# United States Patent [19]

**Melby**

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[54] **LIGHT FIXTURE INCLUDING A PARTIALLY COLLIMATED BEAM OF LIGHT AND REFLECTIVE PRISMS HAVING PEAKS LYING ON A CURVED SURFACE**


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**Related U.S. Application Data**

[63] Continuation of Ser. No. 255,784, Oct. 11, 1988, abandoned.

[51] **Int. Cl.**[5] ..... **F21V 7/00**; G02B 27/14

[52] **U.S. Cl.** ..... **359/618**; 362/348; 362/307; 362/26; 359/850; 359/638

[58] **Field of Search** ..... 350/171, 169, 616, 612, 350/286, 345; 362/26, 27, 348, 307, 247



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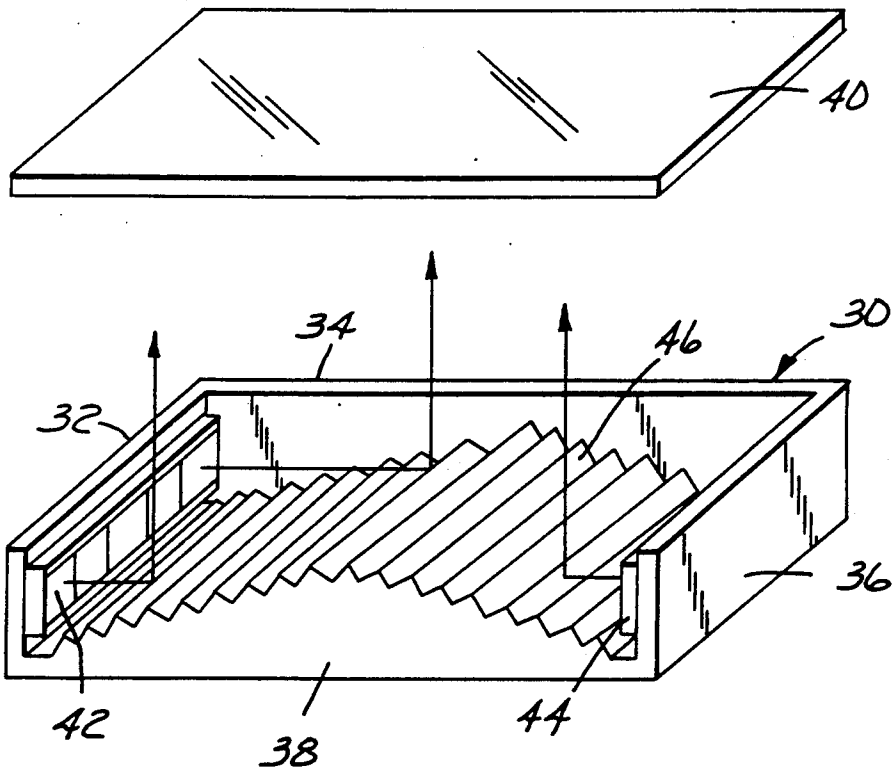
[57] **ABSTRACT**

A light fixture has a source of partially collimated light for emitting light having an axis of collimation. A structured surface has a plurality of prisms that are rendered reflective for reflecting light from the light source out of the cavity. The peaks of the prisms define a surface at least a portion of which makes an acute angle with the axis of collimation.


**5 Claims, 2 Drawing Sheets**



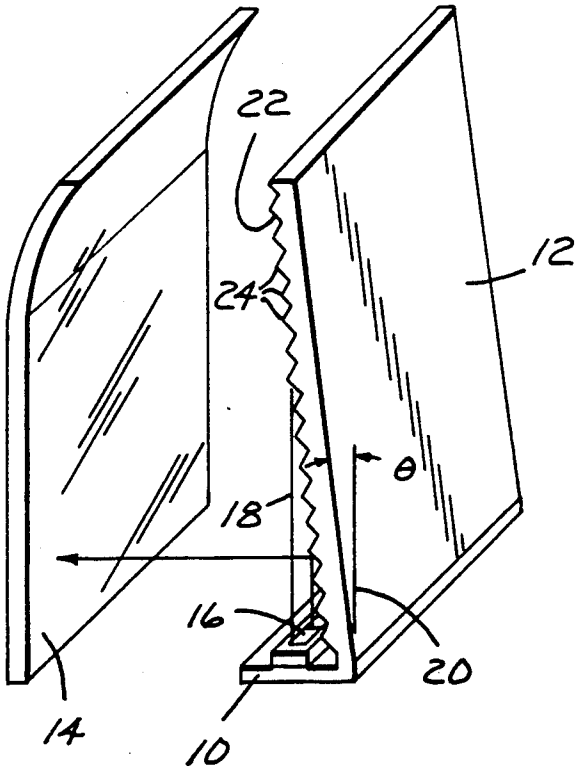



Fig. 1

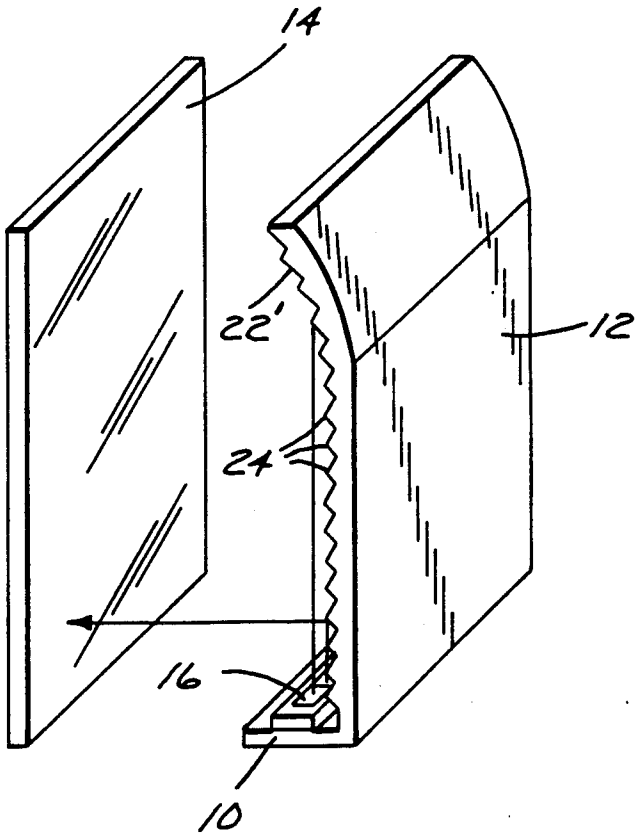



Fig. 2

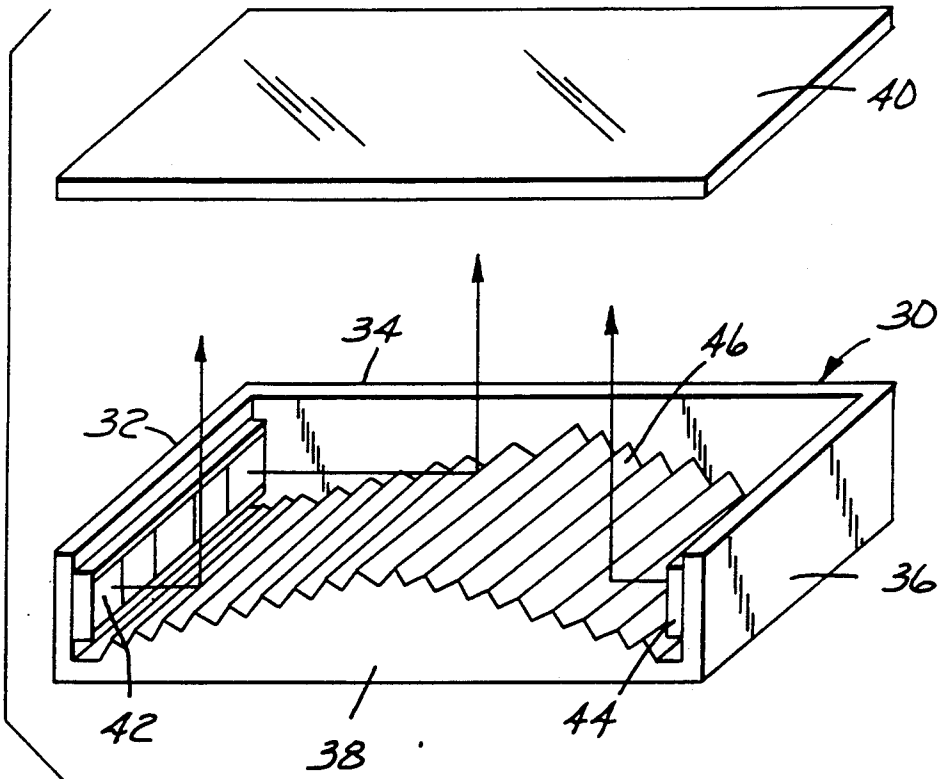



Fig. 3

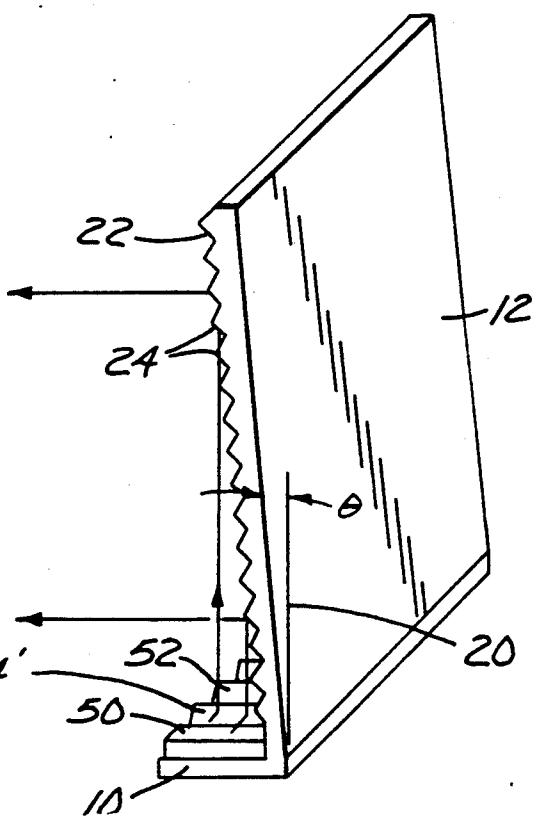



Fig. 4

# LIGHT FIXTURE INCLUDING A PARTIALLY COLLIMATED BEAM OF LIGHT AND REFLECTIVE PRISMS HAVING PEAKS LYING ON A CURVED SURFACE

This is a continuation of application Ser. No. 07/255,784 filed Oct. 11, 1988 now abandoned.

## FIELD OF THE INVENTION

The present invention relates to thin light fixtures.

## BACKGROUND OF THE INVENTION

In various situations thin light fixtures are desirable. For example, back-lit flat panel displays normally should be kept as thin as possible. When they are thinner they tend to be lighter in weight and more compact, both desirable properties when they are used in applications such as portable computers. Automobile taillights and brake lights also should be kept compact where possible. This is because space used by such lights comes at the expense of luggage space in the vehicle's trunk.

Various designs for thin panel lighting have been proposed. For example, copending, commonly assigned U.S. patent application Ser. No. 016,858, filed Feb. 20, 1987, now U.S. Pat. No. 4,789,921 describes a Fresnel-type reflector lying on a conic surface. Typically the Fresnel-type structures of that reflector are designed to mimic the performance of a parabolic reflector. The conic Fresnel provides a highly efficient compact light source, but suffers from the same disadvantage as other parabolic reflectors. That disadvantage is a lack of uniformity in intensity of light output. As may be expected, regions closer to the light source will be more brightly illuminated than those more distant from the light source.

Other designs have been proposed for use when uniform illumination is desirable. One such proposal is described in commonly assigned, copending U.S. patent application Ser. No. 030,033, filed Mar. 24, 1987 now U.S. Pat. No. 4,799,137. That design utilizes a film known as right angle film. The use of right angle film in a light fixture allows the output optical window to be very evenly illuminated, but requires the separate construction of the right angle film and the insertion of that film into the light fixture. In some situations it would be desirable to construct a light fixture having a performance similar to that of the fixture using right angle film, without the requirement of the insertion of a separate film into the fixture.

## SUMMARY OF THE INVENTION

According to the invention a housing defines an optical cavity having an optical window. A source of partially collimated light having an axis of collimation is located inside the optical cavity. A structured surface having a plurality of prisms thereon is positioned within the optical cavity such that the prisms reflect light through the optical window. The peaks of the prisms define a surface at least a portion of which makes an acute angle with the axis of collimation.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view of a first embodiment of a light fixture according to the invention;

FIG. **2** is a view of a second embodiment of a light fixture according to the invention;

FIG. **3** is a view of a third embodiment of a light fixture according to the invention; and

FIG. **4** is a view of a light fixture according to the invention having two light sources.

## DETAILED DESCRIPTION

FIG. **1** illustrates a first embodiment of the invention. In the embodiment of FIG. **1** a housing including walls **10** and **12** defines an optical cavity. The optical cavity has an optical window with a light transmitting member **14**, therein. Light transmitting member **14** may be of a transparent or translucent material. If desired, light transmitting member **14** could include structures such as pillow optics or Fresnel prisms.

A source of partially collimated light **16** is positioned inside the optical cavity and adjacent side **10** of the housing. Light source **16** may be any source of partially collimated light such as a fluorescent tube or other gas discharge lighting element with an appropriate reflector or an incandescent light with a reflector. Alternatively light source **16** could include a plurality of light emitting diodes (LEDs).

Side **22** of wall **12** is a structured surface having a plurality of, preferably triangular, prisms, **24**, thereon. In a preferred embodiment, prisms **24** are linear prisms. Prisms **24** are rendered specularly reflective, typically by aluminum vapor coating. It is only necessary that prisms **24** be specularly reflective on the side adjacent light source **16**, but it is typically easier to vapor coat both sides. Such prisms reflect light from light source **16** in a predetermined direction. Typically the predetermined direction will be perpendicular to transparent or translucent material **14**.

Light source **16** emits a beam of substantially collimated light having an axis of collimation **18**. Line **20** is drawn parallel to collimation axis **18**. As may be seen, the peaks of prisms **24** define a planar surface that makes an acute angle $\theta$ with line **20**, and thus with collimation axis **18**. As a result side **22** of wall **12** cuts through the beam of light emitted by light source **16**. Because structured surface **22** so cuts through the beam of light emitted by light source **16**, the entire aperture of the optical window is illuminated.

The structure of the present invention may be advantageously formed directly on the rear wall of the light fixture. Such a structure could be formed by injection molding. Alternatively a separate film having the structured surface described above could be placed in the light fixture.

FIG. **2** shows an alternative embodiment to that of FIG. **1**. In the embodiment of FIG. **2** structured surface **22'** is curved. Thus the surface defined by the peaks of prisms **24** is curved rather than planar. As a result, that surface is parallel or nearly parallel to the axis of collimation in the region closest to light source **16**, but forms a variety of acute angles with it in regions more distant from light source **16**. This has the effect of causing prisms more distant from light source **16** to intercept a greater portion of the beam than those closer to light source **16**. Because the light beam will naturally expand as it progresses to locations distant from the source, the curvature helps to maintain uniformity of illumination.

FIG. **3** illustrates an alternative embodiment wherein a housing **30** including walls **32**, **34**, **36** and **38** defines an optical cavity having an optical window. A transparent or translucent cover **40** lies in the optical window. Light from two partially collimated light sources is directed from light sources **42** and **44** to structured

surface **46**. The peaks of the prisms of structured surface **46** may define a planar surface lying at an angle to the axis of collimation of the light sources, similar to the embodiment of FIG. **1** or may define a curved surface cutting through the beams of light as in the embodiment of FIG. **2**.

FIG. **4** illustrates another embodiment of the invention wherein light source **14'** includes a light emitter **50** and a structured surface **52**. Structured surface **52** acts in a manner similar to structured surface **22** to take light from a compact source **50** and provide a linear beam. The embodiment of FIG. **4** then acts similarly to the embodiment of FIG. **1** with surface **52** acting as a light source for structured surface **54**.

I claim:

**1**. A light fixture comprising:

a housing defining an optical cavity having an optical window, said housing having an inner surface on a side opposite said optical window;

light emitting means in said housing for emitting a partially collimated beam of light having an axis of collimation;

a plurality of prisms on said inner surface, each of said prisms having a specularly reflective surface on a side adjacent said light emitting means for reflecting light from said light emitting means out of said fixture through said optical window, the peaks of said prisms defining a surface, at least a portion of said surface being smoothly curving and forming an acute angle with said axis of collimation such that said optical window will receive a substantially uniform level of illumination.

**2**. The light fixture of claim **1** further comprising a light transmitting member in said optical window.

**3**. The light fixture of claim **2** wherein said prisms reflect light from said light emitting means in a direction substantially perpendicular to said light transmitting member.

**4**. The light fixture of claim **3** wherein each of said specularly reflective surfaces makes an angle substantially equal to forty-five degrees with said axis of collimation.

**5**. The light fixture of claim **1** wherein said prisms are linear prisms.

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