flange 42 to provide adequate clearance for the socket holder 28 and insulated conductors 14. In FIGURE 4 the lamp 10 is shown in phantom and the bracket arms 26, as well as the socket assembly 12 and the socket holder 28, have been omitted for clarity.

The reflector 40 may be fabricated in one piece and is readily formed of metal utilizing standard metal working techniques. A preferred method of manufacture is to mold the reflector in a unitary structure of a synthetic resin which has the requisite mechanical properties. The reflecting surface 42 can then be provided with a highly reflective coating such as by the employment of the well known process of vacuum metallizing. Other suitable materials will become apparent to those skilled in the materials art and the invention is not restricted to the specific materials mentioned above.

It will be quite apparent that the invention provides a reflector which is readily interchangeable with either lens in a bi-directional warning light assembly to obtain an effective mono-directional warning light assembly in which a maximum number of component parts of the original assembly is common to both devices. Indeed, only one new component part, the reflector 40, is necessary to convert a bi-directional warning light assembly into a mono-directional device. By reducing the radius R of the reflecting surface 42 to a small dimension relative to the radius T of lens 20 and rim 22, a rugged construction is assured while a minimum amount of material is required in fabrication and the overall dimensions of the mono-directional device remains substantially the same as those of the bi-directional device, the necessity for a bulky reflector protruding from the rear of the assembly having been eliminated, thus maintaining a compact assembly.

It is to be understood that the above detailed description of an embodiment of the invention is provided by way of example and is not intended to restrict the invention. Various details of design and construction may be modified without departing from the true spirit and scope of the invention as defined in the appended claims.

I claim:

1. A reflector for providing a mono-directional visual signal in a warning light assembly, the warning light assembly having a lens fixed therein diametrically opposed to the reflector for accepting light from a focal point, and a lamp fixed between the lens and the reflector, the filament of the lamp being located at a fixed point coincident with the focal point of the lens, said reflector comprising:

(A) a semi-spherical reflecting surface having a relatively small radius in comparison to the radius of the lens; and

(B) means cooperating with said reflecting surface and having a portion corresponding to the diameter of the lens for fixing said reflector in the assembly and locating said reflecting surface in the assembly relative to the lamp and the lens with the origin of said relatively small radius displaced a relatively short distance from the fixed point, said short distance being great enough to induce a condition which precludes the projection of a shadow of the lamp filament upon the lens by defeating the tendency for all of the light emanating from the filament and reflected by said reflecting surface to be concentrated at the fixed point and to intercept the filament, and small enough to maintain the optical error arising from such a condition at a minimum compatible with said condition.

2. A reflector of claim 1 wherein said relatively small radius is somewhat less than one-half the radius of the lens.

3. A unitary, molded reflector for providing a mono-directional visual signal in a warning light assembly, the warning light assembly having an annular rim, the reflector being fixed in said rim, a lens fixed in said rim diametrically opposed to the reflector for accepting light from a focal point, and a lamp fixed between the lens and the reflector, the filament of the lamp being located at a fixed point coincident with the focal point of the lens, said reflector comprising:

(A) a semi-spherical reflecting surface having a relatively small radius in comparison to the radius of the lens; and

(B) a continuous annular flange means integral with said reflecting surface and having a diameter corresponding to the diameter of the rim for fixing said reflector to the rim and locating said reflecting surface in the assembly relative to the lamp and the lens with the origin of said relatively small radius displaced a relatively short distance from the fixed point, said short distance being great enough to induce a condition which precludes the projection of a shadow of the lamp filament upon the lens by defeating the tendency for all of the light emanating from the filament and reflected by said reflecting surface to be concentrated at the fixed point and to intercept the filament, and small enough to maintain the optical error arising from such a condition at a minimum compatible with said condition.

4. A reflector of claim 3 wherein said relatively small radius is somewhat less than one-half the radius of the lens.

5. A reflector of claim 3 wherein said reflecting surface extends in the direction of the lens a distance great enough to intercept substantially all of the direct light emanating from the lamp in the direction of the rim and direct such light to the lens.

6. A warning light assembly comprising:

(A) an annular rim;

(B) a lens for accepting light from a focal point, said lens being fixed adjacent one end of said rim;

(C) a lamp supported by said rim, said lamp having a filament located at a fixed point coincident with the focal point of said lens; and

(D) a reflector secured to said rim at an opposite end thereof so as to be diametrically opposed to the lens

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with said lamp located between the lens and the reflector for providing a mono-directional visual signal at the face of the lens, said reflector having

(1) a semi-spherical reflecting surface with a relatively small radius in comparison to the radius of the lens, and

(2) means cooperating with said reflecting surface and with the rim for locating said reflecting surface relative to the lamp and the lens with the origin of said relatively small radius displaced a relatively short distance from the fixed point, said relatively short distance being great enough to induce a condition which precludes the projection of a shadow of the lamp filament upon the lens by defeating the tendency for all of the light emanating from the filament and reflected by said reflecting surface to be concentrated at the fixed point and to intercept the filament, and small enough to maintain the optical error arising from such a condition at a minimum compatible with said condition.

7. A warning light assembly of claim 6 wherein said relatively small radius is somewhat less than one-half the radius of the lens.

8. A warning light assembly of claim 6 wherein said reflecting surface extends in the direction of the lens a distance great enough to intercept substantially all of the direct light emanating from the lamp in the direction of the rim and direct such light to the lens.

9. A warning light assembly comprising:

(A) an annular rim having opposed first and second ends;

(B) a lens for accepting light from a focal point, said lens being fixed to the first end of said rim;

(C) a lamp supported by said rim, said lamp having a filament located at a fixed point coincident with the focal point of said lens; and

(D) a unitary reflector secured at the second end of the rim so as to be diametrically opposed to the lens

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with the lamp lying between the lens and the reflector for providing a mono-directional visual signal at the face of the lens, said reflector having

(1) a semi-spherical reflecting surface having a relatively small radius in comparison to the radius of the lens, and

(2) a continuous annular flange means integral with said reflecting surface and fixed to the rim at the second end for locating said reflecting surface relative to the lamp and the lens with the origin of said relatively small radius displaced a relatively short distance from the fixed point, said relatively short distance being great enough to induce a condition which precludes the projection of a shadow of the lamp filament upon the lens by defeating the tendency for all the light emanating from the filament and reflected by said reflecting surface to be concentrated at the fixed point and to intercept the filament, and small enough to maintain the optical error arising from such a condition at a minimum compatible with said condition.

10. A warning light assembly of claim 9 wherein said relatively small radius is somewhat less than one-half the radius of the lens.

11. A warning light assembly of claim 9 wherein said reflecting surface extends in the direction of the lens a distance great enough to intercept substantially all of the light emanating from the lamp in the direction of the rim and direct such light to the lens.

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NORTON ANSHER, *Primary Examiner.*