Aug. 12, 1958 J. N. DUPREE 2,846,970

ILLUMINATED INSTRUMENT CONSTRUCTION

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Fig. 1.

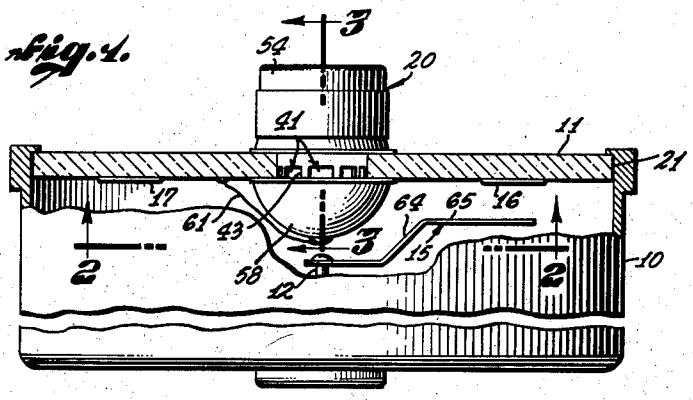


Fig. 2.

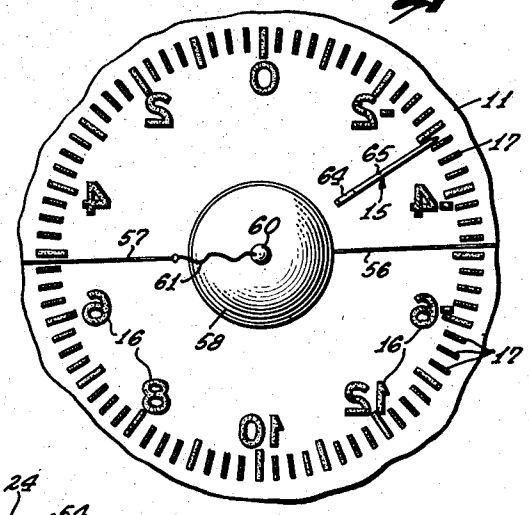


Fig. 4.

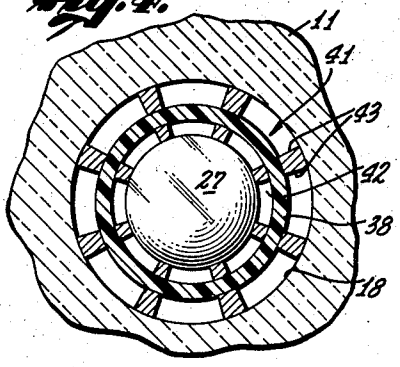
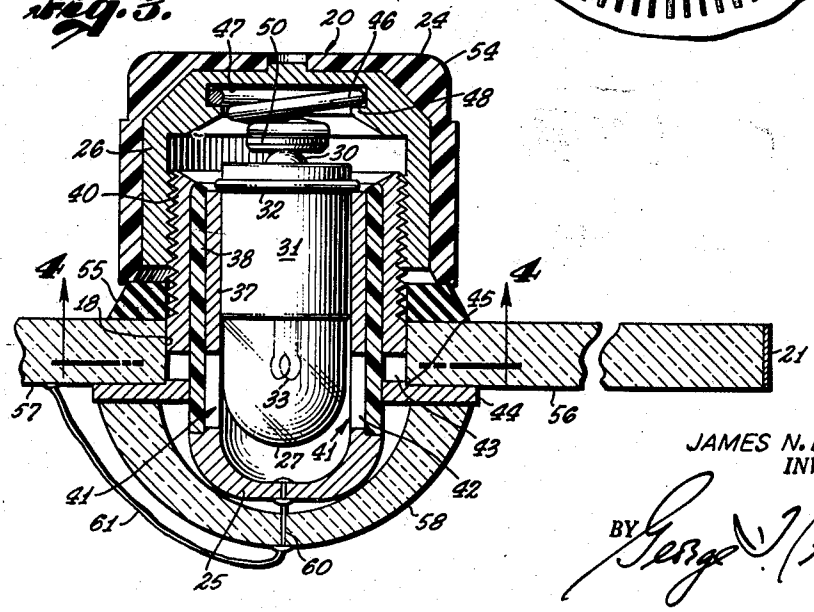


Fig. 3.



JAMES N. DUPREE,
INVENTOR.

BY George J. Smyth

ATTORNEY.

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ILLUMINATED INSTRUMENT CONSTRUCTION

James N. Dupree, Hollywood, Calif., assignor to California Plasteck, Inc., Los Angeles, Calif., a corporation

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10 Claims. (Cl. 116—129)

This invention relates to instruments, such as instruments mounted on an aircraft panel or the like, and is directed to the problem of combining with such an instrument a suitable lamp for illumination of the indicator element of the instrument as well as for illumination of the indicia associated with the indicator element.

One requirement is that the illumination be effective for its purpose and yet be so subdued in character and so directed as to avoid glare and undesirable illumination of the exterior environment of the instrument. The invention meets this requirement by providing a lamp assembly or lamp housing adapted to be mounted in a central aperture in the light-transmitting face plate of the instrument and by restricting the emanation of light from the lamp housing to a window or windows positioned in the periphery of the central housing. While a single window of substantial circumferential extent may be provided, preferably the housing has a series of circumferentially spaced windows. The light source is a suitable lamp bulb in the housing so positioned relative to the housing windows as to cause the light to be emanated in a desired range of directions to illuminate both the region of the indicia and the region of the indicator element of the instrument.

A certain dilemma is involved in those instances in which the indicia are on the face plate of the instrument or immediately adjacent the face plate. On the one hand, if all of the light is directed inward towards the interior of the instrument to avoid excessive illumination of the environment of the instrument, the indicia on or adjacent to the face plate will not be adequately illuminated; on the other hand, if any effective portion of the light is directed radially of the housing along the outer surface of the face plate for the sake of illuminating the indicia, the result will be intolerably excessive illumination of the environment. In this regard it is to be borne in mind that often several such instruments are grouped together on a panel board and stray light from all of the instruments combines for an undesirable general illumination effect that may light up a whole cabin.

The invention solves this dilemma by placing the peripheral windows of the lamp housing in position to extend rearward from a point in the central aperture of the face plate that lies between the two surface planes of the face plate. The lamp bulb is located in the housing with its filament in position to direct light radially outward into the edge of the aperture between these two surface planes. Thus, a substantial portion of the light is directed into the interior of the instrument by the portions of the housing windows that extend inward from the inner surface of the face plate, and at the same time, a substantial portion of the light is directed into the material of the face plate edgewise thereof by the forward portions of the windows between the two surface planes of the face plate.

The portion of light that enters the face plate edgewise thereof does not cause glare or undesirable external illumination because the refractive index of the face plate causes light at such low angles relative to the face plate surfaces to be reflected back by the surfaces in a highly effective manner. Thus, all light emanating edgewise of the face plate is trapped by inward reflection from the face plate surfaces and is thereby sufficiently suffused to provide what may be aptly termed indirect illumination for the indicia on the face plate. In this regard, the invention is preferably characterized by the use of indicia on the inner face of the face plate that is of light-scattering character to make the indicia uniquely visible. A further feature of the preferred practice of the invention is the concept of surrounding the outer peripheral edge of the face plate with light-reflective material to co-operate with the inwardly reflecting face surfaces of the face plate. A still further feature is the provision of filter means at the windows of the housing to modify the emanated light.

By virtue of this arrangement, the filter means provides subdued emanated light of desirable wave lengths and a portion of the filtered light is trapped in an efficient system of reflecting surfaces to make indicia on the face plate plainly visible. At the same time another portion of the filtered light is directed inwardly back of the face plate to make the indicator element or pointer of the instrument plainly visible. The preferred practice of the invention also includes the provision of a suitable lens in the path of the inwardly directed light for desirable redirecting and suffusion of the light that illuminates the indicator element.

Another problem to be met is to provide a lamp assembly of the described character that is adapted for mounting in the face plate aperture in such manner as to permit the instrument to be hermetically sealed and at the same time to permit convenient replacement of a lamp bulb when required. For this purpose, the invention provides a housing for mounting in the face plate aperture that engages both faces of the face plate to hold the housing in assembled position and the housing structure includes a closure member forward of the face plate that is removable for full access to the interior of the housing.

A further problem is to provide for energization of the lamp bulb in the housing by a circuit outside the housing. In this regard, a feature of the invention is the provision of two conductors inside the instrument. At least one of the conductors may be positioned at the inner surface of the face plate so that suitable means incorporated in the housing construction to grip the face plate may have the additional function of contacting this conductor to serve as part of the lamp-energizing circuit.

In the preferred embodiment of the invention, the lamp housing is of laminated construction with outer and inner conducting walls separated by a nonconducting wall. This construction makes it possible for the outer and inner conducting laminations of the housing to serve as part of the lamp circuit on opposite sides of the lamp bulb. In this regard, a special feature of the preferred embodiment of the invention is the use of material for the intermediate insulating wall that will serve the additional purpose of a light filter.

It is apparent from the foregoing that the invention may be embodied in the factory assembly of an instrument, or may be embodied in a combination of face plate and lamp assembly to be sold to manufacturers of instruments, or may be embodied in a lamp assembly as a separate article of manufacture adapted for mounting in a suitably apertured face plate.

The various features and advantages of the invention

will be apparent in the following detailed description considered with the accompanying drawing.

In the drawing, which is to be regarded as merely illustrative:

Figure 1 is a view partly in side elevation and partly in section, illustrating a selected embodiment of the invention;

Figure 2 shows the interior of the instrument as viewed along the line 2—2 of Figure 1;

Figure 3 is an enlarged longitudinal section taken as indicated by the line 3—3 of Figure 1; and

Figure 4 is a fragmentary section taken as indicated by the line 4—4 of Figure 3.

The selected embodiment of the invention illustrates the underlying principles as applied to the construction of an accelerometer. It will be apparent that this selected embodiment will provide adequate guidance for those skilled in the art who may have occasion to apply the same principles to other types of instruments.

The accelerometer shown in Figure 1 has a cup shaped case **10** which is closed by a circular face plate **11** of light-transmitting material such as glass or suitable plastic. The sensing mechanism of the instrument controls a shaft **12** that carries an indicator element in the form of a hand or pointer, generally designated by numeral **15**. Preferably the indicia associated with the movements of the pointer **15** are on the inner surface of the face plate **11**. In this instance, the indicia comprises the usual numerals **16** and scale marks **17**. It is contemplated that the indicia will be of material that will both reflect light and scatter light. Ordinary white paint has been found suitable for this purpose.

In accord with the invention, the face plate **11** has a central circular aperture **18** to receive a lamp assembly generally designated by numeral **20** and preferably the peripheral area of the face plate or outer edge of the face plate is coated with a suitable layer **21** of light reflecting material. The peripheral surface of the face plate **11** may be silvered for this purpose, but preferably the desired light-reflecting surface is provided by the application of heat to fuse a mixture of finely divided silver and low melting powdered glass to the peripheral surface of the face plate.

The lamp assembly **20** includes a housing body **24** of cylindrical configuration that is closed at its inner end by an end wall **25** integral therewith and is normally closed at its outer or forward end by a suitable closure member **26**. The housing body **24** is adapted to receive a lamp bulb **27** which is positioned in the housing body with its base end outward. In the construction shown, the lamp bulb **27** has an end contact or terminal **30** for electrical connection with one side of a lamp circuit and has a base ferrule **31** which serves as a contact or terminal for electrical connection with the other side of the circuit. The base ferrule **31** is formed with a circumferential rib **32** which abuts against the outer end of the housing body **24** for co-operation therewith to fix the longitudinal position of the lamp bulb in the housing member. In the preferred practice of the invention, this position of the lamp bulb **27** places the filament **33** of the lamp bulb between the planes of the outer and inner face surfaces of the face plate **11**.

The housing body **24** is preferably of laminated construction comprising an inner metal shell **37** integral with the end wall **25**, an intermediate insulating sleeve **38**, and an outer sleeve or bushing **40**. The housing body **24** is provided with suitable windows, generally designated **41**, that are spaced circumferentially with the outer ends of the windows between the surface planes of the face plate **11** and with the inner ends of the windows extending inward from the face plate. In the arrangement illustrated by the drawing, the outer ends of the windows **41** are approximately half way between the two surface planes of the face plate **11**.

As shown in Figures 3 and 4, each of the windows **41** comprises an opening **42** in the inner shell **37** and a corresponding opening **43** in the outer housing **40**. The intermediate insulating sleeve **38**, which is bonded both to the inner shell **37** and the outer bushing **40**, is of a suitable plastic material which will not only serve to insulate the inner sleeve and the outer bushing from each other, but also will serve as a filter for each of the windows **41**. For this last purpose, the insulating sleeve is extended to span the window openings **42** and **43** of the inner shell and outer bushing respectively. The insulating sleeve may, for example, be made of a translucent red plastic material.

The outer bushing **40** of the housing body **24** is formed with a radial flange **44** for abutment against the inner face of the face plate **11** and preferably the flange **44** is formed with a circular shoulder **45** dimensioned for relatively close fit in the aperture **18** in the face plate. It is contemplated that the radial flange **44** will be bonded to the inner surface of the face plate **11** and for this purpose a mixture of powdered silver and powdered low melting glass may be used, the mixture being heated until it fuses both to the flange **44** and to the face plate. A feature of the invention in this regard is that with the flange **44** fused to the face plate **11**, the aperture **18** in the face plate will be effectively hermetically sealed. This feature is of importance in those instances where it is desirable to maintain a vacuum inside the instrument and in those instances where it is desirable to confine a gaseous body in the instrument.

The closure member **26** is preferably in the form of a metal cap that threads onto the outer bushing **40** of the housing member **24**, and that is suitably adapted to hold the lamp bulb **27** in its assembled position. In the construction shown, a suitable metal spring **46** is mounted in a recess **47** inside the closure member and is retained therein by a circular shoulder **48** that overhangs the recess. The spring carries a metal disc **50** which presses against the end contact or terminal **30** of the lamp bulb. Preferably, the closure member **26** is covered by a cap **54** of non-conducting material which is bonded to the closure member and is adapted to contact a suitable sealing ring **55**. The cap **54** is made of relatively rigid plastic material, such as hard rubber, and the sealing ring **55** may be made of any relatively soft rubber-like material.

It is apparent that the screw-threaded engagement of the closure member **26** with the housing body **24** makes possible sufficient pressure on the part of the plastic cap **54** against the sealing ring **55** to make the lamp assembly water proof. This feature is important, for example, where it is desirable to protect the interior of the lamp housing against an environment of high humidity.

It is also apparent that since the closure member **26** presses the sealing ring **55** against the outer face of the face plate **11**, the closure member may co-operate with the radial flange **44** of the housing member **24**, to grip the opposite faces of the face plate **11** and thereby clamp the lamp assembly **20** in position. Thus, the continuous bond between the radial flange **44** and the face plate may be omitted in those instances where it is not necessary to seal off the interior of the instrument from the atmosphere. It is also possible, if desired, to bond the sealing ring **55** to the periphery of the outer bushing **40** so that the sealing ring acting independently of the closure member **26** may cooperate with the radial flange **44** to grip the face plate from opposite sides to hold the lamp assembly in place.

In the preferred practice of the invention, the lamp assembly **20** is adapted for connection with an energizing circuit by means of two conductors **56** and **57** that are bonded to the inner surface of the face plate **11** on opposite sides of the lamp assembly. Each of these conductors **56** and **57** may be formed by fusing to the face plate a mixture of powdered silver and powdered low melting glass. The conductor **56** makes electrical connection directly with the radial flange **44** of the outer

bushing **40** and the conductor **57** is electrically connected with the inner metal shell **37** of the lamp assembly.

Preferably, the inner end of the lamp assembly is provided with a concave or dome-shaped lens **58** and the conductor **57** is connected with the inner shell **37** through this lens. The lens **58**, which is shaped to re-direct the light from the windows **41** in a desirable manner, is bonded to the inner surface of the radial flange **44** in any suitable manner. The lens may be bonded, for example, by means of a fused mixture of powdered silver and powdered glass. A suitable metal pin **60** extends through the lens **58** to the inner metal shell **37**, the pin being bonded to the inner shell and being sealed in the lens. A fine wire **61** connects the metal pin **60** with the conductor **57**.

From the foregoing it is apparent that one side of the lamp circuit includes: conductor **56**; the outer bushing **40**; closure member **26**; and the spring **46** in abutment with the end contact or terminal **30** of the lamp bulb. The other side of the circuit includes: the conductor **57**; the fine wire **61**; the metal pin **60**; and the inner metal shell **37** in pressure contact with the rib **32** of the base ferrule **31** of the lamp bulb.

The manner in which the invention serves its purpose will be readily apparent from the foregoing description. Since the filament **33** of the lamp bulb and the outer ends of the series of windows **41** are intermediate the planes of the two surfaces of the face plate **11**, light from the filament is directed into the face plate edgewise thereof from inside the aperture **18**. All of the light that enters the material of the face plate **11** in this manner is at exceedingly low angles relative to the two face surfaces of the face plate and therefore such light is reflected back into the interior of the face plate by the two face surfaces, instead of passing freely out of the face plate. Some of the light that enters the face plate in this manner goes directly to the outer peripheral layer of light-reflecting material **21** and some of the light reaches this outer layer by reflection from the face surfaces of the face plate. The light that reaches the outer reflecting layer **21** is directed back towards the central area of the face plate. Thus, the face plate **11** is bounded by light-reflecting surfaces to constitute a trap for light from the filament **33** and the multiple reflections from the various surfaces results in a desirable diffusion and softening of the light. As a result, the indicia comprising the numeral **16** and the scale marks **17** on the inner surface of the face plate **11** are amply illuminated but no path is offered for direct passage of light from the filament **33** to the region in front of the face plate **11**.

Light from the filament **33** also passes through the windows **41** and the lens **58** directly into the interior of the instrument to illuminate the pointer **15**. Preferably the pointer **15** is formed with an inclined offset **64** which is substantially normal to the rays of light from the filament **33**, and is therefore well illuminated. This offset has the advantage of placing the end portion **65** of the pointer relatively close to the indicia on the face plate or at least closer than would be possible otherwise in view of the presence of the lens **58** in the region of the base of the pointer.

My description of this selected embodiment of the invention by way of example and to illustrate the principles involved will suggest various changes, substitutions, and other departures from my disclosure that fall within the spirit and scope of the appended claims.

I claim:

1. In an instrument of the character described having a movable indicator element, the combination therewith of: a face plate for the instrument of light-transmitting material having an aperture therein; a lamp housing mounted in said aperture in said face plate and extending inward from the face plate, said housing being adapted to confine a lamp and having at least one side window for illumination of the instrument by the lamp,

said side window intersecting planes of said face plate and extending inward beyond the inner surface of the face plate into the space closed by the face plate.

2. In an instrument having a movable indicator element and a light-transmitting face plate forward therefrom, the combination of: a lamp housing mounted in an aperture in said face plate with the housing extending both inwardly and outwardly from the face plate, said housing being open at its outer end to receive a lamp bulb with the base of the bulb directed outward, said lamp housing having at least one window in the region of said face plate, said housing having an inner shell of conducting material to embrace the base of the lamp bulb; anchorage means of conducting material on said housing extending laterally therefrom in contact with the inner surface of said face plate, said anchorage means being insulated from said inner shell; closure means of conducting material releasably mounted on the outer end of said housing, said closure means being normally electrically connected with said anchorage means; a metal spring inside said closure means to press against the outer base end of the lamp bulb; a conductor inwardly of said face plate in contact with said anchorage means and bonded to the inner surface of said face plate to connect one side of a circuit to said lamp bulb through said closure means and said spring; a second conductor inwardly of said face plate and bonded to the inner surface of said face plate adapted to connect the other side of the circuit with the lamp bulb through said inner shell of the housing, and a lens at the inner end of said lamp housing, said second conductor extending through said lens to said inner shell of the lamp housing.

3. A lamp assembly for mounting in a circular aperture in the light-transmitting face plate of an instrument for energization of a lamp bulb inside the assembly by a pair of conductors positioned inwardly of the face plate, said lamp assembly including: a housing body adapted for mounting in said aperture, said housing body having an inner shell of conducting material to enbrace the base of the lamp bulb; anchorage means of conducting material carried by said housing body and insulated from said inner shell, said anchorage means extending laterally from the housing body for contact with the inner surface of said face plate; closure means of conducting material releasably mounted on the outer end of said housing and insulated from said inner shell, said closure means being electrically connected with said anchorage means; a metal spring inside said closure means to press against the base end of the lamp bulb, whereby one terminal of said lamp bulb may be electrically connected to one of said conductors through said spring, closure means, anchorage means; and means for electrically connecting said shell with the other of said pair of conductors thereby to connect the other terminal of the lamp bulb therewith, a resilient sealing ring embracing said outer sleeve adjacent said closure means; and a cap of non-conducting material encasing said enclosure means for making sealing contact with said sealing ring.

4. A lamp assembly for mounting in a circular aperture in the light-transmitting face plate of an instrument for energization of a lamp bulb inside the assembly by a pair of conductors positioned inwardly of the face plate, said lamp assembly including: a metal shell for positioning in said aperture, said shell having at least one peripheral window positioned to extend inwardly from a plane between the two faces of said face plate to a plane spaced inward from the face plate, said shell being open at its outer end and being dimensioned to confine a lamp bulb with the base of the lamp directed outward in contact with the inner surface of the shell and with the filament of the lamp between the planes of the surfaces of said face plate; an insulating sleeve having a continuous cylindrical wall embracing said shell; an outer sleeve of conducting material embracing said insulating sleeve, said outer sleeve being cut away in

the region of said window, said shell and said two sleeves being united to form a housing body; anchorage means of conducting material extending laterally from said outer sleeve for abutment against the inner surface of said window; a closure member of conducting material releasably engaging the periphery of said outer sleeve to close the outer end of said housing body; and a metal spring in said closure member for contact with the end of said lamp bulb whereby said anchorage means may electrically connect one of said conductors with one terminal of said lamp bulb through said outer shell, closure means, and spring, and whereby said shell may electrically connect the other of said conductors with the other terminal of the lamp bulb.

5. A combination as set forth in claim 4 which includes a resilient sealing ring embracing said outer sleeve adjacent said closure means to co-operate with the closure means for forming the seal; and in which said closure means is encased in a cap of non-conducting material for making sealing contact with said sealing ring.

6. A combination as set forth in claim 4 in which said insulating sleeve is of translucent material and extends over said window to serve as a filter for light passing through the window.

7. A combination as set forth in claim 4 in which said anchorage means is a radial flange; and which includes a dome-shaped lens peripherally bonded to said flange.

8. A combination as set forth in claim 7 which includes conducting means extending from said shell through said lens to serve as a terminal for connection with said other of said pair of conductors.

9. In an illuminated panel assembly which utilizes an electric lamp having an illuminating portion and further having a pair of electric contacts; the combination of: a panel of light transmitting material having a recess therein; an electrical conductor formed on one surface of the panel and extending across said one surface of the panel to a point adjacent the edge of the recess; electrically conductive bushing means extending into the recess in the panel and having a first end portion adapted for abutment with said one surface of said panel and for electrical contact with said conductor thereon, said bushing means having a second end portion projecting outwardly from the opposite surface of the panel, and said bushing means having at least one radial light transmitting window therein axially positioned to lie within the recess in the panel between the opposite surfaces of the panel; fastening means at said opposite surface of said panel engaging said second end portion of said bushing means; means for mounting the electric lamp in said bushing means with the illuminating portion of the lamp disposed within the recess in said panel to illuminate the interior of said panel through said radial light transmitting window in said bushing means, one of the electrical contacts of the lamp being in electrical connection with said bushing means; and means for establishing an electrical connection to the other electrical contact of the lamp.

10. In an illuminated panel assembly for utilizing an electric lamp having an illuminating portion and further having a pair of electric contacts, the combination of: an insulating panel of light transmitting material having an aperture extending therethrough; an electrical conductor formed on one surface of the panel and extending from an edge of the panel to a point adjacent the edge of the aperture; an electrically conductive cylindrical sleeve extending through said aperture in said panel and having an integral radial flange for abutment with said one surface of said panel and for electrical connection with said electrical conductor formed on said one surface, said sleeve having a threaded end portion projecting outwardly from the opposite surface of said panel, and said sleeve having a plurality of radial window openings therein axially positioned to lie within the aperture in the panel between said opposite surfaces thereof; fastening means at said opposite surface of said panel threadably engaging said threaded portion of said sleeve to clamp said radial flange of said sleeve firmly against said one surface of said panel and in electrical contact with said conductor; means for mounting the electric lamp in said sleeve with the illuminating portion of the lamp disposed within the aperture in the panel and facing said one surface of the panel, and with one of the electrical contacts of the lamp in electrical connection with said sleeve; means for establishing an electrical connection to the other electrical contact of the lamp; and a tubular light filter of plastic material mounted coaxially with the lamp and with said sleeve, said light filter being axially aligned with said window openings in said sleeve.

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