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Ogle, Jr. et al.

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[54] SELECTIVE REFLECTORS

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[52] **U.S. Cl.** **240/103**, 240/47

[51] **Int. Cl.** **F21v 7/12**, F21v 7/22, F21v 29/00

[58] **Field of Search** 240/103, 47; 29/458; 156/227; 161/214, 4

[56] **References Cited**

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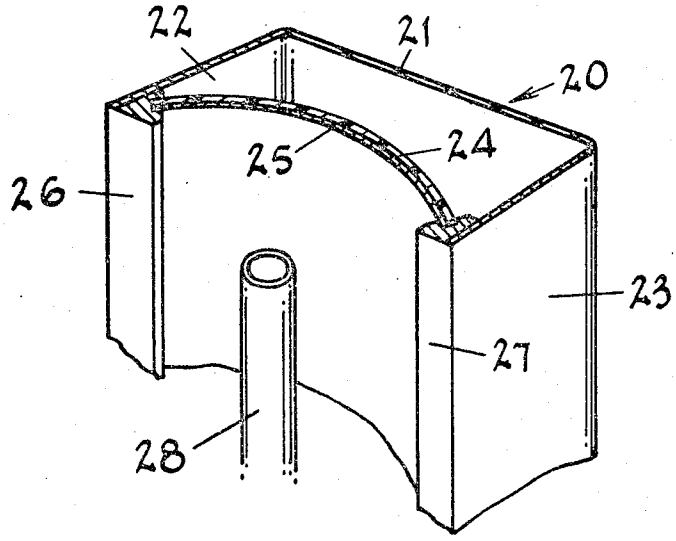
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[57] **ABSTRACT**

A selective reflector, for a source of visible and invisible rays of light, made up of a shaped backing member and a flexible member that carries a light modifying optical coating and is held in conformity to the shaped backing member; and in which the carrying member and optical coating are both capable of transmitting selected rays of light.

1 Claims, 7 Drawing Figures

See graph - Fig 7



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SHEET 1 OF 2

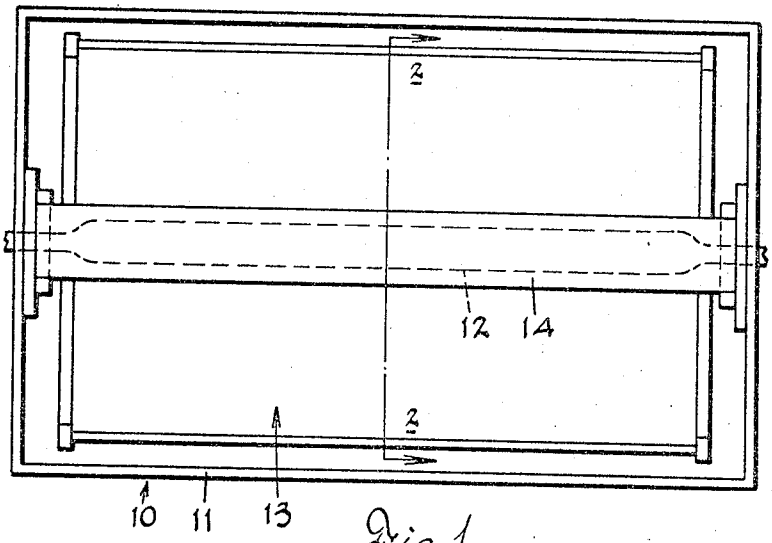


Fig. 1.

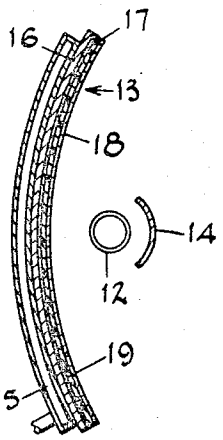


Fig. 2.

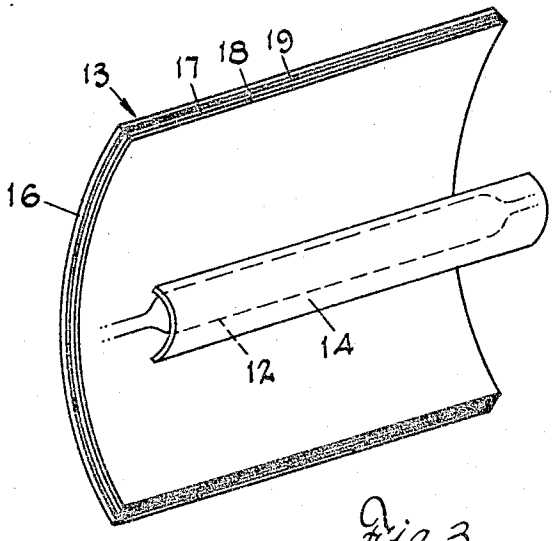


Fig. 3.

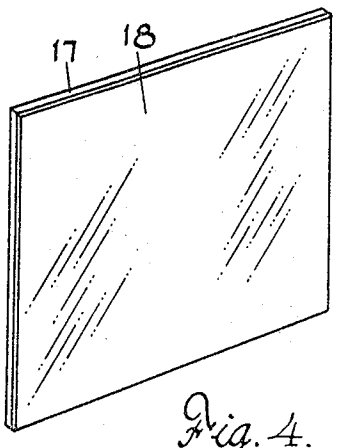


Fig. 4.

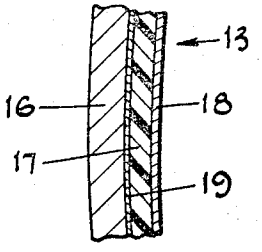


Fig. 5.

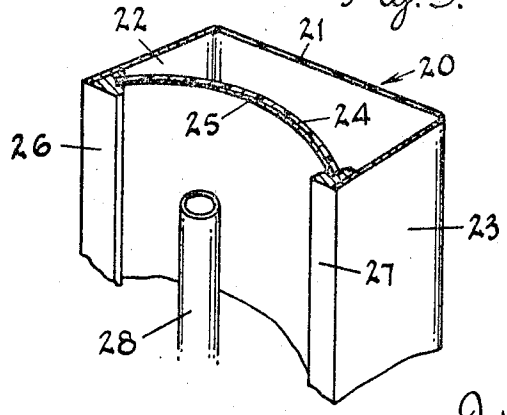


Fig. 6.

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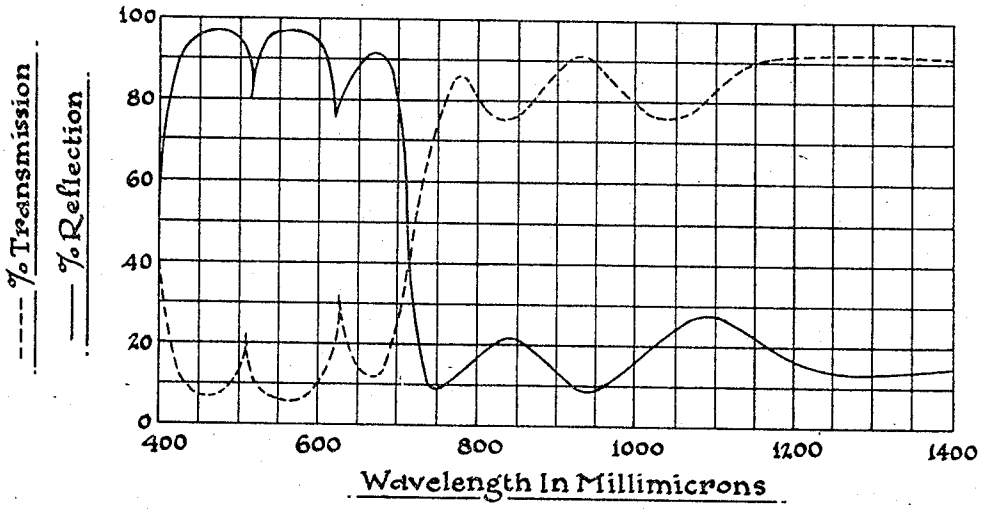


Fig. 7.

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SELECTIVE REFLECTORS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to reflectors and more particularly to an improved form of shaped, and specifically of curved surface reflectors provided with reflective coatings of uniform thickness; and to a novel method of producing the same.

2. Description of the Prior Art

Reflectors, particularly reflectors for light sources of various kinds, are well known and widely used. Usually they are shaped or curved to partially surround the light source so as to direct or focus light rays emitted by the source in a desired manner. The reflecting surface usually consists of a coating on a backing or carrying member and, in its more sophisticated forms, for use with special light sources, is often a multilayer coating that will selectively reflect light rays of desired wave lengths while transmitting light of unwanted wave lengths.

Thus, for lighting purposes, the reflective coating may be wave selective to filter out infrared radiant energy by transmitting it through the coating while reflecting visible radiant energy. In other installations, where the infrared rays are desirable and the visible rays are not, the coating may be of a nature to reflect infrared radiant energy and transmit visible radiant energy. Still other selectively reflective coatings may be employed in situations where it is desirable to filter out or to reflect light rays that are toward the ultraviolet end of the spectrum.

In any event, the production of reflective coatings of these types usually requires somewhat complicated procedures and may involve colloidal dispersion, vacuum deposition or special spray techniques to provide coatings or films so thin as to be measurable only in terms of fractional wave lengths of light and, where the reflector element to be coated is curved, it has proved to be extremely difficult, if not commercially impracticable, to produce a reflective coating on the curved surface of the uniformity necessary to meet the optical requirements.

This is particularly true in connection with reflectors intended for such special uses as high temperature projection lamps, military illuminators and lights for television photography that may require color correction as well as selective reflection and transmission.

The problem has already been recognized as a serious one and workers in the art have attempted and are still attempting to solve it. For example, in U.S. Pat. No. 3,099,403 granted July 30, 1963 to R. L. Strawick, the patentee proposes to at least partially overcome the difficulty encountered in uniformly coating curved surfaces by employing a sectional reflector which permits the individual sections, that are of relatively slight curvature, to be coated separately. The difficulty with this is that, in addition to requiring a more complex and unwieldy structure in the reflector, it still involves the coating of curved surfaces, leaving the same basic difficulty; and complicates the problem by requiring that the multiple coated sections be combined to provide, in effect, a single, continuous, uniform coating.

SUMMARY

Briefly stated, according to the present invention, all of the above-described difficulties are effectively overcome and a surprisingly uniform reflective coating is provided on a shaped or curved reflector of any desired contour by first applying the reflective coating to a flexible carrying member or substrate, while the carrying member is in the flat, and then conforming the coated flexible carrying member to the contour desired in the reflector.

It is, therefore, a primary object of the invention to provide a reflective surface of any desired contour by shaping a precoated, flat, flexible carrying member to that contour.

Another object is to provide a reflective surface for a shaped reflector by coating a flexible carrying member while in the flat and then conforming and securing the coated flexible carrying member to the shaped reflector.

Still another object is to provide a reflector, including a shaped backing member, a flexible carrying member, flat coated with a reflective coating, and means securing and conforming said carrying member to said backing member; in which the backing member is capable of absorbing, and said carrying member and coating are capable of transmitting, selected radiant energies.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the invention will become more apparent during the course of the following description when taken in connection with the accompanying drawings.

In the drawings, wherein like numerals are employed to designate like parts throughout the same;

FIG. 1 is a front elevation of a light fixture including a reflector embodying the invention;

FIG. 2 is a vertical sectional view taken substantially along line 2—2 of FIG. 1;

FIG. 3 is a fragmentary perspective view of the reflector and light source of FIG. 1;

FIG. 4 is a perspective view of the flat-coated, flexible carrying member of the invention;

FIG. 5 is an enlarged view of a part of the reflector as shown in FIG. 2;

FIG. 6 is a vertical sectional view through a modified form of light fixture embodying the invention, and

FIG. 7 is a spectral curve of an optical coating adapted for deposition on the flexible carrying member of fixtures in accordance with the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings, there is illustrated in FIG. 1 a typical form of light fixture 10 into which the invention can be incorporated and, as there shown, the fixture includes a frame 11 in which is mounted a line source of radiant energy 12 and a reflector 13. As illustrated in FIG. 2, a shield 14 may be provided in the frame 11 to prevent unwanted energy and light rays emitted by the source from entering the light column from the fixture.

The source 12 may be any desired lamp, for example, of tubular filament or incandescent type but, to better illustrate the invention, is here intended to be indicated a "Quartzine" type of incandescent lamp having an iodide cycle such as disclosed in U.S. Pat. No. 2,883,571 and which emits both visible and invisible radiant energies.

Suitable electrical connections (not shown) are made to the source or lamp 12 and it, together with the reflector 13 and shield 14, can be mounted in the frame 11 in any well-known and accepted manner and the temperature of the reflector 13 may be controlled if and when desired by a water jacket 15 or other conventional heat exchange means.

The reflector 13 has been illustrated in this embodiment as being arcuately shaped but it is within the preview of the invention to have it otherwise shaped or curved to any desired contour depending on the requirements in the use to which the fixture is to be put.

In any event, the reflector must be provided with a reflecting layer or coating in facing relationship to the source 12 and, as indicated above, in fixtures employing lamps of the character described, this is commonly an ultrathin film or coating which may comprise a plurality of layers and, as also previously explained, in actual practice it has been found extremely difficult, if not commercially impracticable, to apply such films with the required uniformity on curved surfaces.

Accordingly, in a preferred form, the present invention contemplates making up a reflector, such as the reflector 13, for example, by providing a rigid backing plate or member 16 (FIGS. 2, 3 and 5) that has at least its front face shaped to the contour necessary to correctly reflect or focus light rays from the source 12.

Next, a flexible carrying member or sheet 17 is treated while it is in the flat (FIG. 4) in a manner to be more fully hereinafter discussed to form a reflective coating 18 on a sur-

face thereof. Because the coating is applied while the surface being coated is flat, there will be no problems encountered in producing any of the different types of coatings used for such purposes on the carrying member **17** with sufficient uniformity to meet the most rigid specifications by known techniques.

The coated carrying sheet **17** is then conformed to and preferable secured against the shaped surface of the backing member **16** (FIG. 3) in any desired manner, for example, by the use of an adhesive **19**. Because of the flexible nature of the coated carrying sheet **17** it can be readily flexed, shaped and fitted to conform exactly to the shaped face of the backing member **16** and so provide a reflective surface for the reflector **10** of the precise contour desired.

To set forth more specifically and in greater detail the novel features of the invention, there is described in the example below the procedures followed in producing a particular and representative type of light fixture in accordance with the invention.

EXAMPLE

The problem was to provide light fixtures utilizing up to 2,000 watt quartz-iodine lamps as sources of radiant energy, with temperature potentials up to 1,300° F., and requiring a selectively reflective coating directly behind the source in an arcuate curvature similar to that shown in FIG. 1.

Both glass and metal can be and, of course, are commonly used as body portions of reflector elements. For this particular purpose, however, metal was preferred and black, anodized aluminum alloy in a thickness of 0.032 inch, of the desired outline and shaped to the required curvature, was selected to provide a rigid backing member **16** (FIGS. 2 and 3) capable of absorbing infrared or heat rays reaching it from the source **12**, converting them into heat energy and then dissipating the heat.

Also, because of the potentially high temperatures, a highly heat resistant as well as flexible sheet was required for the carrying member **17**. Polyimid resin sheeting met the necessary specifications and sheets of Dupont's "Kapton H" polyimid film in thickness of from 0.001 inch through 0.005 inch were selected because of their availability. Since various thicknesses of plastic in this range were used and proved satisfactory, thickness is not deemed critical except as it affects the factors of desired color, flexibility and handling. This plastic sheeting also transmitted satisfactorily in the infrared portion of the spectrum and was susceptible of sand blasting where a matte finish was desired.

Sheets of the plastic cut to the desired outline were then coated, with the plastic sheets in the flat, by employing well known vacuum deposition filming procedures, generally described in U.S. Pat. No. 2,383,469 issued Aug. 28, 1945 to Colbert et al. More particularly, the coating comprised alternate layers of high- and low-index materials of one-quarter wavelength each; titanium dioxide (TiO_2) being the high-index material and magnesium fluoride (MgF_2) the low-index material. This resulted in a cold mirror coating having the optical properties shown by the spectural curve in FIG. 7. Other high- and low-index materials may be used to provide a coating having substantially the same optical properties.

The coated, flexible carrying member **17** was then conformed and secured to the front face of the rigid backing member **16** with a layer of adhesive **19** capable of transmitting infrared rays passing through the mirror coating **18** from the source **12**. More specifically, the adhesive employed was Dow-Corning 281 pressure-sensitive silicone adhesive which was sprayed uniformly over the front face of the backing member **16**. The adhesive has a clear color, a solids content of 36 to 38 percent after 1 hour at 300° F., by the addition of Xylene, a viscosity and specific gravity at 77° F. of 2,000 to 6,000 centipoises and 0.94 respectively, and a flash point of 81° F. minimum.

When the reflector so produced was mounted in a frame with the several other components, the resulting fixture exhibited uniform reflectance and true color within extremely close tolerances. In tests, such fixtures, incorporating as sources 500, 750, 1,000, 1,200 and 2,000 watt projection lamps, were run for periods varying from 4 to 15 hours with no measurable change in transmission visible or measured by spectrospot brightness meter. There was also no detectable change in color and no indication of degradation.

In FIG. 6 of the drawings, there is illustrated a modified type of fixture for the same purposes described above. However, in this fixture the flexible carrying member is not secured to a rigid backing member but is self-sustaining. As shown, the fixture comprises a frame **20** having a rear wall **21** and forwardly directed opposite side walls **22** and **23**. The carrying member **24** consists of a flexible sheet of Dupont's "Kapton H" plastic provided with a reflective coating **25** which may be the same as described above in Example **1**.

The carrying member **24** is secured in the frame by flexing it and fitting the opposite side edges thereof in grooves formed in the molding pieces **26** and **27** carried by the sides of the frame, or in any other desired manner. The sheet is of such thickness that it will retain the curvature to which it is shaped when fitted in the frame. The visible rays from the light source **28** will be reflected forwardly by the reflective mirror coating while the infrared rays will be transmitted through the coating and flexible carrying member and exhausted by movement of air upwardly through the frame. Thus, the hollow frame is in effect a chimney and upward draft of air therethrough dissipates the heat absorbed in the enclosed area to cool the flexible carrying member.

It is believed to be apparent that hot as well as cold mirror coatings can be used in practicing the invention and, indeed, that coatings that are selectively reflecting and transmitting anywhere in the infrared, visible and ultraviolet regions of the spectrum can be employed, as can reflective coatings that are electrically conducting; and that these coatings can be applied to the flexible carrying member by known and commonly used coating procedures.

Accordingly, it is to be understood that the forms of the invention herein shown and described are to be taken as preferred embodiments only and that various procedural changes as well as changes in the size, shape and arrangement of parts can be resorted to without departing from the spirit of the invention as defined in the following claims.

We claim:

1. A light fixture including a frame, a rigid backing member carried by said frame and having its front surface shaped to a predetermined contour, a sheet of flexible polyimide resin conformed to and attached to said shaped surface by an adhesive, a thermally evaporated cold mirror coating on the free surface of said polyimide resin sheet, and a source of visible and infrared radiant energies mounted forwardly of said coated resin sheet, said backing member being composed of a material which absorbs infrared energy and said adhesive being of a composition which transmits infrared radiant energy.

* * * * *