

[54] **LIGHTING FIXTURE LENS**

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[22] Filed: **Jan. 22, 1973**

[21] Appl. No.: **325,566**

[52] **U.S. Cl.**..... **240/46.01**, 161/189, 240/106 R

[51] **Int. Cl.**..... **F21v 11/00**

[58] **Field of Search**..... 240/46.01, 106 R, 106.1, 240/108; 161/1, 3.5, 189, 408

[56]

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Primary Examiner—Richard L. Moses

[57]

ABSTRACT

A lighting fixture combination including a housing enclosing at least one bulb and having an opening for light and a housing window across the opening comprising a thin film of fluorocarbon, preferably Teflon FEP. Also disclosed are various means for deforming the thin film to cause it to be stretched tautly across the opening and be secured securely in place.

8 Claims, 7 Drawing Figures

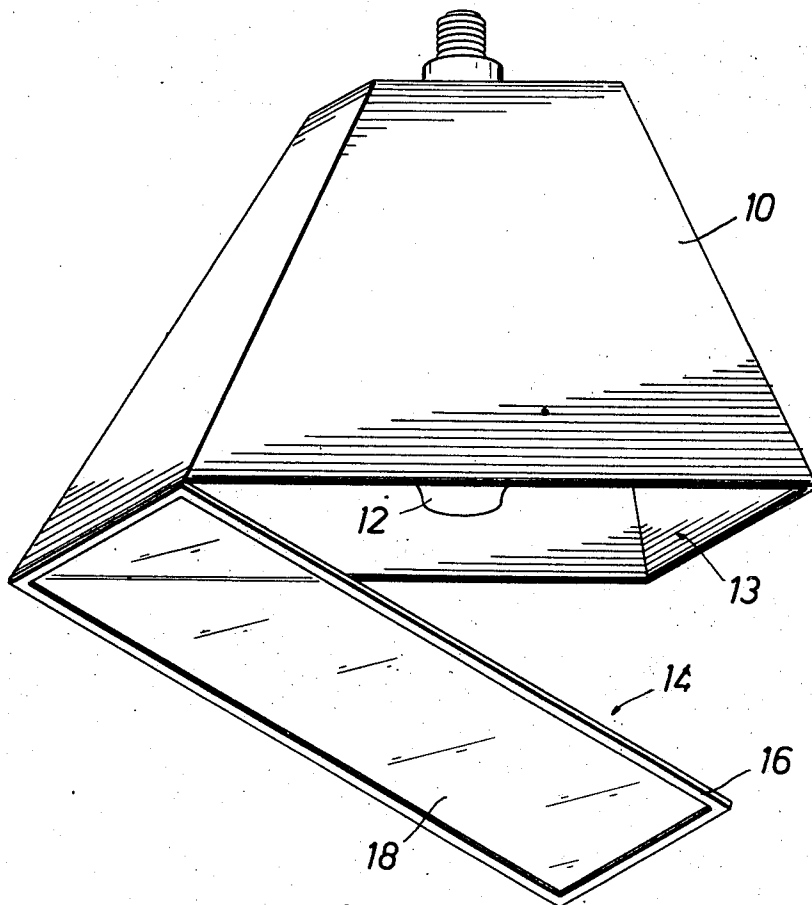


FIG. 1

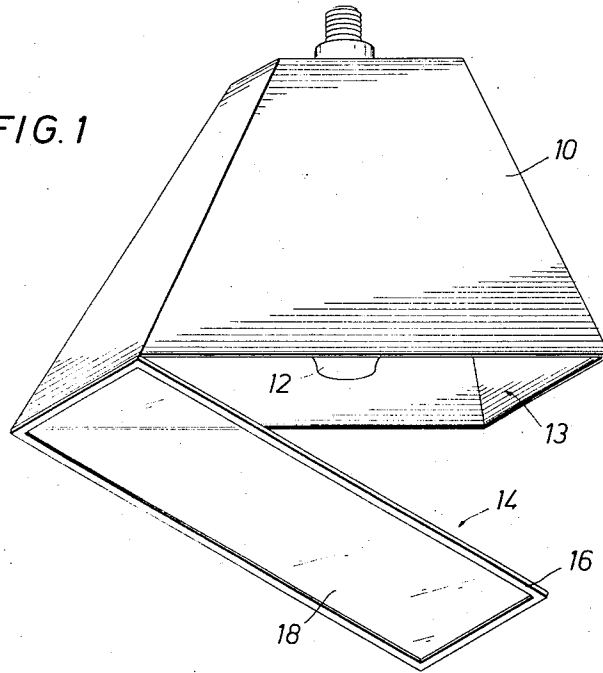


FIG. 2

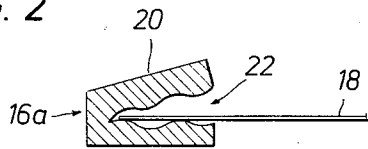


FIG. 3

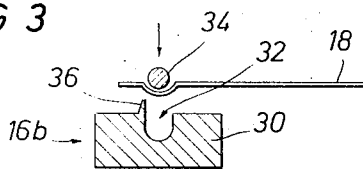


FIG. 4

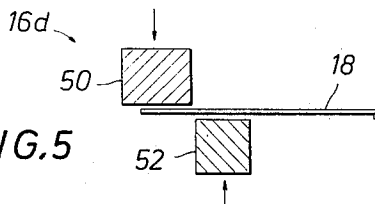
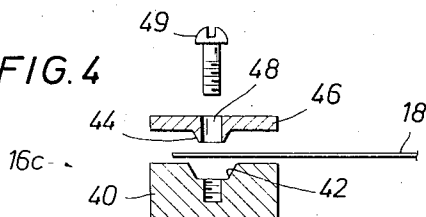


FIG. 5

FIG. 6

PRIOR ART

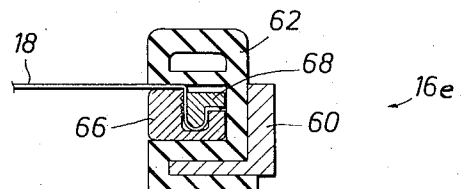
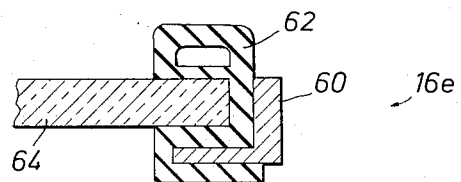


FIG. 7

LIGHTING FIXTURE LENS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to lighting fixtures, and more specifically to the window material used in lighting fixtures.

2. Description of the Prior Art

Commercial lighting fixtures each enclosing one or more bulbs or lamps usually include a large window opening through which light emanates from the bulbs or lamps. The normal material used for closing this window is clear glass. In some installations frosted or otherwise partially opaque glass is employed to soften or diffuse the light.

In a typical installation of a high intensity discharge lamp, such as a mercury vapor lamp, the window opening closed by a pane of clear glass may be approximately two feet by two feet. The entire lighting fixture may be one of a plurality mounted in a high ceiling over a laboratory, industrial process area, a warehouse or similar area.

Although plastics have been substituted for glass in many applications, such as for canopies of airplanes, contact lenses, lenses for photocells and many, many other applications, substitution has never been totally satisfactory in the high temperature, prolonged use, often abusive environment that high intensity discharge lamps are subjected to. An article by J. T. Barnes appearing in *Lighting Design & Application*, December 1972, is believed to reflect the current state of knowledge. The findings of Barnes is that for short-term use in a high temperature, high ultraviolet environment, there are some coated polycarbonates that might be considered reservedly acceptable. For general low temperature use, some acrylics (such as Plexiglas) are acceptable. For high temperature use (over 105°C), there is no known substitute for glass. The sole exception was that in extreme breakage areas or hazardous locations with inside temperatures not in excess of 125°C, polycarbonate may be substituted, provided a very limited service life is acceptable. There are so many characteristics besides accommodation to the above that have to come together in a single plastic, that it has been a real discovery that any plastic could be suitable. For example, for a clear light fixture lens application, there has to be good optical, low-backscatter properties, not just initially, but after months and even years of use. Since most plastics, and even some fluoroplastics, degrade when exposed to ultraviolet light, the selection of a plastic with acceptable optical properties has been extremely difficult. Further, as noted above, the high temperatures attendant to high intensity discharge lamps is also a critical problem pertaining to the selection of a suitable material.

Moreover, unless there was a vast saving in weight, the economics of the substitution did not make any sense. The most common glass substitute for large panes is probably Plexiglas, which is rigid and commonly seven-thirty-seconds inch thick (approximately 250 mils). Because it optically degrades under high temperature conditions and for other reasons, it is not acceptable. Lexan, another sometime glass substitute in other contexts, does withstand high temperatures better than Plexiglas, but it yellows to an objectionable extent. But, the attempts to develop a glass substitute

have led to the conclusion that perhaps something like these substances and similar to glass could be found. Therefore, it is quite surprising that the lens material that has been discovered and which is revealed herein is a flexible thin film material.

The primary advantages of glass as a fixture closure or lens include its low cost, its ready availability, its resistance to high operating temperatures, such as emanate from high wattage lamps, its resistance to changes in color and opaqueness, even over a prolonged period of time, and its uniform light transmittance qualities over the full range of the visible spectrum.

Glass as a closure for such a fixture has a number of disadvantages, however. First, it is breakable. Should something accidentally strike the glass or should the bulb within the fixture explode, the glass is very likely to break at not only an inconvenience to the persons working in the area, but also creating a hazard. So-called non-breakable tempered or safety glass is available and is used. But, even tempered glass does break. In such case, beads result, rather than jagged pieces, but even beads can be hazardous.

Further, glass is thought of as being relatively slick and therefore resistant to the build up of dust. However, as most persons can attest to who have had experience with dust build-up on glass, it really does not take very long for an appreciable amount to accumulate. The rapid accumulation of dust results in reduced illumination from the fixture and a requirement to clean the fixture. The more often someone has to clean the fixture, the more expensive is the maintenance.

The glass used in a fixture such as the one described above is also an appreciable percentage of the overall weight of the fixture. A lighter window closure would effect a reduction in manufacturing and shipping costs.

It is therefore a feature of this invention to provide an improved lighting fixture closure that is relatively inexpensive when compared to the cost of glass and which is truly non-breakable.

It is another feature of this invention to provide an improved lighting fixture closure which has a slicker surface than the prior art glass closures and which, therefore, has better dust build-up characteristics than such glass.

It is still another feature of this invention to provide an improved lighting fixture closure having a weight much less than the glass used in the prior art and which has light transmittance qualities, heat resistance qualities, and age degradation qualities sufficiently equal to glass as to be totally acceptable as a general substitute for glass.

SUMMARY OF THE INVENTION

Fluoroplastics, or fluorocarbon polymers, all have the property of having a resistance to high temperatures, being light weight in small thicknesses and being unbreakable. Some fluoroplastics, and in particular Teflon FEP (a fluorocarbon copolymer made by polymerizing a mixture of tetrafluoroethylene and hexafluoropropylene), have the additional properties of being nearly transparent in thin-film form (no thicker than about 10 mils), having a high and uniform light-spectrum transmittance, having a long-term aging quality without appreciable discoloring, and having an extremely low coefficient of friction and therefore providing a dust resistant surface. It has been discovered

that a lighting fixture closure made of such a material has sufficiently equal or superior qualities in all of its necessary characteristics that it is an overall superior closure to that of glass.

BRIEF DESCRIPTION OF THE DRAWINGS

So that the manner in which the above-recited features, advantages and objects of the invention, as well as others which will become apparent, are attained and can be understood in detail, more particular description of the invention briefly summarized above may be had by reference to the embodiments thereof which are illustrated in the appended drawings, which drawings form a part of this specification. It is to be noted, however, that the appended drawings illustrate only typical embodiments of the invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

In the drawings:

FIG. 1 is an oblique view of a typical high intensity discharge lamp fixture including a lens in accordance with the present invention, the lens or closure assembly being illustrated in the partly opened position.

FIG. 2 is a partial cross sectional illustration of one method of mounting the lens of the present invention.

FIG. 3 is a partial cross sectional illustration of another method of mounting the lens of the present invention.

FIG. 4 is a partial cross sectional illustration of still another method of mounting the lens of the present invention.

FIG. 5 is a partial cross sectional illustration of yet another method of mounting the lens of the present invention.

FIG. 6 is a partial cross sectional illustration of a prior art method of mounting glass in the frame of a lighting fixture.

FIG. 7 is a partial cross sectional illustration of a method of mounting the lens of the present invention in the frame of the lighting fixture shown in FIG. 6.

DESCRIPTION OF PREFERRED EMBODIMENTS

Now referring to the drawings and first to FIG. 1, a typical high intensity discharge lamp fixture 10 is shown housing a high intensity discharge lamp. The window in the fixture through which light emanates from lamp 12 is designated with reference numeral 13. A closure or lens assembly 14 is typically hinged at one end of window 13 to permit access to the fixture for changing a burned-out lamp 12. Assembly 14 comprises a frame structure 16 and lens 18.

Lens 18 to be more fully hereinafter described is a non-self-supporting or non-rigid thin film of fluoroplastic material capable of being at least slightly stretched. Typically, the film is on the order of 5 mil thick. The term lens is not used herein to necessarily imply optical magnification or demagnification, but is used in the sense as that term is commonly used in the lighting industry to refer to the window or window pane closure of a lighting fixture.

Several alternative methods of attaching lens 18 into frame 16 are illustrated in FIGS. 2-7. These frame structures are referred to generally in FIGS. 2-5 as frames 16a, 16b, 16c and 16d, respectively, and in FIGS. 6 and 7 as frame 16e.

FIG. 2 illustrates a cross section of a frame structure 20 made of material capable of at least some bending without breaking, such as aluminum. Frame 20 has a jaw-like receiving opening 22, the opposing surfaces thereof being at least slightly rippled in a mating relationship. To hold lens film 18 within frame 20, the lens is cut to size and inserted into opening 22. It is desirable that the film does not extend all of the way into the opening. This prevents the film from wrinkling. The jaws of opening 22 are then squeezed together to securely clamp film 18 therein, the internal rippling causing the film to slightly stretch so that the film becomes taut in the frame. In addition, the rippling causes a better gripping than non-rippled surfaces.

FIG. 3 shows a frame 30 with a groove 32 therein large enough for accommodating a wire form 34 as well as lens film 18. A lip 36 is formed at one side of groove 32. To secure film 18 to frame 30, wire form 34 is pressed into groove 32 carrying film 18 with it. Lip 36 is then bent over wire form 34 to secure film 18 in place. Again, as with frame 20, film 18 is slightly stretched during the securing operation, to draw film 18 slightly taut.

FIG. 4 illustrates still another frame 40 having a groove 42 for receiving a mating tongue 44 formed in facing piece 46. Facing piece 46 has a plurality of holes 48 therethrough, preferably at the location of the tongue, and frame 40 has an equal number of internally threaded, matingly located screw holes. To secure film 18 to frame 40, facing 46 is pressed so as to squeeze and somewhat deformably stretch film 18 between tongue 44 and groove 42. Screws 49 are then tightened through holes 48 into the receiving screw holes in frame 40 to complete the securing.

FIG. 5 illustrates yet another method of attaching film 18 to a suitable frame. A two part frame comprising outside piece 50 and inside piece 52 are capable of press fitting together in the direction shown by the arrows to secure film 18 therebetween, much in the manner of operation of an embroidery hoop. Again, when the frame pieces are squeezed together, the operation stretches film 18 taut to remove wrinkles that might otherwise be present.

Finally, FIGS. 6 and 7 illustrates a convenient method of attaching film 18 to a frame originally designed to accommodate glass. In this case, frame 16e comprises an L-shaped peripheral frame structure 60 onto which is pressfitted a grommet 62 made of rubber or other suitable material. Grommet 62 offers a cross-sectional U-shaped opening to the inside of the frame for accommodating glass 64. To convert frame 16e to accommodate film 18, a two-piece insert is used that is roughly the same thickness as glass 64. This insert includes larger piece 66, which is approximately J shaped and smaller piece 68, which has a tongue for wedging into the groove portion of J-shaped piece 66. J-shaped piece 66 is also rippled slightly on the inside of the leg of the J.

In the mounting operation, film 18 is stretched over the long side of the J of piece 66 and piece 68 is wedged into place, holding film 18 between it and piece 66 and stretching film 18 slightly. The ripples help prevent slippage of film 18.

Several qualities are necessary or highly desirable for the material of lens 18. Not having one or more of these qualities or properties, eliminates, from a practical standpoint, many materials that might be otherwise as-

sumed to be acceptable. Suitable materials should have all of the following characteristics: be unbreakable and impact resistant; resistant to high temperatures beyond the range of use application, and especially be non-flammable, non-toxic and noncontaminating; possessive of a low coefficient of friction (and therefore be resistant to dust build up); be translucent, and in some applications, be at least nearly transparent; be essentially inert to environmental conditions of use for prolonged periods of time, and particularly be essentially immune to ultraviolet degradation when used with a lamp such as a fluorescent or mercury vapor lamp, which emits a large amount of such radiation; be possessive of good transmittance qualities over the full visible spectrum, and preferably well into both the ultraviolet and infrared ranges; and be at least cost-competitive with glass in the use dimension.

It is surprising that any material other than glass could have all of these qualities. It is an even greater surprise that not only is there a material that does have these qualities equal or better than glass, but in addition, has some qualities even surpassing those of glass. The unexpectedness of this discovery, especially in view of the fact that lighting fixtures have had closure lenses for decades, makes this discovery even more remarkable.

The material that has been discovered that exhibits all of the above properties appears to be Teflon FEP. Teflon is a registered trademark of E. I. duPont de Nemurs, Inc. Teflon FEP is a fluorocarbon copolymer made by polymerizing mixtures of tetrafluoroethylene and hexafluoropropylene (which are a fluorinated ethylene and a fluorinated propylene). The properties of the final polymer can be varied slightly by changing the ratio of the two monomers.

It has been discovered that in addition to exhibiting all of the above qualities, Teflon FEP is meltextrudable so that thin-film production is readily accomplished. Teflon FEP is readily produced in thicknesses of 10 mil and less. In fact, a 5 mil thickness has been found to be the optimum thickness as a compromise between strength and transmittance for Teflon FEP. At this thickness, the strength is still ample to resist tearing even upon accidental impact. On the other hand, it exhibits only a very, very slight bluish cast and is still essentially transparent. In fact, the transmittance of Teflon FEP at this thickness is greater than for one-fourth inch glass, the preferred thickness for glass which is subjected to tempering.

Teflon, and particularly Teflon FEP, is the most inert of all plastics known, and is virtually immune to all normal environmental conditions, including direct exposure to ultra-violet rays for prolonged periods of time. In addition, Teflon FEP withstands temperatures from -270°C to $+205^{\circ}\text{C}$. In outdoor exposure testing in Florida, there was no measurable change in the material in any regards after a 10-year test.

Teflon FEP may be secured as a lens in any of the frame structures described above. In addition, Teflon FEP may also be invisibly surface treated for bonding one or both sides thereof with adhesives. Therefore, its superior anti-stick property does not preclude securing to a frame as a closure via such an adhesive, if desired.

Teflon FEP is not the only Teflon material that is suitable, however. Teflon TFE may also be used, particularly where it is not a requirement that the lens be

nearly transparent, such as where glazed or frosted glass would otherwise be used. Teflon TFE is a fluorocarbon homopolymer called polytetrafluoroethylene, tetrafluoroethylene (TFE) being a single monomer which is polymerized to give the polymer. Since it is the only monomer, the polymer is a homopolymer.

Teflon TFE has essentially all of the desirable properties of Teflon FEP except for its translucent quality. It is a milky white at thicknesses of approximately 5 mil. It is also a little more expensive to produce in sheet or lens form, since to produce sheets, it is normal to shave a solid block, rather than to merely extrude the material in sheet form, as with Teflon FEP.

Teflon FEP and TFE are both considered generically as fluorocarbon polymers and are known commercially as fluoro-plastics. Other fluorocarbon polymers exhibiting qualities that would indicate they are acceptable as lens materials are Tefzel, which is a copolymer of ethylene and tetrafluoroethylene (referred to generically as ETFE); "Kel-F", which is polychlorotrifluoroethylene (CTFE) and polyvinylidene fluoride. In addition, polymethylpentene and polysulfone also exhibit temperature, optical and other characteristics that would indicate their acceptability as lens materials.

Note that a plastic sheet may retain a static charge during cleaning or otherwise, that can result in dust being attracted thereto. Having a low coefficient of friction does not prevent or eliminate this problem. Therefore, after cleaning, either the charge should be discharged, or the surface cleaned or treated with a substance that substantially reduces the possibility of a charge being retained.

While particular embodiments of the invention have been shown, it will be understood that the invention is not limited thereto. For example, several frame structures are revealed, but other frame holding techniques operating on similar principles are suggested. Also, the lens material may be heat sealed to a frame, the act of sealing also causing a slight shrinkage of the material that desirably stretches the material suitably across the window of the frame. Many other modifications may also be made and will become apparent to those skilled in the art.

What is claimed is:

1. A lighting fixture combination, comprising: a housing for enclosing at least one light bulb therein that emits light in the visible spectrum, such that said bulb is sufficiently recessed so that the plane of an opening through which light emanates does not intersect said bulb; and a housing window comprising a thin film of fluorocarbon copolymer combining tetrafluoroethylene and hexafluoropropylene stretched across said opening in said plane.
2. A lighting fixture combination as set forth in claim 1, wherein said thin film of fluorocarbon copolymer combining tetrafluoroethylene and hexafluoropropylene is no thicker than about 10 mils.
3. A lighting fixture combination, comprising: a housing for enclosing at least one light bulb therein that emits light in the visible spectrum such that said bulb is sufficiently recessed that the plane of an opening through which light emanates does not intersect said bulb; and a housing window comprising a non-self-supporting film of fluorocarbon copolymer combining tetra-

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fluoroethylene and hexafluoropropylene secured across said opening in said plane.

4. In a light fixture housing for retaining therein at least one light bulb that emits light in the visible spectrum, housing window means comprising:

a thin film window of fluorocarbon copolymer combining tetrafluoroethylene and hexafluoropropylene; and

means for securing said thin film across the opening of said housing through which light emanates, said means securing said film by deforming said film to place said film in stretched tension.

5. A light fixture housing in accordance with claim 4, wherein said securing means includes a deformable frame for stretching and securing said film therein.

6. A light fixture housing in accordance with claim 4, wherein said securing means includes a two-part frame having mating parts for deforming and stretching therebetween said thin film.

7. A lighting fixture combination, comprising:
a housing for enclosing at least one light bulb therein

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that emits light in the visible spectrum, such that said bulb is sufficiently recessed so that the plane of an opening through which light emanates does not intersect said bulb; and

a housing window comprising a thin film of fluorocarbon stretched across said opening in said plane.

8. A lighting fixture combination, comprising:

a housing for enclosing at least one light bulb therein that emits light in the visible spectrum, such that said bulb is sufficiently recessed so that the plane of an opening through which light emanates does not intersect said bulb; and

a thin film of material stretched across said opening selected from the group consisting of a fluorocarbon copolymer combining tetrafluoroethylene and hexafluoropropylene; polytetrafluoroethylene; a copolymer of ethylene and tetrafluoroethylene; polychlorotrifluoroethylene; polyvinylidene fluoride; polymethylpentene; and polysulfone.

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